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UL Standard for Safety
for
Electric Dry Bath Heaters, UL 875

Sixth Edition, Dated August 30, 1994

Revisions: This Standard contains revisions through and including August 2, 1996.

A change is indicated by a note following the affected item. The note is preceded and followed by an asterisk.

The new and/or revised requirements are substantially in accordance with UL's Bulletin on this subject dated March 18, 1996. The bulletin is now obsolete and may be discarded.

The revisions dated August 2, 1996 include a reprinted title page (page 1) for this Standard.

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

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UL 875

Standard for

Electric Dry Bath Heaters

Prior to the first edition, the requirements for the products covered by this standard were included in the Standard for Electric Heating Appliances, UL 499.

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Sixth Edition

August 30, 1994

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

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

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

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F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

- f) Resistance to distortion at temperatures to which the enclosure may be subjected under conditions of use.

For a nonmetallic enclosure or part of an enclosure, all these factors are considered with regard to thermal aging.

3.3 A heater shall have provisions for mounting it to the floor, wall, or ceiling. Any fittings, such as brackets, hangers, bolts, or the like, necessary for proper mounting, shall be furnished with the heater together with instructions in accordance with 38.1(d).

3.4 An opening in the bottom of a heater shall not be located below:

- a) An electrical part,
- b) Wiring, or
- c) A sheath-type heating element

unless a solid, noncombustible protective barrier complying with Figure 3.1 is located between such part, wiring, or element and the supporting surface.

Exception: A barrier is not required under wiring that is provided with insulation having a flame-retardant rating (FR-1).

3.5 The barrier mentioned in 3.4 shall:

- a) Be horizontal,
- b) Be located as indicated in Figure 3.1, and
- c) Not have an area less than that described in the illustration.

Openings provided in the barrier for drainage, ventilation, and similar purposes shall not permit molten metal, burning insulation, or equivalent parts to fall on combustible material or persons (for ceiling-mounted heaters).

3.5 revised August 2, 1996

3.6 The structure of the part or of the heater may provide the equivalent of the barrier mentioned in 3.4 if it complies with Figure 3.1.

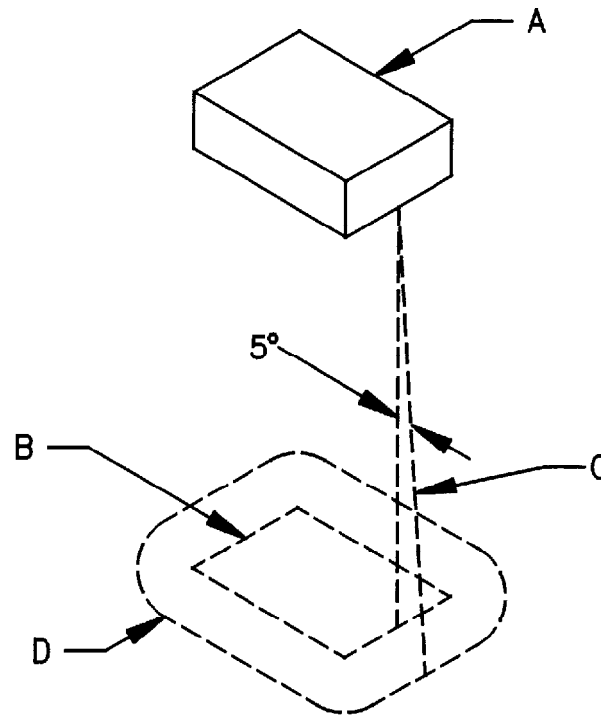
3.7 The requirement in 3.4 requires use of a barrier of noncombustible material:

- a) Under a motor unless one of the following four items applies:
 - 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 when the motor is energized under each of the following fault conditions:
 - i) Main winding opened,
 - ii) Starting winding opened,

- iii) Starting switch short-circuited, and
 - iv) For a permanent-split-capacitor motor, the capacitor short-circuited (the short circuit is to be applied before the motor is energized, and the rotor is to be locked);
- 3) The motor is provided with a thermal motor protector (a protective device that is sensitive to both temperature and current) that will restrict 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 complies with the requirements for impedance-protected motors.
- b) Under wiring, unless it is of the flame-retardant type. Neoprene-, and thermoplastic-insulated wires have been determined to be of this type.

3.7 revised August 2, 1996

Figure 3.1
Location and extent of barrier



SA0604-1

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. When moving, the line is always:

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

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

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4.3 The location of the heater will be taken into consideration in evaluating the intended degree of exposure of mechanical and electrical parts. For example, a greater degree of exposure may be used in a ceiling-mounted heater.

4.4 An edge, projection, or corner of an enclosure, opening, frame, guard, knob, handle, or the like of a heater shall be smooth and rounded, and not sharp enough to cause a cut-type injury when contacted during intended use or user maintenance.

4.5 If the external surface of the heater is of metal and exceeds 70°C (158°F) during intended operation or is of nonmetallic material and exceeds 95°C (203°F) during intended operation, the heater shall be provided with a nonmetallic guard or fence to restrict unintentional physical contact with the heater.

Exception: If the room is not provided as part of the heater, the installation instructions required in 38.1(h) shall state the type of fence or guard to be installed.

4.6 The construction of a wall- or ceiling-mounted heater and its mounting hardware shall be subjected to the Static Loading Test, Section 31.

4.6 revised August 2, 1996

4.7 The construction and supporting hardware of a floor-mounted heater shall be subjected to the Static Loading Test, Section 31, and the Strength of Legs Test, Section 32.

4.7 revised August 2, 1996

5 Assembly

5.1 The door or cover of an enclosure shall be hinged if:

- a) It gives access to any fuse, circuit breaker, or manually-resettable thermal cutoff and
- b) Uninsulated current-carrying parts are exposed in connection with the intended replacement of the fuse or resetting of a manually resettable device.

Such a door or cover also shall be provided with a latch or the equivalent and a captive screw to secure the door or cover in place.

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

5.3 A spring latch, magnetic latch, 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, may be used as a means for holding the door in place as required in 5.2.

5.4 A component of a heater that is likely to need inspection, replacement, cleaning, or other servicing shall be as readily accessible as practicable, without the use of special tools (flat blade and Phillips screwdrivers are not considered special tools) if it is intended to be manually operated or adjusted or if it will require periodic servicing.

5.5 A switch, lampholder, motor-attachment plug, or similar component shall be mounted securely and restricted from turning.

Exception No. 1: The requirement that a switch be restricted from turning may be waived if the following four conditions exist:

- a) *Means of mounting the switch make it unlikely that operation of the switch will loosen it;*

b) The switch is of a plunger or other type that does not tend to rotate when operated (a toggle switch is considered to be subject to forces that tend to turn the switch during the intended operation of the switch);

c) The spacings are not reduced below the minimum required values if the switch rotates; and

d) Intended operation of the switch is by mechanical means rather than by direct contact by persons.

Exception No. 2: 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 a nonremovable jewel) need not be restricted from turning if rotation cannot reduce spacings below the minimum required values.

5.6 The means for restricting the turning mentioned in 5.5 and 5.7 is to consist of more than friction between surfaces – for example, a lock washer, applied as intended, may be used as means to restrict turning of a small stem-mounted switch or other device having a single-hole mounting means.

5.7 A current-carrying part shall be secured to the base or mounting surface so that it will be restricted from turning or shifting in position if such motion may result in a reduction of spacings below the minimum values indicated in Spacings, Section 21.

6 Corrosion Resistance

6.1 Iron and steel parts shall be made resistant to corrosion by enameling, galvanizing, plating, or other equivalent means if the breakdown of such unprotected parts would be likely to result in the risk of fire, electric shock, or injury to persons.

Exception: Under certain conditions in which the oxidation of steel is not likely to be accelerated due to the exposure of metal to air, 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 made resistant to corrosion. Cast-iron parts are not required to be made resistant to corrosion. A sheath used on a heating element operating in air and terminal parts attached directly to the heating element need not be made resistant to corrosion.

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

7 Supply Connections

7.1 General

7.1.1 A heater shall have provision for connection of one of the wiring systems in accordance with the National Electrical Code, ANSI/NFPA 70.

7.2 Field-wiring compartment

7.2.1 The location of a wiring compartment in which field-wiring connections are to be made shall be such that these connections may be readily inspected without moving the heater after it is installed as intended.

7.2.2 If a separate wiring compartment is provided for field-wiring connections, it shall be attached to the heater and restricted from turning with regard to the heater.

7.2.3 A wiring compartment for field-wiring connections shall be of metal and shall have a volume that will accommodate the wiring of the size indicated in 7.4.1 and conduit and fittings sized for that wire.

7.3 Wire-bending space

7.3.1 The wire-bending space from a connector to the wall of an enclosure and to any barrier or other obstruction that is part of the equipment shall be as specified in Column A of Table 7.1. The width of a wiring gutter provided at a knockout shall not be less than specified in Column A of Table 7.1.

Table 7.1
Wire-bending space

Wire size		Minimum bending space, terminal to wall			
AWG	(mm ²)	A ^a		B ^b	
		inches	(mm)	inches	(mm)
14 – 10	2.1 – 5.3	Not Specified		Not specified	
8	8.4	1-1/2	38.1	1-1/2	38.1
6	13.3	1-1/2	38.1	2	50.8
4	21.2	2	50.8	3	76.2
3	26.7	2	50.8	3	76.2
2	33.6	2-1/2	63.5	3-1/2	88.9
1	42.4	3	76.2	4-1/2	114.3
1/0	53.5	3-1/2	88.9	5-1/2	139.7
2/0	67.4	3-1/2	88.9	6	152.4

NOTE – The minimum bending space required for wire sizes or combinations not covered in this table will be determined by investigation.

^a See 7.3.1 for construction applications of the wire-bending space.

^b See 7.3.2 for construction applications of the wire-bending space.

7.3.2 If a hole, knockout, or other provision for connection of a wiring system is provided in the wall opposite the terminal, it is to be assumed that a conductor will enter or exit the enclosure through that wall; in this case, the wire-bending space shall be as specified in Column B of Table 7.1.

7.3.3 If a conductor is restricted from being bent where it leaves the connector by a barrier or other means, the distance shall be measured from the end of the barrier or other obstruction.

7.3.4 The distance mentioned in 7.3.2 is to be measured in a straight line from the edge of the wire terminal closest to the wall in a direction perpendicular to the enclosure wall or barrier. The wire terminal is to be turned to all positions it can assume without defeating any means provided to prevent its turning, such as a box or shoulder, the walls of a recess, or multiple bolts securing the connector.

Exception: Wire-bending space may be measured in a straight line from the center of the wire opening in the direction the wire leaves the terminal. However, it is to be assumed that the connector is not

oriented so the wire will be directed into a corner of the enclosure to such an extent that the location of the transverse wall would necessitate additional bending. If the connectors for a circuit are fixed in position – for example, by the walls of a recess – so they are turned toward each other, the distance is to be measured at the wire opening nearest to the wall, in a direction perpendicular to the wall.

7.4 Field-wiring terminals and leads

7.4.1 A heater shall be provided with field-wiring terminals or leads for the connection of conductors having an ampacity not less than 125 percent of the current rating of the heater.

7.4.2 No electrical component shall be mounted on a part intended for use as a cover plate that must be removed for examination of field-wiring connections.

7.4.3 A lead intended for connection to a power supply conductor shall have a minimum 90°C (194°F) temperature rating.

7.4.3 revised August 2, 1996

7.4.4 In determining the size of the power-supply conductors in a heater intended for connection to multiple power supplies and in which it is likely that more than three such conductors will occupy the same raceway, the ampacity deratings given in the National Electrical Code, ANSI/NFPA 70, are to be applied.

7.4.5 For the purpose of these requirements, field-wiring terminals are terminals to which power-supply or control connections will be made in the field when the heater is installed. If field-supplied wiring is taken into the room or walls, it is assumed that minimum 90°C (194°F) wire is to be used for connection of field-wiring terminals in accordance with 36.12.

7.4.6 A field-wiring terminal shall be provided with a soldering lug or with a pressure wire connector securely fastened in place (for example, firmly bolted or held by a screw).

Exception: A wire-binding screw may be used at a field-wiring terminal intended to accommodate a No. 10 AWG (5.3 mm²) or smaller conductor if upturned lugs or the equivalent are provided to hold the wire in position.

7.4.7 A wire-binding screw at a field-wiring terminal shall not be smaller than No. 10 (4.8 mm diameter).

Exception: A No. 8 (4.2 mm diameter) screw may be used at a terminal intended only for the connection of a No. 14 AWG (2.1 mm²) conductor, and a No. 6 (3.5 mm diameter) screw may be used for the connection of a No. 16 AWG (1.3 mm²) or No. 18 AWG (0.82 mm²) control-circuit conductor.

7.4.8 A terminal plate tapped for a wire-binding screw shall be of metal not less than 0.050 inch (1.3 mm) thick. There shall be two or more full threads in the metal, which may be extruded if necessary to provide the threads.

Exception: A plate not less than 0.030 inch (0.8 mm) thick may be used if the tapped threads have adequate strength.

7.4.9 Upturned lugs or a cupped washer shall be capable of retaining a conductor of the size mentioned either in 7.4.1 [but not smaller than No. 14 AWG (2.1 mm²)] or in 7.4.13, whichever is applicable, under the head of the screw or the washer.

7.4.10 A heater provided with field-wiring terminals or leads and intended to be connected to a grounded power-supply conductor shall have one terminal or lead identified for the connection of that conductor if necessary because of the requirements in 17.1, 18.4, 18.5, and 20.1.5.

7.4.11 A field-wiring terminal intended for the connection of a grounded conductor shall be made of, or plated with, a metal substantially white in color and shall be readily distinguishable from the other terminals, or proper identification of that terminal shall be clearly shown in some other manner, such as on an attached wiring diagram. A lead intended for the connection of a grounded conductor (as distinguished from the equipment grounding conductor) shall be finished to show a white or natural gray color and shall be readily distinguishable from the other leads.

Exception: Internal wiring that is not visible in a wiring compartment in which field connections are to be made need not be color coded for identification.

7.4.12 An equipment grounding terminal or lead shall be provided.

7.4.13 A grounding terminal shall be capable of securing a conductor of the intended size.

7.4.14 The surface of an insulated lead intended solely for the connection of an equipment-grounding conductor shall be green with or without one or more yellow stripes, and no other lead shall be so identified.

Exception: Internal wiring that is not visible in a wiring compartment in which field-wiring connections are to be made need not be color coded for identification.

7.4.15 A wire-binding screw intended for the connection of an equipment-grounding conductor shall have a green head that is hexagonal-shaped, slotted, or both. A pressure wire connector intended for connection of such a conductor shall be plainly identified, such as by being marked "G," "GR," "GND," "Ground," "Grounding," or the like, or by a suitable marking on a wiring diagram provided on the heater. The wire-binding screw or pressure wire connector shall be located so that it is unlikely to be removed during servicing of the heater, and the wire-binding screw shall have upturned lugs or the equivalent to retain the conductor.

7.4.16 The free length of the lead for connection to the branch circuit inside an outlet box or wiring compartment shall be 6 inches (152 mm) or more.

Exception: The lead may be less than 6 inches long if the field-wiring supply connections are enclosed in the motor terminal box.

8 Current-Carrying Parts

8.1 Plated iron or steel may be used for current-carrying parts whose temperature during intended operation is more than 100°C (212°F), but plain (unplated) iron or steel shall not be used regardless of temperatures. Stainless steel and other corrosion resistant alloys may be used for current-carrying parts regardless of temperature.

8.2 Unplated iron or steel, if provided with a corrosion-resistant coating, may be used for a current-carrying part within a motor or associated governor.

9 Internal Wiring

9.1 General

9.1.1 The internal wiring of a heater shall not be less than No. 18 AWG (0.82 mm²) and shall be standard building wire, fixture wire, or other type rated for the application considering temperatures, voltage, current, and conditions of service to be encountered.

9.1.2 There is no temperature limit applicable to glass fiber, beads of noncarbonizable material, or the equivalent used as conductor insulation.

9.2 Sleeving and tubing

9.2.1 Coated or impregnated insulating tubing complying with the applicable requirements for such tubing may be used. Where not subjected to moisture in use, uncoated and unimpregnated sleeving of closely-woven glass fiber may be used if it complies with the requirements in Table 9.1.

Table 9.1
Sleeving and tubing

Maximum inside diameter, inch (mm)		Voltage across tubing	Minimum thickness, inch (mm)	
0.085	2.16	300 volts or less	0.020	0.51
(No. 12 AWG)		301 – 600 volts	0.025	0.64
0.50	12.70	600 volts or less	0.025	0.64
Larger than 0.50	Larger than 12.70	600 volts or less	0.031	0.79

9.3 Protection of wiring

9.3.1 The wiring and connections between parts of a heater shall be protected or enclosed.

Exception: A length of flexible cord may be used for internal connections that may be exposed during servicing if flexibility of the wiring is essential.

9.3.2 A conductor utilizing beads for insulation shall not be used outside an enclosure.

9.3.3 A probe as illustrated in Figure 3.2 shall be restricted from contacting internal wiring that is exposed through an opening in the enclosure of a heater or a control assembly.

Exception: Internal wiring that is capable of being contacted by the probe illustrated in Figure 3.2 shall be secured within the enclosure so that it will not be subjected to stress or mechanical damage.

9.3.3 revised August 2, 1996

9.3.4 If the wiring of a heater is located so that it may be in proximity to combustible material or may be subjected to physical damage, it shall be in:

- a) Armored cable,
- b) Rigid metal conduit,
- c) Electrical metallic tubing, or
- d) Metal raceway;

or otherwise protected.

9.3.5 Wiring shall be protected from sharp edges (including male screw threads), burrs, fins, moving parts, and other features that might cut or abrade the insulation.

9.6 Barrier material and thickness

9.6.1 A barrier used to provide separation of different circuits shall be of metal or insulating material, shall have mechanical strength if exposed or otherwise likely to be subjected to mechanical damage, and shall be held in place. Unclosed openings in a barrier for the passage of conductors shall not be larger than 1/4 inch (6.4 mm) in diameter and shall not exceed in number, on the basis of one opening per conductor, the number of wires that will need to pass through the barrier. The closure for any other opening shall present a smooth surface wherever an insulated wire may be in contact with it; and the area of any such opening, with the closure removed, shall not be larger than required for the passage of the necessary wires.

9.6.2 A metal barrier shall have a thickness not less than the required thickness of the enclosure metal. A barrier of insulating material shall not be less than 0.028 inch (0.71 mm) thick and shall be of greater thickness if its deformation may be readily accomplished so as to defeat its purpose.

9.7 Low-voltage circuits

9.7.1 A low-voltage circuit is one involving a potential of not more than 30 volts rms (42.4 volts peak) and is supplied by:

- a) A primary battery,
- b) A standard Class 2 transformer, or
- c) A suitable combination of a transformer and a fixed impedance that, as a unit, complies with all the performance requirements for a Class 2 transformer.

Exception: A circuit derived from a source of supply classified in 9.8.1 as a line-voltage circuit, by connecting resistance in series with the supply circuit as a means of limiting the voltage and current, is not considered to be a low-voltage circuit.

9.8 Line-voltage circuits

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

10 Heating Elements

10.1 General

10.1.1 A heating element shall be supported in a substantial and reliable manner.

10.1.2 In determining if a heating element complies with the requirement in 10.1.1, consideration is to be given to sagging, loosening, and other adverse conditions of the element resulting from continuous heating or flexing of the element supports, or related wiring due to alternate heating and cooling of the element.

10.1.3 A heater in which the heating element is intended for operation only in an air blast shall be wired or controlled so that the element can be operated only while under the cooling effect of the blast. A heater in which the cooling effect of the motion of a part is necessary to reduce the risk of excessive temperatures shall be wired or controlled so that the element cannot be operated without such motion.

10.2 Sheathed heating element

10.2.1 A sheathed heating element shall comply with the requirements in the requirements for sheathed heating elements, UL 1030.

10.3 Guarding of heating elements

10.3.1 The heating element and any part of the element assembly (such as an element support, sheath, and the like) shall be guarded so that combustible material as well as persons will be restricted from contacting it.

10.3.2 The evaluation of a guard is made with regard to its general serviceability and to the shape or size, or both, of the openings in it, in conjunction with the distance of the guard from the heating element and parts operating at a temperature of more than 280°C (536°F). An opening in a guard may be used if, with the heater in any intended operating position, the shape and size of any opening is such that a test gage in the form of a right-circular cone having a base diameter of 2-3/4 inches (69.9 mm) and a height of 5-1/2 inches (139.7 mm) is restricted from touching any component or part of the heater operating at more than 280°C when the gage is inserted, apex first, as described in 10.3.3.

10.3.3 If rocks are provided by the manufacturer, or recommended by the operating instructions, they are to be in place in accordance with the manufacturer's instructions while temperature measurements are made to determine those components or parts that operate at a temperature greater than 280°C (536°F). After this determination is made, the rocks are to be removed and the cone gage described in 10.3.2 is to be applied in an attempt to contact any component or part of the heater previously determined to operate at a temperature greater than 280°C. No attempt is to be made to distort a guard when using the gage.

10.3.4 If a heater is required to have a guard for resistance to unintentional contact or for compliance with 28.3.1, either the guard shall be permanently fastened in place by welding, riveting, or the equivalent (bolting is not to be used) or the heater shall be marked as specified in 36.23.

11 Electrical Insulation

11.1 An insulating washer, bushing, and the like, that is an integral part of a heater and a base or support for the mounting of current-carrying parts, shall be of a moisture-resistant material that will not be damaged by the temperatures to which it will be subjected under conditions of actual use. A molded part shall be constructed so that it will have the mechanical strength and rigidity to withstand the stresses of actual service.

11.2 Insulating material used in a heater is to be evaluated with regard to its particular application. Materials such as mica, some molded compounds, and certain refractory materials are capable of being used as the sole support of current-carrying parts; and some other materials not for general use, such as magnesium oxide, are capable of being employed when used in conjunction with other more appropriate insulating materials, or when located and protected so that mechanical damage is restricted and absorption of moisture is reduced. When it is required to investigate a material to determine whether it is capable of being used, the following are to be evaluated:

- a) Mechanical strength,
- b) Dielectric properties,
- c) Insulation resistance (in accordance with 12.7 and 26A.1),

- d) Heat-resistant qualities,
- e) The degree to which it is enclosed or protected, and
- f) Any other features having a bearing on the risk of fire, electric shock, or injury to persons involved;

in conjunction with conditions of actual service. All these factors are evaluated with regard to thermal aging.

11.2 revised August 2, 1996

11.3 A screw or other fastening used for mounting or supporting small, fragile insulating parts shall not be tight enough to cause cracking or breaking of these parts with expansion and contraction. Generally, such parts shall be slightly loose.

12 Thermal Insulation

12.1 Thermal insulation shall be of such a nature and located and mounted or supported so that it will not be adversely affected by any operation of the heater.

12.2 Thermal insulation that is flexible shall be mounted or supported so that it will not sag. Adhesive material used for mounting thermal insulation shall be rated for use at the temperature to which it may be subjected.

12.3 An adhesive is not required to be evaluated when the thermal insulation is mechanically supported by at least one rivet or the equivalent per square foot of material (at least 11 rivets or the equivalent per square meter of material).

12.3 revised August 2, 1996

12.4 Combustible thermal insulation or other combustible material is not to be used if it is located so that it may be in a current of air within the heater.

12.5 Combustible or electrically-conductive thermal insulation shall not make contact with current-carrying parts of a heater.

12.6 Some types of mineral-wool thermal insulation contain conductive impurities in the form of slag, which should not be used if it contacts current-carrying parts.

12.7 A unit using thermal insulation, such as mineral wool in contact with current-carrying parts or electrical insulation material that is likely to be adversely affected by moisture under the conditions of intended use, shall comply with the Insulation Resistance Test, Section 26A.

12.7 revised August 2, 1996

13 Motors

13.1 A motor shall be rated for the particular application and shall be capable of handling its maximum intended load without introducing any risk of fire, electric shock, or injury to persons.

13.2 A motor winding shall be such as to resist the absorption of moisture.

13.3 With reference to the requirement in 13.2, film-coated wire is not required to be additionally treated to resist absorption of moisture, but fiber slot liners, cloth coil wrap, and similar moisture-absorptive material shall be provided with impregnation or otherwise treated to reduce the risk of moisture absorption.

14 Overcurrent Protection

14.1 A heater using resistance-type heating elements rated at more than 48 amperes shall have the heating elements subdivided. Each subdivided circuit shall not exceed 48 amperes and shall be protected at not more than 60 amperes. The protective device shall be factory-installed within or on the appliance enclosure, or provided as a separate assembly by the appliance manufacturer.

14.2 It is assumed that the rating of the branch-circuit overcurrent protection device will be 150 percent of the rating of the heater unless the heater is marked to specify the use of a protective device having a lower rating. Standard ampere ratings for overcurrent protective devices are 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 110, 125, 150, 175, and 200. If 150 percent of the rating of the heater does not equal one of the standard overcurrent-protective device ratings specified, it is assumed that the next lower rating or setting of overcurrent-protective device will be used.

14.3 The overcurrent protection specified in 14.1, 14.2, and 16.1 – 16.6 shall be of a type rated for branch circuit protection. Fuses, if provided as the overcurrent protection specified in 14.1, 14.2, and 16.1 – 16.6, shall be Class G, H, J, K, or Type S or Edison-base plug fuses.

15 Motor-Running Overcurrent Protection

15.1 A heater using a fractional-horsepower motor (one rated for less than 746 W output) and intended to be remotely or automatically controlled, or a permanently-connected, continuous-duty, manually-started heater using a fractional-horsepower motor (one rated for less than 746 W output) shall incorporate thermal or overcurrent protection that will restrict the motor from attaining excessively high temperatures under any operating conditions.

Exception: A motor of the impedance-protected type that complies with the requirements in the Standard for Impedance-Protected Motors, UL 519, is not required to have running-overload protection.

15.2 Fuses shall not be used as motor-overcurrent protective devices unless the motor is made resistant to the largest size fuse that can be inserted in the fuseholder.

16 Short-Circuit Protection

16.1 If a heater is rated at more than 16 amperes, any motor associated with it shall be protected by an overcurrent device having a maximum ampere rating in accordance with the National Electrical Code, ANSI/NFPA 70. Such overcurrent protection shall be provided as a part of the heater appliance unless it can be determined that equivalent overcurrent protection would be incorporated as the branch-circuit protective device.

Exception: A motor having an inherent thermal protector that complies with the requirements for such devices may be used with regard to the requirements in this paragraph if, in the appliance, it will be connected in series with a branch-circuit overcurrent protective device of the same type and having a current rating not more than that with which the motor-protector combination was tested during the investigation of the protector.

16.2 Overcurrent protection at not more than 20 amperes shall be provided by a circuit breaker or fuse as a part of a heater for each general-use duplex receptacle circuit, each transformer primary circuit, and each lampholder circuit independent of a heating element included in the heater unless the heater is intended for connection to a branch circuit rated at 20 amperes or less.

Exception: The overcurrent protection may be omitted from the primary of a Class 2 transformer and from the primary of any other transformer if there is no emission of flame or molten metal from the heater enclosure, or emission of dense smoke in an occupancy compartment, when the transformer is operated under the conditions described in 16.5.

16.3 Overcurrent protection at not more than 15 amperes shall be provided by a fuse or circuit breaker for each general-use single receptacle unless the heater is intended for connection to a branch circuit rated at 15 amperes.

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

16.5 The transformer is to be operated continuously at the test voltage indicated in Table 24.3 and at rated frequency with the enclosure grounded. The load connected to the output terminals is to be a resistance of such value that three times the full load of rated current will be drawn from the secondary windings; operation is to be continued until constant temperatures are indicated by a thermocouple on the enclosure or until burnout occurs. The circuit on which the transformer is tested is to be protected by fuses rated at not less than that required for the heater.

Exception: The test is to be conducted with the output terminals of the transformer short-circuited if such condition results in less than three times its rated current being drawn from the secondary. If the transformer controls a motor, and the motor-locked rotor load plus the additional load on the transformer is greater than three times the full-load rated current, the test is to be conducted with the output terminals connected to the motor with the rotor locked, and the other loads are parallel. If the transformer does not control a motor, the load imposed on the transformer is determined by the coils of any solenoids, relays, or the like, with the armature of the larger of such devices blocked open. The test is to be conducted with an equal resistance load substituted for the coil if this load is greater than three times the full-load rated current. If accessible fuses are provided on the transformer, they are to be replaced with dummy fuses, but inaccessible fuses are to remain in the circuit.

16.6 A fuse or circuit breaker provided as a part of a heater shall be rated for the particular application and shall not be accessible from outside the heater without opening a door or cover. A fuseholder for a plug fuse shall be constructed and installed so that live parts will not be exposed to contact by persons removing or replacing fuses.

Exception No. 1: The operating handle of a circuit breaker may project outside the enclosure.

Exception No. 2: A fuse holder with a removable end cap may have the end cap accessible outside the enclosure.

Exception No. 3: The screw shell of a fuseholder for a plug fuse may be exposed to contact during removal or replacement of the fuse.

16.7 A fuseholder shall be constructed and installed so that no uninsulated live parts other than the screw shell or clips are exposed to contact by a person removing or replacing a fuse. The screw shell of a plug-type fuseholder, and the accessible contact of an extractor-type fuseholder, shall be connected toward the load.

16.7 added August 2, 1996

17 Lampholders

17.1 An Edison-base type lampholder supplied as a part of the heater shall be wired so that the screw shell will be connected to the identified grounded conductor of the supply.

17.2 A lampholder shall be constructed and installed so that no live part other than the screw shell will be exposed to contact by persons removing or replacing lamps during service.

Exception: The requirement in this paragraph does not apply if, in order to remove or replace a lamp, it is necessary to dismantle the heater with a tool, as described in 36.9.

18 Switches

18.1 A switch or other control device shall be of a type intended for the particular application and shall have a current and voltage rating not less than that of the circuit (load) it controls.

18.2 A switch shall be located or protected so that it will not be subjected to physical damage during use.

18.3 It is recommended that each switch be of the indicating type.

18.4 If a switching device (or a pilot device controlling it) has a marked on or off position or both, and operates to interrupt the main power supply circuit to a heater, it shall, when open, disconnect all ungrounded conductors of the supply circuit.

18.5 A switching device as described in 18.4, but without a marked on or off position, shall comply with the requirement in 18.4 unless there is no uninsulated current-carrying part exposed to unintentional contact when the switching device is open, or the fact that such part is live is definitely apparent.

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

18.7 A switch or other means of control intended to permit the use of a limited number of elements at one time shall be located or be of such a type that the user cannot readily change the connections to permit the use of more elements than intended.

18.8 A switch that controls a medium-base lampholder of other than a pilot- or indicating-light shall be rated for use with tungsten-filament lamps.

18.9 A timed-cutoff switch shall be provided with the heater as indicated in 18.10 and 18.11 unless the heater is marked in accordance with 38.1.

18.9 revised August 2, 1996

18.10 If a timed-cutoff switch is installed at the factory as an integral part of the heater or control panel, it shall:

- a) Be connected so that it will simultaneously disconnect the number of ungrounded conductors required to interrupt the current flow to the heater,
- b) Have a maximum "on" period of 1 hour, and
- c) Be arranged and installed so that the time feature does not lend itself to being overridden.

18.11 If a timed-cutoff switch is shipped with the heater, the switch shall be rated for the application and shall be of such construction that it can be installed in accordance with the markings specified in 38.1.

18.11 revised August 2, 1996

No Text on This Page

19 Receptacles

19.1 No receptacle shall be provided as part of a heater or inside a combination heater-room, as specified in 38.2.

19.1 revised August 2, 1996

20 Automatic Temperature Controls

20.1 General

20.1.1 A heater shall be provided with two independent temperature controls:

- a) An automatic temperature-regulating control that is either an integral part of the heater or that is a separate component for installation as part of the room assembly and
- b) A manual-reset limit control that is integral with the heater.

20.1.2 With reference to 20.1.1, if contactors are used, separate contactors shall be used for the automatic temperature-regulating control and the manual-reset limit control.

20.1.3 The manual-reset limit control shall comply with the requirements in the Standard for Limit Controls, UL 353, or with the requirements for temperature-limiting controls specified in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873. The control shall comply with the 30,000-cycle endurance requirements in UL 353 or UL 873.

Exception: When a heater is intended for household use only, the manual-reset limit control shall comply with the 6000-cycle endurance test specified in UL 353 or UL 873, and shall be marked in accordance with 36.28.

20.1.3 revised August 2, 1996

20.1.3.1 The automatic temperature-regulating control shall comply with the requirements in the Standard for Limit Controls, UL 353, or with the requirements for temperature-limiting controls in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873. The control shall comply with the 100,000-cycle endurance requirements in UL 353 or UL 873.

20.1.3.1 added August 2, 1996

20.1.4 The manual-reset limit control shall be secured in place and located so that it will be accessible for resetting without disturbing internal wiring. No current-carrying part shall be accessible during resetting of the control.

20.1.5 Each of the control devices described in (a) – (c), when in the disconnect position, shall interrupt power to the element(s) it controls from all ungrounded conductors of the power supply circuit:

- a) A manual-reset limit control.
- b) An automatic temperature-regulating control that has a marked position indicating "off" or the equivalent.
- c) An automatic temperature-regulating control without a marked position indicating "off" or the equivalent, that controls a live part exposed to unintentional contact, the live condition of which is not apparent.

20.1.6 A control intended to reduce the risk of fire, electric shock, or injury to persons in operation of a heater shall be operative whenever the heater is connected to its power supply.

20.1.7 A contactor actuated by a control shall comply with the endurance test requirements for the control. Refer to 20.1.3 and 20.1.3.1 for the number of cycles.

20.1.7 revised August 2, 1996

20.1.8 If a control has a marked position as described in 20.1.9, it shall not respond to temperature changes while the actuating member is in that position.

20.1.9 The requirement in 20.1.8 applies to a control that is marked:

- a) With an "Off" position, or
- b) With another wording (such as "No heat," "Cold," or the like) that conveys the same meaning as the word off.

20.1.10 A control that does not reclose (remains open) when cooled to a temperature of minus 35°C (minus 31°F) may be used with regard to the requirement in 20.1.8.

20.2 Terminals and actuating members of temperature controls

20.2.1 The terminals of a temperature control within the enclosure of a heater shall be located or further enclosed to reduce the risk of their becoming short-circuited or damaged.

20.2.2 The bulb, capillary tubing, or other sensing element of a control or limit switch that is depended upon to reduce the risk of fire, electric shock, or injury to persons shall be located or guarded against physical damage during installation and use of the heater.

20.2.3 The bulb, capillary tubing, or other sensing element of an automatic temperature-regulating control that is a separate component for installation in a room shall be provided with a guard to reduce the risk of it becoming physically damaged.

20.2.4 The guard for the sensing element and for any exposed capillary tubing shall reduce the risk of physical damage and be fastened in place by screws, nails, or the equivalent.

20.2.5 The guard may be metallic or nonmetallic, but no metallic portion shall be exposed to contact more than 12 inches (305 mm) below the ceiling of the room.

21 Spacings

21.1 General

21.1.1 Each spacing in a heater shall be in accordance with Tables 21.1 – 21.3.

Exception No. 1: The spacings specified in the tables do not apply to the inherent spacings of a component part of a heater. Such spacings are evaluated under the requirements for that component.

Exception No. 2: At closed-in points only, such as the screw-and-washer construction of an insulated terminal mounted in metal, a spacing of 3/64 inch (1.2 mm) may be used in a heater rated at 250 volts or less. Within a temperature regulating control, other than at contacts, the spacing between uninsulated current-carrying parts on opposite sides of the contacts is not to be less than 1/32 inch (0.8 mm) through air and 3/64 inch over the surface of insulating material, and the construction is to be such that the spacings will be maintained permanently.

Table 24.1
Maximum temperatures

Material or component	°C	°F
1. Any point within a terminal box or wiring compartment in which field-installed conductors are to be connected, including such conductors themselves	90	194
2. Any point on a surface adjacent to a heater (including the surface on which the heater is mounted and the guard), specified points on test surfaces and enclosures at designated clearances from the heater, a metal surface of a heater at the point of contact with the test surface, and the exterior surface of a recessed heater that comes into contact with combustible material within the test enclosure	90	194
3. Fuses		
a) Class J, T, CC	110	230
b) Class R	75	167
c) Other fuses	90	194
4. Fiber used as electrical insulation or as cord bushings	90	194
5. Wood or other combustible material that is a part of the heater	90	194
6. Cotton or rayon braid of a flexible cord	90 ^a	194 ^a
7. Class 105 insulated relay or solenoid winding	90 ^b	194 ^b
8. Class A insulation on coil windings of DC, universal, and integral-horsepower motors:		
a) In open motors:		
Thermocouple method	90	194
Resistance method	100	212
b) In totally enclosed motors:		
Thermocouple method	95	203
Resistance method	105	221
9. Class A insulation on coil windings of fractional-horsepower AC motors, other than universal, and on vibrator coils – thermocouple or resistance method ^c :		
a) In open motors	100	212
b) In totally enclosed motors	105	221
10. Class B insulation, other than as indicated in items 11 and 12 – thermocouple method ^c	110	230
11. Class B insulation on coil windings of DC, universal, and integral-horsepower AC motors:		
a) In open motors:		
Thermocouple method	110	230
Resistance method	120	248
b) In totally enclosed motors:		
Thermocouple method	115	239
Resistance method	125	257

(Continued)

Table 24.1 (Cont'd)
Maximum temperatures

Material or component	°C	°F
12. Class B insulation on coil windings of fractional-horsepower AC motors other than universal – thermocouple or resistance method ^c :		
a) In open motors	120	248
b) In totally enclosed motors	125	257
13. Phenolic composition used as electrical insulation or where failure results in a condition of risk ^d	150	302
14. Insulated wire or cord	The temperature rating ^e of the insulating material	
15. Sealing compound	f	f
16. Copper conductors:		
a) Tinned or bare strands having:		
1) A diameter less than 0.015 inch (0.38 mm)	150	302
2) A diameter of 0.015 inch or more	200	392
b) Plated with nickel, gold, silver, or a combination of these	250	482
17. Termination of copper conductor in a pressure terminal connector, unless both are tinned, nickel coated, or silver plated	150	302
^a Inside a heater, the braid of a heater cord is capable of being subjected to a greater temperature when the insulation is held in place by other suitable means. ^b A maximum temperature of 110°C (230°F) complies under the resistance method. ^c See 24.6 and 24.7 for further thermocouple specification. ^d The limitation on phenolic composition does not apply to a compound that has been investigated and determined to have complying heat-resistant properties. ^e Inside a heater, the maximum temperature on a wire or cord is capable of being greater than the specified maximum temperature when the insulation on each conductor is protected by supplementary insulation (such as a braid, wrap, tape, or close-fitting tubing) that is rated for the temperature and type of insulation involved. ^f Unless the material is thermal-setting, the maximum sealing compound temperature, when corrected to a 25°C (77°F) ambient temperature, is 15°C (27°F) less than the softening point of the compound as determined by the Test for Softening Point by the Ring and Ball Apparatus, ASTM E28-1992.		

Table 24.1 revised August 2, 1996

24.4 Temperatures are to be measured by thermocouples consisting of wires not larger than No. 24 AWG (0.21 mm²) and not smaller than No. 30 AWG (0.05 mm²). When thermocouples are used in determining temperatures in electrical equipment, it is standard practice to use thermocouples consisting of No. 30 AWG iron and constantan wire and a potentiometer type instrument; such equipment is to be used whenever referee temperature measurements by thermocouples are necessary. The thermocouples and related instruments are to be accurate and calibrated in accordance with laboratory practice. The thermocouple wire is to comply with the requirements for special thermocouples as listed

in the table of limits of error of thermocouples in Temperature Measurement Thermocouples, ANSI MC96.1-1982. A temperature is considered to be constant when three successive readings, taken at intervals of 10 percent of the previously elapsed duration of the test (but not less than 5-minute intervals), indicate no change.

Exception: A coil temperature is to be determined by the change-of-resistance method in 24.6 if the coil is inaccessible for mounting thermocouples.

24.5 A thermocouple junction and the adjacent thermocouple lead wire are to be held in effective thermal contact with the surface of the material whose temperature is being measured. In most cases, effective thermal contact will result from securely taping or cementing the thermocouple in place but, if a metal surface is involved, brazing or soldering the thermocouple to the metal may be necessary.

24.6 A thermocouple is to be used for determining the temperature of a coil or winding if it can be mounted, without removal of encapsulating compound or the like, on:

- a) The integrally applied insulation of a coil without a wrap or
- b) The outer surface of a wrap that is not more than 1/32 inch (0.8 mm) thick and consists of cotton, paper, rayon, or the like (but not of asbestos or similar thermal insulation).

The change-of-resistance method is to be used if the thermocouple measurement cannot be conducted in accordance with the foregoing considerations. For a thermocouple-measured temperature of a motor coil as specified in items 9 and 12 of Table 24.1, the thermocouple is to be mounted on the integrally applied insulation on the conductor.

24.7 At a point on the surface of a coil where the temperature is affected by an external source of heat, the temperature measured by means of a thermocouple may be as shown in Table 24.2 if the temperature of the coil measured by the resistance method is not greater than specified in Table 24.1.

Table 24.2
Points affected by external heat source

Item in Table 24.1	Maximum temperature,	
	°C	°F
Part a) of item 8	105	221
Part a) of item 9	105	221
Part a) of item 11	130	266
Part a) of item 12	130	266

24.8 To determine if a heater complies with the requirement in 24.1, it is to be operated continuously until constant temperatures have been reached. The test voltage is to be as indicated in Table 24.3.

Exception: If the application of the indicated test voltage does not result in the measured wattage input to the heater being equal to or more than the marked wattage rating, the test voltage is to be increased until the measured wattage input equals the marked wattage rating.

24.9 A motor that is used in the heater in addition to a heating element is to be operated at the marked voltage rating of the heater, whether integrally connected or on a separate circuit.

Table 24.3
Voltage for temperature test

Marked voltage rating	Test potential in volts
Value within one of the specified ranges	Highest value of corresponding specified ranges ^a
Value not within one of the specified ranges	Rated voltage (minimum 120, 208, 240, or 277 depending on nominal branch circuit supply voltage to which heater is to be connected)
^a Specified range refers to any of the ranges of voltage mentioned in 35.1.	

24.10 The tests described in 24.1, 28.1.2, and 28.1.3 are to be performed:

- a) With rocks if the manufacturer supplies the rocks, recommends their use in the operating instructions, and provides a marking on the heater in accordance with 36.13 to indicate that the rocks are essential to the intended operation.
- b) With and without rocks if the rocks are not supplied by the manufacturer.

Exception: Constructions for which rocks obviously cannot be used need not be tested with rocks.

24.11 When rocks are used in the following tests, the rock compartment in the heater is to be filled with rocks having a density of 170 – 185 pounds per cubic foot (2720 – 2960 kg/m³).

24.12 In conducting a test to determine if a heater complies with the temperature requirements, the heater is to be mounted or supported as in service and tested under conditions approximating those of intended operation. The heater is to be installed in a room of the minimum size specified by the manufacturer's installation instructions. The walls, ceiling, and the floor of the room shall be constructed of 3/4-inch (19.1-mm) thick, non-delaminating, unpainted plywood on conventional 16-inch (0.4-m) centers using 2 by 4 inch (50.8 by 102 mm) studding and 2 by 2 inch floor joists with 1 by 3 inch (25.4 by 76.2 mm) furring over the studding. Foil-faced 3-inch (7.62-mm) glass fiber insulation having a minimum R (thermal resistance) factor of 11 is to be stretched, foil-face inward, over the studding flush with the inside surface of the studs. The thermal insulation is to be securely fastened. Three-quarter inch square corner trim, 3/4-inch square ceiling trim, and 1/2 by 1-5/8 inch (12.7 by 41.2 mm) base trim are to be used. The outside is to be finished with wood or plywood at least 1/4 inch (6.4 mm) thick. See Figure 24.1.

24.12 effective November 1, 1994

24.13 The heater is to be operated with the door of the test room closed. If vents are provided in the room they are to be closed during the test. The temperatures on the inner surfaces of the room shall not exceed 120°C (248°F) during the first hour of operation and shall not exceed 90°C (194°F) at the end of the first hour. The manually-resettable thermal cutoff shall not operate during this test.

24.14 The heater is to be located as close to a wall corner as its construction will permit, and it is to be placed relative to the walls so that maximum heating will occur on the walls. See Figure 24.2.

Exception: The heater may be spaced away from the walls if the heater is marked as described in 36.17.

Figure 24.1
Typical wall construction

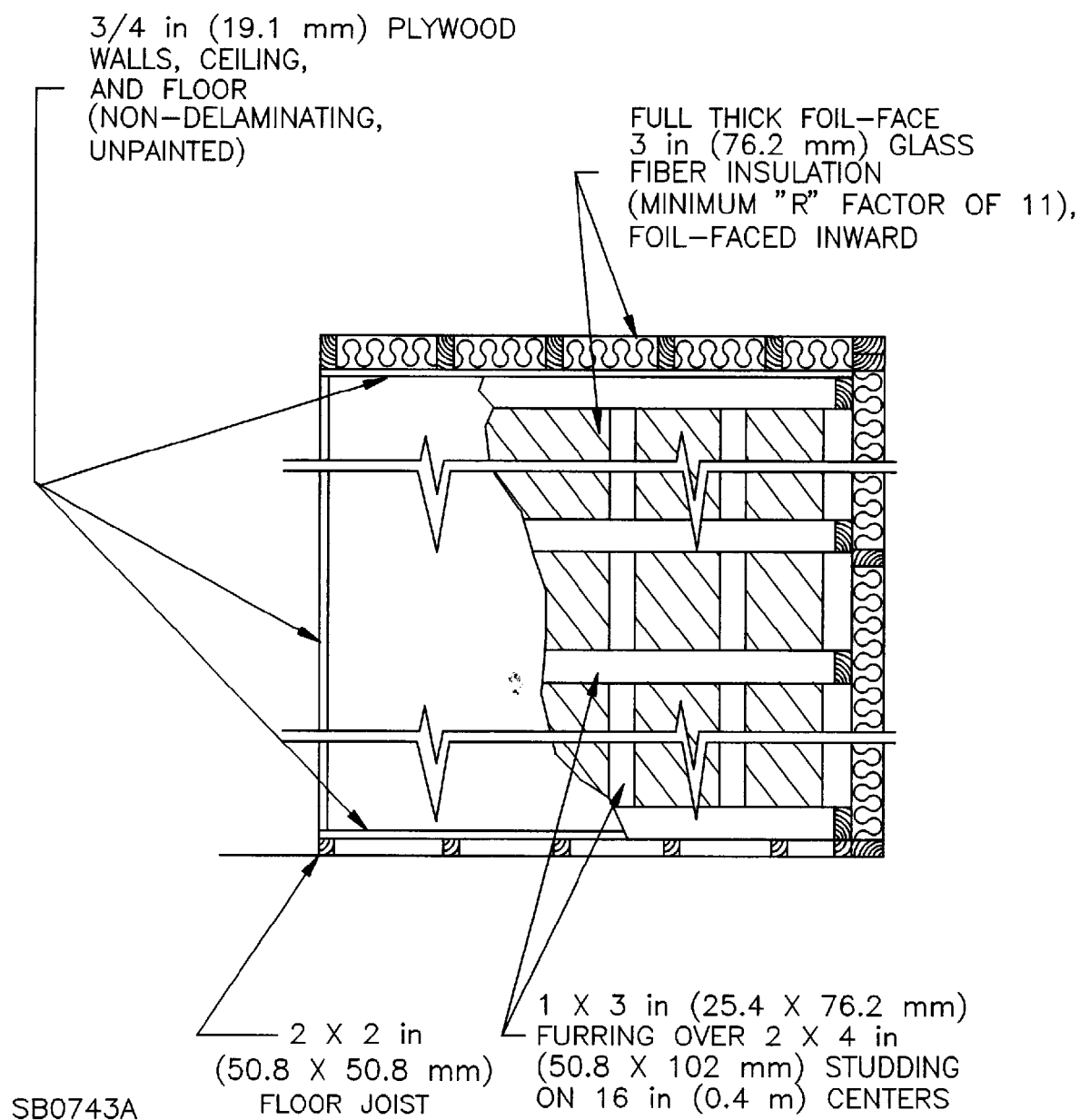


Figure 24.1 revised August 2, 1996

Figure 24.2
Arrangement of the heater test room

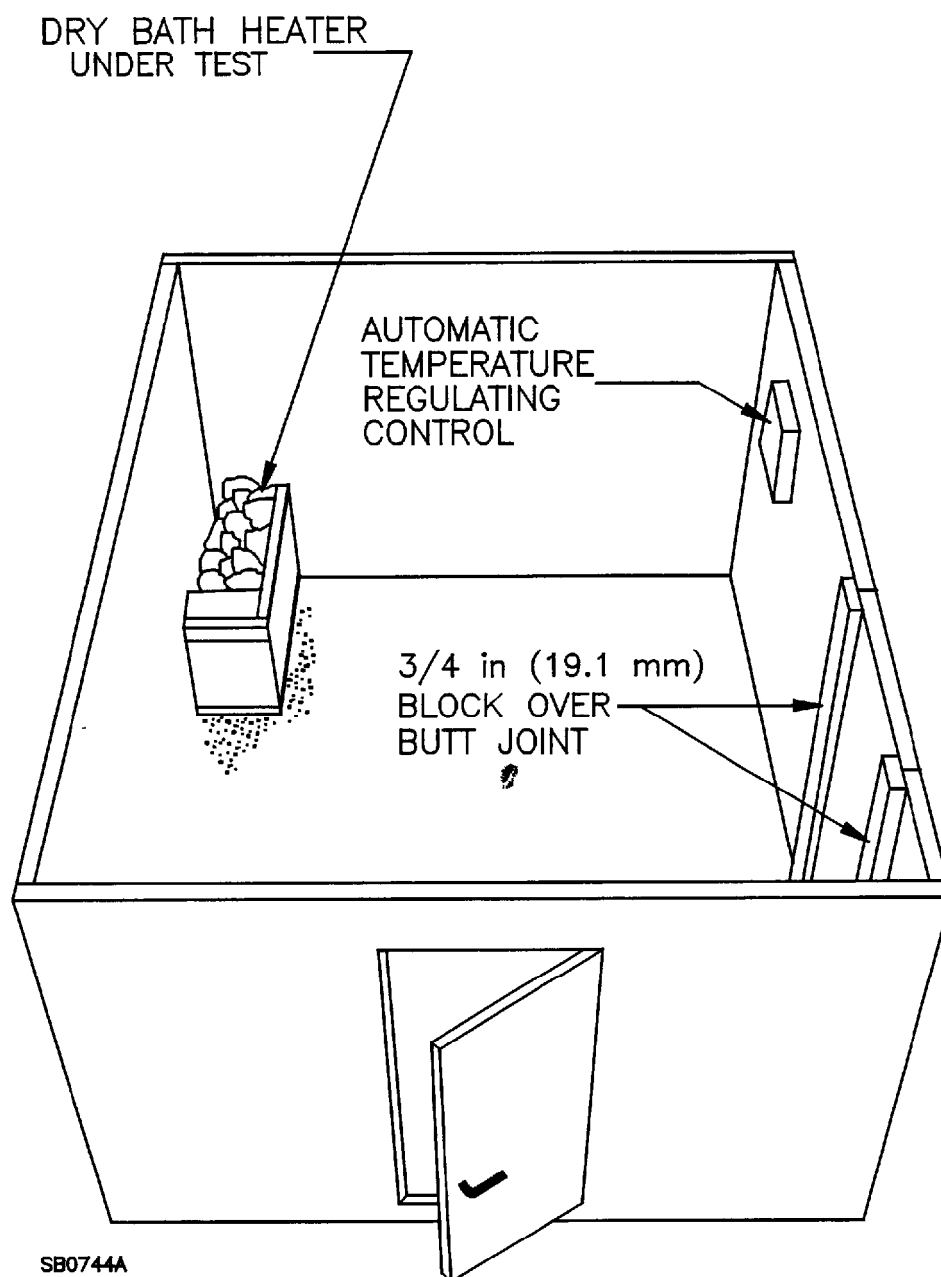


Figure 24.2 revised August 2, 1996

25 Minimum Room Air Temperature Test

25.1 The air temperature inside the test room under stabilized conditions shall be not less than 71°C (160°F) when tested in accordance with 25.2.

25.2 In a test to determine compliance with the requirement in 25.1, the test room is to be equipped with a thermocouple centrally located in the room 2 feet (0.6 m) below the ceiling. The heater is to be operated in accordance with 24.8 – 24.14.

Exception: If a series of room sizes, heater sizes, or both, are being represented by the sample under test, the voltage to the heating elements is to be adjusted, if necessary, to attain a ratio of watts to room unit volume equivalent to the lowest ratio of the series.

25.2 effective November 1, 1994

26 Insulation Resistance and Dielectric Voltage-Withstand Tests

Section 26 deleted August 2, 1996

26A Insulation Resistance Test

26A.1 A sample is to be heated to a temperature of 34°C (93°F) to reduce the risk of condensation of moisture during conditioning. The heater is then to be placed in a humidity cabinet having a relative humidity of 85 ±5 percent at a temperature of 32 ±2°C (89.6 ±3.6°F) for 24 hours. After the conditioning:

- a) A heater shall have an insulation resistance between live parts and noncurrent-carrying metal parts of not less than 50,000 ohms.
- b) A heater shall comply with the requirements when subjected to a repeated Dielectric Voltage-Withstand Test, Section 26B.

Exception: A ceiling-recessed heater or ceiling surface-mounted heater is not required to comply with these requirements.

26A.1 added August 2, 1996

26A.2 Insulation resistance is typically to be measured by a megohmmeter providing a test potential of 260 volts DC. The heater is not to be energized for this test.

26A.2 added August 2, 1996

26B Dielectric Voltage-Withstand Test

26B.1 A heater shall withstand without breakdown for 1 minute, the application of a 60-hertz essentially sinusoidal potential between live parts and interconnected dead metal parts with the heater at its maximum intended operating temperature.

26B.1 added August 2, 1996

26B.2 The test potential (rms) is to be 1000 volts for a heater rated 250 volts or less, and 1000 volts plus twice the rated voltage for a heater rated more than 250 volts.

26B.2 added August 2, 1996

26B.3 The test transformer is to have a capacity of 500 volt-amperes or more and an output voltage that is essentially sinusoidal. The applied potentials are to be increased gradually from zero to the required values and then maintained for 1 minute. There shall be no dielectric breakdown as a result of this test.

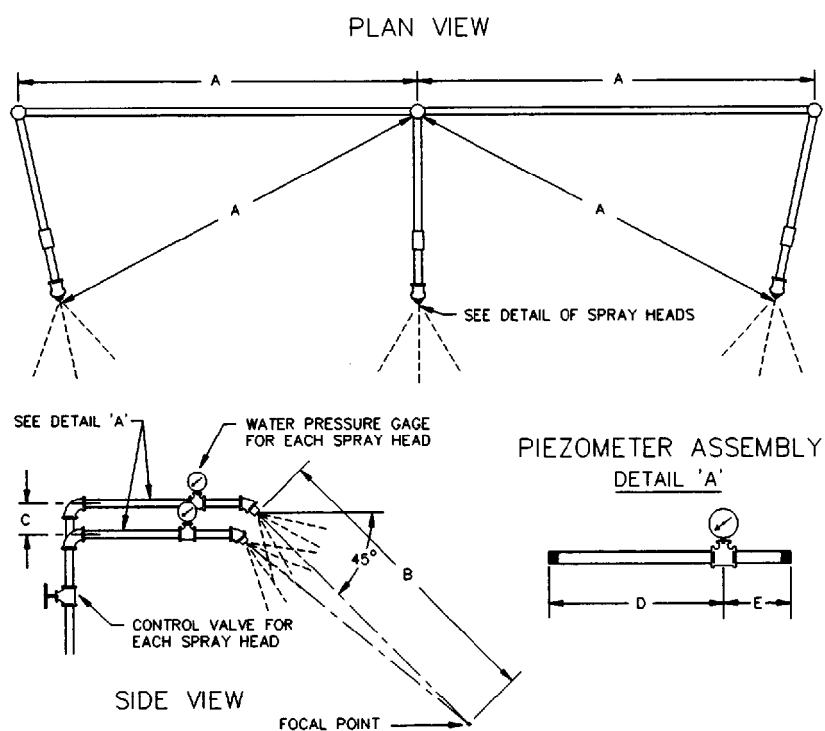
26B.3 added August 2, 1996

27 Water Spray Test

27.1 The heater is to be connected to a source of supply having voltage in accordance with Table 24.3 and operated until well heated. The heater is then to be subjected to a water spray test using the apparatus illustrated in Figures 27.1 and 27.2. The spray is to be applied to the top front of the enclosure at an angle of 45 degrees to the vertical. The rate of waterfall is to be 0.21 inch (5.36 mm) per minute as determined by the rise of water in a small pan with vertical sides, placed horizontal and completely within the area covered by the water spray. The water is to have a resistivity of 2540 ohm-centimeters. The spray cycle consists of a 15-second spray and a 105-second drying period. The cycle is to be repeated for 1 hour (total 30 cycles). The heater is then to be de-energized and immediately subjected to the tests described in the Insulation Resistance Test, Section 26A, and the Dielectric Voltage-Withstand Test, Section 26B.

27.1 revised August 2, 1996

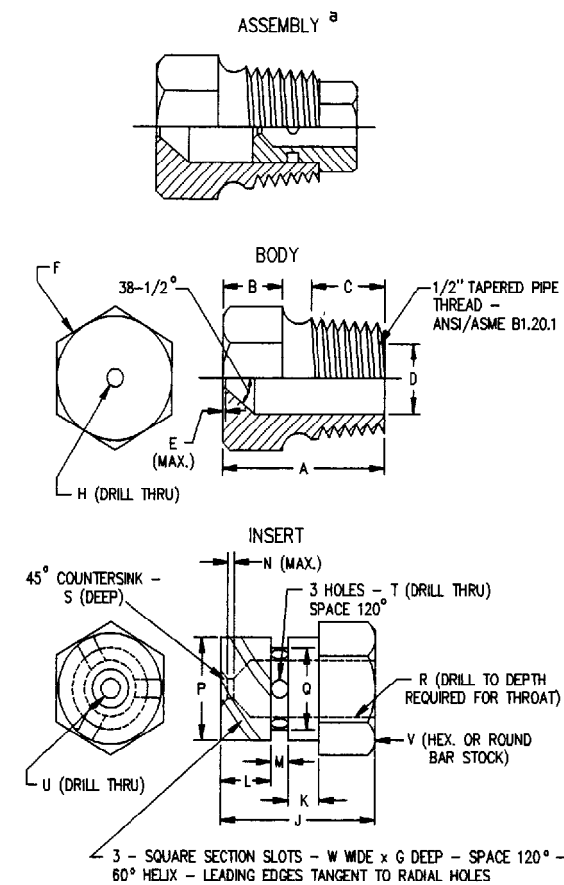
Figure 27.1
Water-spray piping



Item	inch	mm
A	28	710
B	55	1400
C	2-1/4	55
D	9	230
E	3	75

RT101D

Figure 27.2
Spray head



Item	inch	mm	Item	inch	mm
A	1-7/32	31.0	N	1/32	0.80
B	7/16	11.0	P	.575	14.61
C	9/16	14.0		.576	14.63
D	.578	14.68	Q	.453	11.51
	.580	14.73		.454	11.53
E	1/64	0.40	R	1/4	6.35
F	c	c	S	1/32	0.80
G	.06	1.52	T	(No. 35) ^b	2.80
H	(No. 9) ^b	5.0	U	(No. 40) ^b	2.50
J	23/32	18.3	V	5/8	16.0
K	5/32	3.97	W	0.06	1.52
L	1/4	6.35			
M	3/32	2.38			

^a Nylon Rain-Test Spray Heads are available from Underwriters Laboratories Inc.

^b ANSI B94.11M Drill size

^c Optional – To serve as wrench grip.

RT100C

28 Abnormal Operation Test

28.1 Temperature

28.1.1 If the conditions of intended operation are not representative of abnormal conditions likely to occur in actual service, a heater shall be subjected to the tests described in 28.1.2 and 28.1.4. A heater shall not constitute a risk of fire, electric shock, or injury to persons when operated continuously under conditions as described in 28.1.2 – 28.1.4.

28.1.2 The temperature test described in 24.1 is to be performed with any automatic temperature-regulating control shunted out of the circuit. The manual-reset limit control shall operate to limit the temperatures of the inner surfaces of the room to not more than 150°C (302°F) during the first hour of operation and to not more than 120°C (248°F) thereafter.

Exception: If the manual-reset limit control does not operate and the temperatures stabilize at or below 120°C, the manual-reset limit control is to be caused to operate by simulating abnormal conditions. The simulation of abnormal conditions may consist of increasing the input voltage to the heater, applying thermal insulation to the room, or similar means to increase the inner surface temperatures of the room. When the limit control operates, the temperature limits specified in 28.1.2 shall apply.

28.1.3 The test mentioned in 28.1.2 is to be conducted immediately following the temperature test.

28.1.4 If a motor is connected across a portion of a resistance element, the heater shall not constitute a risk of fire and shall not emit flame or molten metal as the result of an open circuit in that portion of the element that is in parallel with the motor.

28.2 Mechanical abuse

28.2.1 Any element in a heater constructed so that the rocks used in the unit come in direct contact with the element shall be subjected to the mechanical abuse tests in 28.2.2 and 28.2.3.

28.2.2 The element is to be placed on a flat surface as shown in Figure 28.1 and is to be energized. A downward force of 100 pounds-force (445 N) is to be applied in turn for 15 minutes at each of three locations using a 1-1/2-inch (38.1-mm) angle-iron. Insulation resistance and dielectric withstand tests are then to be conducted in accordance with the Insulation Resistance Test, Section 26A, and the Dielectric Voltage-Withstand Test, Section 26B.

28.2.2 revised August 2, 1996

28.2.3 A load is to be applied as shown in Figure 28.2, increasing slowly from 0 to 550 pounds-force (0 to 2.45 kN). Permanent deflection after the load is removed shall not exceed 1/16 inch (1.6 mm). Insulation resistance and dielectric withstand tests are then to be conducted in accordance with the Insulation Resistance Test, Section 26A, and the Dielectric Voltage-Withstand Test, Section 26B.

28.2.3 revised August 2, 1996

Figure 28.1
Mechanical abuse test set-up

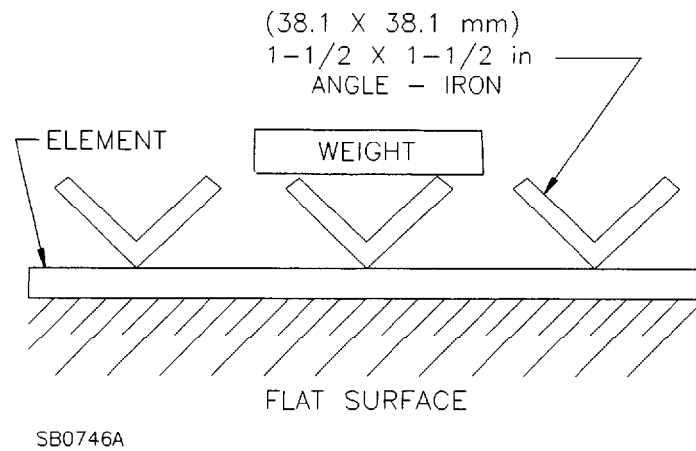


Figure 28.1 revised August 2, 1996

Figure 28.2
Mechanical abuse test set-up

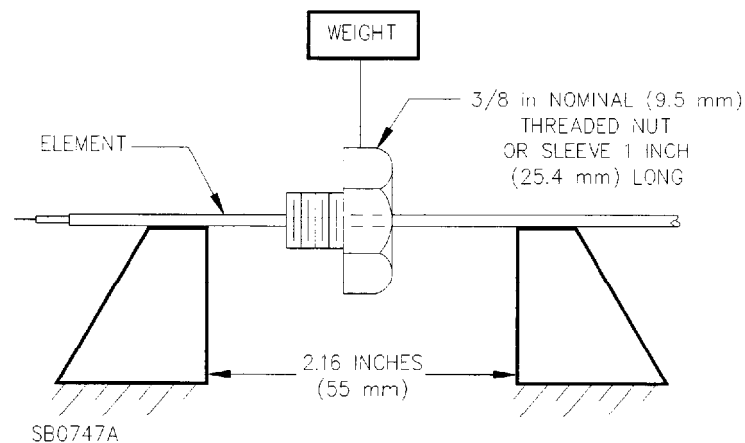


Figure 28.2 revised August 2, 1996

28.3 Cheesecloth and towel drape

28.3.1 A heater that is loosely covered with a double layer of cheesecloth backed by a terrycloth towel shall not cause the cloth or towel to glow or flame.

Exception: A ceiling-recessed heater or, as described in 28.3.6, certain types of wall or ceiling surface-mounted heaters, need not be drape tested.