UL 1996

STANDARD FOR SAFETY

Electric Duct Heaters

UL Standard for Safety for Electric Duct Heaters, UL 1996

Fourth Edition, Dated August 31, 2009

SUMMARY OF TOPICS

This revision of ANSI/UL 1996 dated August 30, 2022 includes alternate compliance paths for UL 873 and UL 353: 3.8.2.1, 3.8.3.1, 21.1, 22.5 and 23.3.2.

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.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated July 22, 2022.

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AUGUST 31, 2009
(Title Page Reprinted: August 30, 2022)

ANSI/UL 1996-2022

UL 1996

Standard for Electric Duct Heaters

The First edition was titled the Standard for Duct Heaters.

First Edition – December, 1992
Second Edition – December, 1996
Third Edition – November, 2004

Fourth Edition

August 31, 2009

This ANSI/UL Standard for Safety consists of the Fourth Edition including revisions through August 30, 2022.

The most recent designation of ANSI/UL 1996 as an American National Standard (ANSI) occurred on August 30, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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 https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover fixed electric duct heaters, and remote control assemblies for such equipment, rated at 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 fan-coil units, central heating furnaces, panel or cable type radiant heating equipment, electric boilers, baseboard heaters, air heaters, nor any other electric heating equipment or appliances which are covered in or as a part of separate, individual requirements.

1.3 Duct heaters intended for use in a hazardous location are judged on the basis of its compliance with the requirements in this standard, together with the requirements for hazardous location equipment included in other applicable standards.

1.4 Duct heaters designed to be connected to air-duct systems are intended for installation in accordance with the Standard for the Installation of Air Conditioning and Ventilating Systems, NFPA 90A, and the Standard for the Installation of Warm Air Heating and Air Conditioning Systems, NFPA 90B.

1.5 These requirements apply to relays and other auxiliary control devices that may be provided as part of a duct heater to make it usable with other heating or cooling equipment, and are intended to take into account the effects of operating the duct heater in conjunction with or in proximity to such equipment.

1.6 A duct heater is a self-contained heater designed to be installed in the field in the air stream of a ducted system, external to the air-moving unit. It is designed to be installed in a duct where an adequate flow of air from a separate, interlocked fan or blower system is provided. Such a heater may be located in the main supply duct of an air heating system, or in one of the branch ducts. Two or more duct heaters may be installed in a group (in proximity to one another in the duct) if tests indicate acceptable results when the heaters are installed in accordance with the manufacturer's instructions.

1.7 A duct heater intended to be employed in conjunction with another source of heat is judged on the basis of its compliance with the requirements in this standard, and further examination and tests to determine whether or not the combination is acceptable.

2 General

2.1 General

2.1.1 A low voltage circuit is one that has an ac potential of not more than 30 volts alternating current (42.4 peak), and power of 100 VA or less; or 30 V dc supplied by a primary battery; or supplied by a Class 2 transformer; or supplied by a combination of a transformer and fixed impedance that, as a unit, complies with all the performance requirements for a Class 2 transformer. A circuit that is derived from a circuit that exceeds 30 V by connecting resistance or impedance, or both, in series with the supply circuit to limit the voltage and current is not considered to be a low voltage circuit.

2.1.2 A high-voltage circuit is one having characteristics in excess of those of an low-voltage circuit.

2.1.3 Duct heaters intended for installation within 1.22 m (4 ft) of heating or cooling equipment shall be evaluated for the combination use in accordance with the requirements in the standard. See 45.1.8.

2.2 Terminology

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

2.3 Units of measurement

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

2.4 Undated references

2.4.1 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.

2A Glossary

2A.1 For the purpose of this standard, the following definitions apply.

2A.2 CAPACITOR, CLASS X – Capacitor or RC unit of a type suitable for use in situations where failure of the capacitor or RC unit would not lead to danger of electrical shock but could result in a risk of fire. Examples would be units connected phase to phase or phase to neutral.

Notes:

1) X1 capacitors are generally used in circuits of permanently connected appliances. However, if the appliance is provided with a separate surge protective device that limits the impulse voltage to £ 2.5KV, an X2 capacitor is permitted.

2) X2 capacitors are generally used in circuits of cord-connected appliances.

2A.3 CAPACITOR, CLASS Y – Capacitor or RC unit of a type suitable for use in situations where failure of the capacitor could lead to danger of electric shock. Examples would be capacitors connected across the primary and secondary circuits where electrical isolation is required to prevent an electric shock or between hazardous live parts and accessible parts.

Notes:

1) Y1 capacitors are used in circuits where the prevention of electric shock is afforded solely by the isolation provided by the capacitor. Two Y2 capacitors connected in series is considered to provide the same level of protection as one Y1 capacitor.

2) Y2 capacitors are used where the prevention of electric shock is provided by the combination of the capacitor and earth ground for circuits operating at voltages ≥ 150V and ≤ 300V.

3) Y4 capacitors are used where the prevention of electric shock is provided by the combination of the capacitor and earth ground for circuits operating at voltages ≤ 150V.

2A.4 SAFETY CRITICAL FUNCTION – Control, protection and monitoring functions which are being relied upon to reduce the risk of fire, electric shock or casualty hazards.

3 Components

3.1 *Deleted*

3.2 *Deleted*

3.3 *Deleted*

3.4 *Deleted*

3.1 General

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

a) Comply with the requirements for that component as indicated in 3.2 – 3.8 or the individual component section;

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.

Note – 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; or

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 UL component standard other than those cited in 3.2 – 3.8 or the individual component section is acceptable if:

a) The component also complies with the applicable component standard of 3.2 – 3.8 or the individual component section; or

b) The component standard:

1) Is compatible with the ampacity and overcurrent protection requirements of the National Electrical Code, 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.

3.1.2 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 duct heater, the additional component standard(s) need not be applied.

3.1.3 A component not anticipated by the requirements of this standard, not specifically covered by the component standards of 3.2 – 3.8 or individual component sections and that involves a potential risk of electric shock, fire, or personal injury, shall be additionally investigated in accordance with the applicable UL standard, and shall comply with 3.1.1 (b) – (d).

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

3.2 Attachment plugs, receptacles, connectors, and terminals

3.2.1 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 3.2.9.

Exception: Attachment plugs and appliance couplers integral to cord sets or power supply cords are covered under the requirements of the Standard for Cord Sets and Power-Supply Cords, UL 817, and need not comply with UL 498.

3.2.2 Quick-connect terminals, both connectors and tabs, for use with one or two 22 – 10 AWG copper conductors, having nominal widths of 3.5, 3.2, 4.8, 5.2, and 6.3 mm (0.110, 0.125, 0.187, 0.205, and 0.250 in), intended for internal wiring connections in duct heaters, or for the field termination of conductors to the appliance, shall comply with the Standard for Electrical Quick-Connect Terminals, UL 310.

Exception: Other sizes of quick-connect terminals shall be investigated with respect to crimp pull out, insertion-withdrawal, temperature rise, and all tests shall be conducted in accordance with UL 310.

3.2.3 Single and multipole connectors for use in data, signal, control and power applications within and between electrical equipment, and that are intended for factory connection and for factory assembly to copper or copper alloy conductors, or for factory assembly to printed wiring boards, shall comply with the Standard for Component Connectors for Data, Signal, Control and Power Applications, UL 1977. See 3.2.9.

3.2.4 Wire connectors shall comply with the Standard for Wiring Connectors, UL 486A-486B.

3.2.5 Splicing wire connectors shall comply with the Standard for Splicing Wire Connectors, UL 486C.

3.2.6 Multi-pole splicing wire connectors that are intended to facilitate the connection of hard-wired utilization equipment to the branch-circuit conductors of buildings or that are intended for consumer connection within and between parts of electrical equipment, shall comply with the Standard for Multi-Pole Splicing Wire Connectors, UL 2459. See 3.2.9.

3.2.7 Equipment wiring terminals for use with all alloys of copper, aluminum, or copper-clad aluminum conductors, shall comply with the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

3.2.8 Terminal blocks shall comply with the Standard for Terminal Blocks, UL 1059, and, if applicable, be suitably rated for field wiring.

3.2.9 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.

3.3 Electrical enclosures and raceways

3.3.1 Electrical enclosures and the associated bushings and fittings, and raceways, of the types specified in Chapter 3 of the National Electrical Code, ANSI/NFPA 70 and that comply with the following standards and 3.1 are considered to fulfill the requirements of this standard:

a) Standard for Metallic Outlet Boxes, UL 514A;

b) Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C; or

c) Standard for Cover Plates for Flush-Mounted Wiring Devices, UL 514D.

3.4 Cords, cables, and internal wiring

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

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

3.4.3 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) Standard for Thermoset-Insulated Wires and Cables, UL 44;

b) Standard for Thermoplastic-Insulated Wires and Cables, UL 83; or

c) Standard for Fixture Wire, UL 66.

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 or personal injury need not comply with UL 758.

3.5 Lampholders

3.5.1 Lampholders and indicating lamps shall comply with the Standard for Lampholders, UL 496.

Exception: Lampholders forming part of a luminaire that complies with the Standard for Luminaires, UL 1598 is considered to fulfill this requirement.

3.6 Power supplies

3.6.1 A Class 2 power supply shall comply with one of the following:

a) Standard for Class 2 Power Units, UL 1310; or

b) Standard for Information Technology Equipment, Part 1: General Requirements, UL 60950-1, with an output marked “Class 2”, or that complies with the limited power source (LPS) requirements and is marked “LPS”.

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

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

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

c) The circuits requirements in Section 24B.

3.7 Printed wiring boards

3.7.1 A printed-wiring board shall comply with the requirements in the Standard for Printed-Wiring Boards, UL 796, including direct support criteria, and shall be classed V-0, V-1, or V-2 in accordance with the requirements in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

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.

3.8 Controls

3.8.1 General

3.8.1.1 Auxiliary controls shall be evaluated using the applicable requirements of this end product standard and the parameters in Section 24A.

Exception: A circuit meeting the parameters of Section 24A and evaluated to the alternate circuit requirements of Section 24B.

3.8.1.2 Operating (regulating) controls shall be evaluated using the applicable component standard requirements specified in 3.8.2 – 3.8.4, and if applicable, the parameters in Section 24A, unless otherwise specified in this end product standard.

Exception: A circuit meeting the parameters of Section 24A and evaluated to the alternate circuit requirements of Section 24B.

3.8.1.2.1 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 safety, such as a speed control unexpectedly changing its output, shall comply with the:

a) Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991; and Standard for Software in Programmable Components, UL 1998; or

b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; or

c) Parameters of Section 24A and the alternate circuit requirements of Section 24B.

3.8.1.3 Controls that perform safety critical functions shall be evaluated using the applicable component standard requirements specified in 3.8.2 – 3.8.4, and if applicable, the parameters in Section 24A, unless otherwise specified in this end product standard.

Exception: A circuit meeting the parameters of Section 24A and evaluated to the alternate circuit requirements of Section 24B.

3.8.1.3.1 Solid-state controls that perform safety critical functions (protective controls) that do not rely upon software as a protective component shall comply with:

a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991;

b) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1, except Clause H 11.12 (Controls using software); or

c) A circuit meeting the parameters of Section 24A and the alternate circuit requirements of Section 24B.

3.8.1.3.2 Controls that perform safety critical functions (protective controls) that rely upon software as a protective component shall comply with:

a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991; and Standard for Software in Programmable Components, UL 1998;

b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; or

c) A circuit meeting the parameters of Section 24A and the alternate circuit requirements of Section 24B.

3.8.1.4 An electronic, non-protective control that is simple in design need only be subjected to the applicable requirements of this end-product standard. A control that does not include an integrated circuit or microprocessor, but does consist of a discrete switching device, capacitors, transistors, and resistors, is considered simple in design.

3.8.2 Electromechanical and electronic controls

3.8.2.1 A control, other than as specified in 3.8.3 – 3.8.4, shall comply with:

a) *Deleted*

aa) The Standard for Temperature Indicating and Regulating Equipment, UL 873; or

b) The Standard for Automatic Electrical Controls; Part 1: General Requirements, UL 60730-1; or

c) A circuit meeting the parameters of Section 24A and the alternate circuit requirements of Section 24B.

3.8.3 Temperature controls

3.8.3.1 A temperature control shall comply with the:

a) *Deleted*

aa) The Standard for Temperature Indicating and Regulating Equipment, UL 873; or

b) Standard for Industrial Control Equipment, UL 508; or

c) Standard for Automatic Electrical Controls; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls; Part 2: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9; or

d) Parameters of Section 24A and the alternate circuit requirements of Section 24B.

3.8.3.2 A temperature sensing positive temperature coefficient (PTC) or negative temperature coefficient (NTC) thermistor, that performs the same function as an operating or protective control shall comply with the Standard for Thermistor-Type Devices, UL 1434.

3.8.3.3 A thermal cutoff shall comply with the Standard for Thermal-Links (Thermal Cutoffs) for Use in Electrical Appliances and Components, UL 60691.

3.8.4 Timer controls

3.8.4.1 A timer control shall comply with the Standard for Automatic Electrical Controls for Household and Similar Use; 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.

Exception: A circuit meeting the parameters of Section 24A and evaluated to the alternate circuit requirements of Section 24B.

CONSTRUCTION

4 Enclosures

4.1 Enclosures for duct heaters shall be so formed and assembled that, they have the strength and rigidity to resist abuse during shipment, installation, or use without increasing their fire and accident hazards due to a total or partial collapse that could result in a reduction of spacings, a loosening or displacement of parts, or any other defect.

4.2 Enclosures for individual electrical components and wiring, outer enclosures, and combinations of the two, shall be considered in determining compliance with the requirements of 4.1.

4.3 Among the factors to be used in determining the acceptability of an enclosure are:

a) Physical strength,

b) Resistance to impact,

c) Moisture-absorptive properties,

d) Flammability,

e) Resistance to corrosion, and

f) Resistance to distortion or melting caused by the temperatures that is possible under conditions of anticipated use or by electrical disturbances within.

g) Intended installation within ducts and plenums.

4.4 Nonmetallic enclosures or parts thereof shall be considered to comply with 4.3 (d) and (f), when: