



UL 1693

Underwriters Laboratories Inc. Standard for Safety

Electric Radiant Heating Panels and Heating Panel Sets



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UL Standard for Safety for Electric Radiant Heating Panels and Heating Panel Sets, UL 1693

Third Edition, Dated September 13, 2010

SUMMARY OF TOPICS:

These revisions to UL 1693 are being issued to incorporate the addition and revision of requirements to relocate component Standard references from Appendix A into the body of the Standard as component requirements.

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

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated July 29, 2011.

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1

UL 1693

Standard for Electric Radiant Heating Panels and Heating Panel Sets

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September 13, 2010

This UL Standard for Safety consists of the Third Edition including revisions through October 14, 2011.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <http://csds.ul.com>.

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CONTENTS

INTRODUCTION

1 Scope	5
2 Components	6
3 Units of Measurement	6
4 References	6
5 Glossary	6

CONSTRUCTION

6 General	6A
6A Insulated Wire, Cable and Nonheating Leads	6C
6B Connectors	6C
6C Supplemental Insulation, Insulating Bushings and Assembly Aids	6D
6D Boxes and Raceways	6D
7 Enclosure	6D
8 Protection Against Corrosion	11
9 Supply Connections	11
10 Wire Connectors	12
11 Electrical Insulation	13
12 Thermal Insulation	13
13 Flammability	14
13.1 General	14
13.2 Flexible heating products	14
13.3 Rigid heating products with polymeric enclosures	14
14 Spacings	14
15 Grounding	14A

PERFORMANCE

GENERAL

16 Details	14B
------------------	-----

ALL HEATING PRODUCTS

17 Power Input Test	17
18 General Test Conditions	17
19 Normal Temperature Test	18
19.1 General	18
19.2 Test alcove construction	19
19.3 Ceiling installation	25
19.4 Floor installation	25
19.5 Common ceiling/floor section installation	26
19.6 Concrete or poured masonry installations	26
19.7 Test procedure	27
20 Abnormal Temperature Test	28A
20.1 Ceiling installation	28A
21 Contact Loss Test	29
21.1 Parallel type heating products	29

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FLEXIBLE HEATING PRODUCTS

22 Dielectric Voltage-Withstand Test (Dry)	29
23 Dielectric Voltage-Withstand Test (In Water)	30
24 Cold Bend Test	30
25 Mechanical Abuse Tests	31
25.1 General	31
25.2 Conditioning	31
26 Scratch Test	32
27 Concrete Slab Cracking Test	32
28 Nonheating Conductor (Busbar) Overload Test	33
28.1 Parallel type flexible heating products intended for feed through connection to other heating products	33

RIGID HEATING PRODUCTS

29 Dielectric Voltage-Withstand Test (Dry)	33
30 Dielectric Voltage-Withstand Test (Water)	34
31 Impact Test	34
32 Drop Test	34

MANUFACTURING AND PRODUCTION TESTS

33 Production-Line Dielectric Voltage-Withstand Test	35
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MARKINGS

34 Details	36
35 Warning Labels	38

INSTALLATION INSTRUCTIONS

36 Details	39
------------------	----

APPENDIX A

INTRODUCTION

1 Scope

1.1 These requirements cover radiant heating panels and heating panel sets, for use on ac supply system voltages not exceeding 600 V, designed for installation indoors in nonhazardous locations in household, commercial, and industrial applications, in accordance with Article 424, Part IX, of the National Electrical Code, ANSI/NFPA 70.

1.1 revised October 14, 2011

1.2 These requirements cover products designed to be permanently connected to a supply circuit, and that are intended to form an integral part of the building construction after on-site assembly, installation, and connection.

1.3 These requirements do not cover electric heating equipment or appliances that are covered by individual requirements that are separate from this Standard. Other related standards include :

- a) Electrical Resistance Heat Tracing for Commercial and Industrial Applications, UL 515;
- b) Fixed and Location-Dedicated Electric Room Heaters, UL 2021;
- c) Movable and Wall- or Ceiling-Hung Electric Room Heaters, UL 1278;
- d) Outline of Investigation for Mobile Home Pipe Heating Cables, Subject 1462;
- e) Outline of Investigation for Roof and Gutter De-Icing Cable Units, Subject 1588;
- f) Electric Space Heating Cables, UL 1673;
- g) Outline of Investigation for Residential Pipe Heating Cables, Subject 2049; and
- h) Electric Heating Appliances, UL 499.

1.3 revised October 14, 2011

1.4 These requirements do not cover the following:

- a) Heating equipment connected to the supply by use of a flexible cord with attachment plug;
- b) Heating equipment that is movable after installation;
- c) Heating equipment with integral means of producing air flow;
- d) Heating equipment manufactured and sold as an integral part of a floor or ceiling covering materials such as heated floor tiles, heated carpet, and heated laminate floor;
- e) Heating equipment exceeding 355 W/m^2 (33 W/ft^2) when installed in concrete or poured masonry;
- f) Electric Space-Heating Cables of Article 424 Part V of the National Electrical Code, ANSI/NFPA 70;

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g) Heating panels and panel sets for mounted directly underfloor coverings in accordance with 424.99 of the National Electrical Code, ANSI/NFPA 70; and

h) Radiant heating panels intended to be installed in a dropped or suspended ceiling.

1.4 added October 14, 2011

1.5 These requirements do not cover switches, transformers, power supplies, controls (e.g. temperature) or protective devices (e.g. ground fault protection) that are typically installed separate from the heating panels but may be installed at the same time as part of the space heating system. Those devices are covered by individual requirements that are separate from this Standard.

1.5 added October 14, 2011

2 Components

Section 2 deleted October 14, 2011

3 Units of Measurement

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

4 References

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

5 Glossary

5.1 For the purpose of this standard, the following definitions apply.

5.2 ACTIVE AREA – That part of a heating product forming a plane area bounded by the perimeter of the heating element and its non-heating components.

5.3 ASSOCIATE PART – A nonintegral part of a heating product essential for the correct operation, installation, or both, of the product.

5.3.1 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. outlet box) 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.

5.3.1 added October 14, 2011

5.4 FLEXIBLE HEATING PRODUCT – A heating product of nonrigid construction, composed of thin flexible sheets of electrical insulating material enclosing a heating element, which is intended for installation in contact with normal building construction materials.

5.5 HEATING ELEMENT – That portion of a heating panel or heating panel set that is the actual electrical conducting medium, including a continuously applied or patterned conductive film, intended to be heated by an electric current.

5.6 HEATING PANEL – A complete assembly provided with a junction box or a length of flexible conduit for connection to a branch circuit.

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5.7 HEATING PANEL SET – An assembly provided with nonheating leads or a terminal junction assembly identified as being suitable for connection to a wiring system. It may be of fixed dimension, or of continuous form where the final product dimension is determined during installation.

5.8 HEATING PRODUCT – A collective term used to refer to heating panels and heating panel sets.

5.9 NONHEATING COMPONENT – A component of a heating product that carries current or is conductively coupled to a supply circuit, and that is not primarily intended to produce heat.

5.10 NONHEATING LEADS – Lead wires provided to facilitate connection of a heating product directly to branch circuit conductors. Also known as “cold leads.”

5.11 RIGID HEATING PRODUCT – A heating product of fixed construction designed to be mounted on or above a ceiling, forming all or part of a ceiling, or mounted below a subfloor.

5.11.1 SENSOR WIRE – Factory provided wiring intended for installation in ceilings or floors in proximity to heating product and for connection to a control and/or protective device installed as part of the space heating system.

5.11.1 added October 14, 2011

5.12 TERMINAL BOX – A box or enclosure, inside which connections between branch circuit conductors and cold leads or terminals are made.

CONSTRUCTION

6 General

6.1 A heating product shall be provided with means for mounting in the intended manner. Any fittings – such as brackets, hangers, or the like – necessary for mounting shall be furnished with the heating product.

6.2 A heating product intended to be installed in contact with combustible building construction materials, such as furring, nailing strips or joists shall be provided with an integral means to facilitate securement during installation.

6.3 A heating product shall be installed in accordance with the manufacturer's installation instructions provided with the heating product. See Details, Section 36.

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

- a) Comply with the requirements for that component as indicated in 6A – 6D;
- 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

- e) Not contain mercury.

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.

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 complying with a component standard other than those cited in 6A – 6D is acceptable if:

- a) The component also complies with the applicable component standard of 6A – 6D; or*
- b) The component standard:*
 - 1) Is compatible with the ampacity and overcurrent protection requirements in the National Electrical Code (NEC), ANSI/NFPA 70, where appropriate;*
 - 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.*

6.4 added October 14, 2011

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

Exception: Where 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.

6.5 added October 14, 2011

6.6 A component not anticipated by the requirements of this standard, not specifically covered by the component standards of 6A – 6D, and that involves a potential risk of electric shock, fire, or personal injury, shall be additionally investigated in accordance with the applicable standard, and shall comply with 6.4(b) – (e).

6.6 added October 14, 2011

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

6.7 added October 14, 2011

6A Insulated Wire, Cable and Nonheating Leads

6A.1 Unless specified elsewhere, insulated conductors, nonheating leads, and sensor wire shall comply with one of the following:

- a) The Standard for Appliance Wiring Material, UL 758;
- b) The Standard for Thermoset-Insulated Wires and Cables, UL 44;
- c) The Standard for Thermoplastic-Insulated Wires and Cables, UL 83; or
- d) other types specified in Chapter 3 of the National Electrical Code (NEC), ANSI/NFPA 70 complying with the appropriate standard.

6A.1 added October 14, 2011

6B Connectors

6B.1 Multi-pole connectors shall comply with the Standard for Insulated Multi-Pole Splicing Wire Connectors, UL 2459.

6B.1 added October 14, 2011

6B.2 Splices complying with one of the following are considered to fulfill the requirement of 10.1 – 10.5:

- a) the Standard for Wire Connectors, UL 486A-486B, provided with supplemental insulation complying with 6C.1 and 11.1 – 11.3;
- b) the Standard for Splicing Wire Connectors, UL 486C;
- c) the Standard for Sealed Wire Connector Systems, UL 486D; or
- d) the Standard for Equipment Wiring Terminals for Use With Aluminum and/or Copper Conductors, UL 486E, provided with supplemental insulation complying with 11.1 – 11.3 provided with supplemental insulation complying with 6C.1 and 11.1 – 11.3.

6B.2 added October 14, 2011

6C Supplemental Insulation, Insulating Bushings and Assembly Aids

6C.1 The requirements for supplemental insulation (e.g. tape, sleeving or tubing) are not specified unless the insulation or device is required to fulfill 10.2. In such cases:

- a) Insulating tape shall comply with the Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape, UL 510 and be used within use limitations (e.g. adherence to itself).
- b) Sleeving shall comply with the Standard for Coated Electrical Sleeving, UL 1441.
- c) Tubing shall comply with the Standard for Extruded Insulating Tubing, UL 224.

6C.1 added October 14, 2011

6D Boxes and Raceways

6D.1 Electrical boxes and raceways of the types specified in Chapter 3 of National Electrical Code (NEC), ANSI/NFPA 70 and that comply with the relevant standard and Section 7, Enclosure, are considered to fulfill the requirements of this Standard.

6D.1 added October 14, 2011

7 Enclosure

7.1 The enclosure of a heating product 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 heating product 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.

Exception: A heating product need not be rigid if, when installed per the manufacturer's instructions, the building construction materials completely enclose the product except for the nonheating leads.

7.2 Among the factors taken into consideration if an enclosure is being judged for acceptability are its mechanical strength, resistance to impact, moisture-absorption properties, flammability, resistance to corrosion, and resistance to distortion and or delamination at temperatures to which the enclosure may be subjected under conditions of intended or abnormal use.

7.3 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 7.4.

7.4 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 heating product.

7.5 Sheet metal to which a wiring system is to be connected in the field shall have an average thickness not less than 0.81 mm (0.032 inch) if uncoated steel, not less than 0.86 mm (0.034 inch) if galvanized steel, and not less than 1.14 mm (0.045 inch) if nonferrous.

7.6 An electrical part of a heating product, installed in accordance with the manufacturer's installation instructions, shall be so located or enclosed to provide protection against unintentional contact with uninsulated live parts.

7.7 Determination of the acceptability of a polymeric material used as an enclosure of a rigid heating product shall be made based on the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

7.8 The flexible enclosure material of a flexible heating product shall have a relative thermal index and adhesive bond strength suitable for the temperatures to which it is exposed during the Normal and Abnormal Temperature Tests and shall comply with the requirements in Flammability, Section 13. Determination of the acceptability of a polymeric material used as an enclosure of a flexible heating product with respect to its relative thermal index and adhesive bond strength shall be made based on the requirements of UL 746C.

Table 7.1
Minimum acceptable thickness of enclosure metal

Metal	At small, flat, unreinforced surfaces and at surfaces that are reinforced by curving, ribbing and the like (or are otherwise of a shape and/or size) to provide mechanical strength		At relatively-large unreinforced flat surfaces	
	Millimeters	(Inches)	Millimeters	(Inches)
Die-cast	1.2	(3/64)	2.0	(5/64)
Cast malleable	1.6	(1/16)	2.4	(3/32)
Other cast metal	2.4	(3/32)	3.2	(1/8)
Uncoated sheet steel	0.66 ^a	(0.026) ^a	—	—
Galvanized sheet steel	0.74 ^a	(0.029) ^a	—	—
Nonferrous sheet metal	0.91 ^a	(0.036) ^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 7.4.

7.9 See Wire Connectors, Section 10, for requirements for insulating covers for wire connectors and pre-insulated wire connectors.

7.10 To reduce the likelihood of unintentional contact that may involve a risk of electric shock from an uninsulated live part, an opening in an enclosure shall comply with one of the following:

- a) For an opening that has a minor dimension (see 7.12) less than 25.4 mm (1 inch), such a part or wire shall not be contacted by the probe illustrated in Figure 7.1.
- b) For an opening that has a minor dimension of 25.4 mm (1 inch) or more, such a part or wire shall be spaced from the opening as specified in Table 7.2.

Table 7.2
Minimum acceptable distance from an opening to a part that may involve a risk of electric shock

Minor dimension of opening ^a		Minimum distance from opening to part	
Millimeters ^b	(Inches) ^b	Millimeters ^b	(Inches) ^b
19.1	(3/4)	114.0	(4-1/2)
25.4	(1)	165.0	(6-1/2)
31.8	(1-1/4)	190.0	(7-1/2)
38.1	(1-1/2)	318.0	(12-1/2)
47.6	(1-7/8)	394.0	(15-1/2)
54.0	(2-1/8)	444.0	(17-1/2)
c	c	762.0	(30)

^a See 7.12.
^b Between 19.1 mm (3/4 inch) and 54 mm (2-1/8 inches), interpolation is to be used to determine a value between values specified in the table.
^c More than 54 mm (2-1/8 inches), but not more than 152 mm (6 inches).

7.11 The probe illustrated in Figure 7.1 shall be used as a measuring instrument to judge the accessibility provided by an opening, and not as an instrument to judge the strength of a material; it shall be applied with the minimum force necessary to determine accessibility.

7.12 With reference to the requirements in 7.10, 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.