UL 998

STANDARD FOR SAFETY

Humidifiers

UL Standard for Safety for Safety for Humidifiers, UL 998

Sixth Edition, Dated April 9, 2020

Summary of Topics

This new edition of UL 998 dated April 9, 2020 includes a revising the Scope in Supplement SA and other editorial updates.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated August 9, 2019.

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Fifth Edition

Underwriters Laboratories Inc.
UL 998
Sixth Edition

Humidifiers

April 9, 2020

Approved American National Standard

ANSI/UL 998-2020

Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (operating as “CSA Group”) and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to CSA Group or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of CSA Group and UL. CSA Group and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.

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This Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup. org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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This ANSI/UL Standard for Safety consists of the Sixth Edition.

The most recent designation of ANSI/UL 998 as an American National Standard (ANSI) occurred on April 9, 2020. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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PREFACE

This is the harmonized CSA Group and UL Standard for Humidifiers. It is the fifth edition of CSA C22.2 No. 104, and the sixth edition of UL 998. This edition of CSA C22.2 No. 104 supersedes the previous edition(s) published on April 25, 2011. This edition of UL 998 supersedes the previous edition(s) published on April 25, 2011.

This harmonized Standard was prepared by CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of the Air Conditioning and Refrigeration Institute (ARI) and the Heating, Refrigerating and Air Conditioning Institute of Canada (HRAI) are gratefully acknowledged.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

This Standard was reviewed by the CSA Subcommittee on Humidifiers, under the jurisdiction of the CSA Technical Committee on Consumer and Commercial Products and the Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee. This standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

Level of Harmonization

This standard uses the IEC format but is not based on, nor is it considered equivalent to, an IEC standard.

This standard is published as an identical standard for CSA Group and UL.

An identical standard is a standard that is exactly the same in technical content except for national differences resulting from conflicts in codes and governmental regulations. Presentation is word for word except for editorial changes.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

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HUMIDIFIERS

INTRODUCTION

1 Scope

1.1 These requirements cover humidifiers rated 600 V or less, and intended to be used in accordance with the National Electrical Code (NEC), ANSI/NFPA 70, and the rules of CSA C22.1, Canadian Electrical Code (CEC), Part I.

1.2 These requirements cover humidifiers intended for residential and commercial use. This includes humidifiers of the centrifugal atomizing type, evaporative-media type, water-injection type, steam type, and the like. The humidifiers are intended for installation in a room, mounted on a wall or a ceiling, or for duct or plenum mounting.

1.3 These requirements apply to equipment that includes an electric heating element to heat air or water, or both.

1.4 These requirements do not apply to evaporative coolers that are also intended to be used for cooling.

1.5 These requirements do not apply to portable, electrode-type products, such as vaporizers, which are covered by UL 499 and CAN/CSA-C22.2 No. 64.

2 Definitions

2.1 The following definitions apply in this Standard.

2.2 CIRCUIT, EXTRA-LOW-VOLTAGE – A circuit that has an ac potential of not more than 30 V (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 which 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 an extra-low-voltage circuit.

2.3 CIRCUIT, HAZARDOUS VOLTAGE – A circuit having characteristics in excess of those of an extra-low-voltage circuit.

2.4 COMBINATION TEMPERATURE-REGULATING AND TEMPERATURE-LIMITING THERMOSTAT – A thermostat whose function is to regulate the temperature under normal conditions of use, and that also serves to prevent a hazard that might result from conditions of abnormal operation of the heater.

2.5 ENCLOSURE – The enclosure that houses the electrical components, live parts, and/or moving parts. It may be an integral part of the component, a separate item, part of the ultimate enclosure, or the ultimate enclosure (e.g., the outer cabinet).

2.6 HEATER ELEMENT – A complete or partial assembly of a heating element, an electrical insulation (e.g., refractory, mica), a metal sheath, a glass or quartz envelope or panel, thermal insulation, and a frame or adaptor for holding the assembly together and fastening it in the heater; and leads or terminal connections, or both, which may or may not include bolts and nuts.

2.7 HEATING ELEMENT – The actual electrical conducting medium that is intended to be heated by an electric current.

2.8 HUMIDIFIER – Equipment that is designed to increase the relative humidity of air.

2.9 JUNCTION BLOCK – A wiring device that encloses splices between wires and that may provide a receptacle for connecting a component of the equipment.

2.10 PORTABLE EQUIPMENT – Equipment designed to not be used in a fixed position and that receives current through a flexible cord or cable and an attachment plug.

2.11 SAFETY-CIRCUIT– A circuit that includes contacts of any controls integral with, or external to, the equipment that are intended to prevent unsafe operation of the equipment due to circuit wiring becoming grounded, open circuited, or short circuited, such as:

a) A device to prevent overheating of a motor due to overload (including locked rotor);

b) A temperature limit switch, the failure of which to operate might result in an unsafe operation; or

c) A pressure-limiting device in a system, the failure of which to operate might result in an unsafe condition.

2.12 TEMPERATURE-LIMITING THERMOSTAT – A thermostat that functions only under conditions that produce abnormal temperatures. The failure of such a thermostat might result in a hazard.

2.13 TEMPERATURE-REGULATING THERMOSTAT – A thermostat that functions only to regulate the temperature under normal conditions of use. The failure of such a thermostat would not result in a hazard.

2.14 USER SERVICING – Any form of servicing that is likely to be performed by personnel other than those who are trained to maintain the product. Some examples include routine cleaning, filter replacement, and replacement of an accessible fuse or lamp.

3 General

3.1 Components

3.1.1 Except as indicated in Clause 3.1.2, a component of a product covered by this Standard shall comply with the requirements for that component. See Annex A for a list of Standards covering components used in the products covered by this Standard. A component shall comply with the CSA and UL Standards.

3.1.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this Standard; or

b) Is superseded by a requirement in this Standard.

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

3.1.4 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.

3.1.5 For products intended for use in Canada, general requirements are given in CAN/CSA-C22.2 No. 0.

3.1.6 Products covered by this Standard shall comply with the referenced installation codes and standards noted in Clause 3.2.

3.2 Reference publications

3.2.1 Where reference is made to any Standards, such reference shall be considered to refer to the latest editions and revisions thereto available at the time of printing, unless otherwise specified.

CSA Group

B51-14
Boiler, Pressure, Vessel, and Pressure Piping Code

C22.1-18
Canadian Electrical Code, Part I

CAN/CSA-C22.2 No. 0-10 (R2015)
General Requirements – Canadian Electrical Code, Part II

C22.2 No. 0.3-09 (R2014)
Test Methods For Electrical Wires and Cables

C22.2 No. 0.15-15
Adhesive Labels

CAN/CSA-C22.2 No. 0.17-00 (R2018)
Evaluation of Properties of Polymeric Materials

C22.2 No. 64-10 (R2014)
Household Cooking and Liquid-Heating Appliances

C22.2 No. 72-10 (R2014)
Heater Elements

C22.2 No. 77-14
Motors with Inherent Overheating Protection

C22.2 No. 100-14
Motors and Generators

CAN/CSA-198.1-06 (R2015)
Extruded Insulating Tubing

CAN/CSA-198.3-05 (R2014)
Coated Electrical Sleeving

CAN/CSA-C22.2 No. 60950-1-07 (R2016)
Information Technology Equipment – Safety – Part 1: General Requirements

CAN/CSA-E60730-1-15
Automatic Electrical Controls for Household and Similar Use – Part 1: General Requirements

UL (Underwriters Laboratories Inc.)

UL 94
Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 244A
Solid-State Controls for Appliances

UL 486A-486B
Wire Connectors

UL 499
Electric Heating Appliances

UL 723
Tests for Surface Burning Characteristics of Building Materials

UL 746C
Polymeric Materials – Use in Electrical Equipment Evaluations

UL 840
Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment

UL 900
Air Filter Units

UL 969
Marking and Labeling Systems

UL 1004-1
Rotating Electrical Machines – General Requirements

UL 1004-2
Impedance Protected Motors

UL 1004-3
Thermally Protected Motors

UL 1030
Sheathed Heating Elements

UL 1441
Coated Electrical Sleeving

UL 1581
Reference Standard for Electrical Wires, Cables, and Flexible Cords

UL 60730-1
Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements

UL 60950-1
Information Technology Equipment – Safety – Part 1: General Requirements

ASME (American Society of Mechanical Engineers)

ASME
Boiler and Pressure Vessel Code

ASTM (American Society for Testing and Materials)

ASTM D395
Standard Test Methods for Rubber Property – Compression Set

ASTM E162
Standard Test Method for Surface Flammability of Materials, Using a Radiant Heat Energy Source

IEC (International Electrotechnical Commission)

IEC 60417
Graphical Symbols for Use on Equipment

NFPA (National Fire Protection Association)

ANSI/NFPA No. 70
National Electrical Code

ULC (Underwriters Laboratories of Canada)

CAN/ULC-S102-10
Standard Methods of Test for Surface Burning Characteristics of Building Materials and Assemblies

3.3 Units of measurement

3.3.1 The values given in SI (metric) units shall be normative. Any other values given shall be for information purposes only.

3.4 Terminology

3.4.1 In this standard, a requirement that applies only to a particular type of humidifier is so identified by a specific reference in that requirement to the type or types of humidifiers involved. Absence of such specific reference or use of the term "product" indicates that the requirement applies to all types of humidifiers unless the context indicates otherwise.

CONSTRUCTION

4 General

4.1 A product shall be completely assembled when it is shipped from the factory. A product shipped partially, for example, to facilitate packaging or installation, shall be able to be properly assembled without a risk of fire, electric shock, or injury to persons, and each part shall be marked as required by Clause 76.3.

4.2 A product intended for mounting to the ceiling, floor, or wall shall have provisions for such mounting. All required fittings such as brackets, hangers, or the like, necessary for mounting shall be furnished with the product. Parts commonly available for the mounting of the product are not required to be provided if mounting instructions that refer to such parts are furnished in accordance with Clause 76.8.

4.3 A humidifier that is intended for mounting on the hot air plenum or duct of a furnace, and that requires the installation of an air deflecting means in the path of the moving air, shall include the necessary deflecting means as a part or accessory of the humidifier, and shall be accompanied by explicit instructions for the installation of the means so as to avoid impairment of the function of the furnace.

5 Enclosures

5.1 General

5.1.1 Products shall be constructed so that they have the strength and rigidity necessary to resist the abuse to which they might be subjected, without increasing the risk of fire, electric shock, or injury to persons, due to partial collapse with resultant reduction of spacings, loosening or displacement of parts, or other defects.

5.1.2 In determining compliance with Clause 5.1.1, all elements that contribute to the enclosing function, including enclosures of individual components and the exterior (decorative) cabinet, shall be considered.

5.1.3 Enclosures made in the form of grilles, etc., of wire or sheet metal, and intended to accommodate air flow required for the operation of the equipment, shall be considered to comply with Clause 5.1.1 if they provide resistance to deflection or impact that would be acceptable to the requirements specified in Clause 5.1.4 for enclosures of sheet metal.

5.1.4 Unless the surface under consideration is curved, ribbed, or otherwise reinforced, cast and sheet-metal sections of an enclosure shall not be thinner than as specified in Table 1.

5.1.5 A metal plate or metal plug used to cover an unused conduit opening or other hole that is required to be covered in the enclosure shall have a thickness not less than:

a) 0.35 mm (0.014 in) if steel, or 0.48 mm (0.019 in) if nonferrous metal, for a hole having a 6.4 mm (1/4 in) maximum dimension; and

b) 0.68 mm (0.027 in) if steel, or 0.81 mm (0.032 in) if nonferrous metal, for a hole having a 34.9 mm (1-3/8 in) maximum dimension. A closure for a larger hole shall have a thickness no less than that required for the enclosure of the product. Such plates or plugs shall be securely mounted.

5.2 Nonmetallic materials

5.2.1 Enclosures or parts of equipment manufactured of nonmetallic materials shall not cause a risk of fire, electric shock, or injury to persons, because of susceptibility to ignition or melting by electrical disturbances within, or because of deterioration from aging effects, or because of exposure to the operating environment.

5.2.2 Enclosures shall be considered to comply with Clause 5.2.1 if:

a) They comply with the flammability test specified in UL 746C and CAN/CSA-C22.2 No. 0.17;

b) They have temperature ratings not less than the maximum temperatures to which they may be exposed during normal operation; and

c) The equipment is in compliance with Clauses 5.2.3, 5.2.4, and 5.2.5.

5.2.3 In addition to the requirements of Clause 5.2.1, an enclosure of polymeric material having in any unbroken section an exposed surface greater than 0.93 m^2 (10 ft^2), or a single dimension greater than 1.83 m (6 ft), shall have maximum flame spread rating of:

a) 200 for a portable product; and

b) 50 for a product intended to be permanently connected to the electrical supply.

5.2.4 The flame spread rating mentioned in Clause 5.2.3 shall be determined in accordance with the requirements in UL 723, or the radiant panel test requirement in accordance with ASTM E162 or CAN/ULC-S102.

5.2.5 Where bare live parts of electrical components, such as switch terminals, are individually enclosed with metal, or insulating tube or sleeving that complies with VW-1 flammability requirements in accordance with UL 224 and CSA C22.2 No. 198.1, or UL 1441 and CSA C22.2 No. 198.3, respectively; or polymeric material that complies with the requirements of the vertical burning test for classifying materials 5 VA in accordance with UL 94, and flammability rating of 5V (500 W), in CAN/CSA-C22.2 No. 0.17, the surrounding equipment enclosure shall be of material that is not more flammable than material classed as HB as specified in CAN/CSA-C22.2 No. 0.17, and HB as specified in UL 94, provided:

a) The equipment does not employ open-coil heaters;

b) Internal wiring within the surrounding equipment enclosure complies with flame test classification VW-1 as referenced in UL 1581 and FT1 of C22.2 No. 0.3;

c) Splices within the surrounding equipment enclosure are made with insulated wire connectors that are resistant to loosening due to vibration; and

d) The surrounding equipment enclosure, where relied upon to prevent a risk of electric shock, complies with the impact test requirements of Clause 59.

5.3 Enclosure integrity

5.3.1 The enclosure of a product shall reduce the likelihood that molten metal, burning insulation, flaming particles, or the like will fall on combustible materials, including the surface upon which the product is supported.

5.3.2 The requirement in Clause 5.3.1 necessitates the use of a barrier under wiring, unless it is neoprene- or thermoplastic-insulated, and under a motor unless:

a) The structural parts of the motor or the product provide the equivalent of such a barrier;

b) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the product when the motor is energized under each of the following fault conditions:

1) Open main winding;

2) Open starting winding;

3) Starting switch short-circuited; and

4) Capacitor of permanent-split capacitor motor short-circuited – the short circuit shall be applied before the motor is energized, and the rotor shall be locked;

c) The motor is provided with a thermal motor protector, that is, a protective device that is sensitive to temperature and current that keeps the temperature of the motor windings from exceeding 125°C (257°F) under the maximum load under which the motor runs without causing the protector to cycle, and from exceeding 150°C (302°F) with the rotor of the motor locked; or

d) The motor complies with the requirements for impedance-protected motors in UL 1004-2, and C22.2 No. 77.

5.3.3 Aside from the terminals, Clause 5.3.1 also requires that a switch, a relay, a solenoid, or the like, be individually and completely enclosed. A component is not required to be completely enclosed if:

a) Malfunction of the component would not result in a risk of fire; or

b) There are no openings in the bottom of the product enclosure.

5.3.4 The barrier mentioned in Clause 5.3.2 shall be horizontal, shall be located as illustrated in Figure 1, and shall have an area not less than that described in the illustration. Openings for drainage, ventilation, and the like, that would not permit molten metal, burning insulation, or the like, to fall on combustible material, may be employed in a barrier.

5.3.5 If an opening for ventilation is provided in the enclosure of a product or an externally mounted component, and if the product is intended to be recessed into a wall or false ceiling, such an opening shall not allow venting into concealed space.

6 Doors and Covers

6.1 Doors and covers that give access to uninsulated live hazardous voltage parts shall be secured firmly in place and shall require the use of a tool or key to open them or shall be provided with an interlocking mechanism; however, components having covers that comply with their respective standards do not require additional enclosures.

6.2 An interlocking mechanism complies with the requirements of Clause 6.1 if it:

a) Secures the cover in the closed position when engaged; and

b) Must be engaged before parts in a hazardous voltage circuit can be energized.

6.3 Accessibility shall be afforded to all parts that require normal servicing or adjustment (for example, controls, filters, oiling of bearings, adjustment of belts) when the equipment is installed as intended. Covers or access panels giving access to such parts that are required to be removed for routine maintenance shall not expose uninsulated live parts.

6.4 The assembly shall be arranged so that any overcurrent protective device that can be replaced or reset as required is accessible without removal of parts other than the service covers or panels.

6.5 The door or cover of an enclosure shall be hinged, sliding type, pivoted, or the equivalent, and not intended for removal, if it gives access to any overcurrent protective device. If more than one door or cover has to be opened to provide access to the overcurrent protective device, only one of these shall comply with this requirement. A cover, panel, door, or other part of an enclosure that, due to its function or size, must be in place to complete the overall enclosure, is not required to be hinged, sliding type, or pivoted.

6.6 A cover as specified in Clause 6.5 is not required if fuses only of the following types are enclosed:

a) Fuses connected in extra-low-voltage circuits;

b) Extractor type fuses that have their own enclosures;

c) Control circuit fuses, provided that the control circuit loads (other than fixed loads, such as pilot lamps) are housed in the same enclosure as the fuses; or

d) Supplementary type fuses rated 2 A or less used in small, auxiliary resistance heater circuits having a maximum rating of 100 W.

6.7 The reset button or lever of manual resettable devices (for example, the operating handle of a circuit breaker, the reset button of a motor protector, the reset button of a pressure switch, the adjusting screw or knob of an adjustable temperature or pressure control) may be accessible without the use of a tool, provided that the resetting of the device does not result in exposure to uninsulated live hazardous voltage parts or moving parts.

7 Accessibility of Uninsulated Hazardous Voltage Live Parts and Film-Coated Wire

7.1 To reduce the risk of unintentional human contact with an uninsulated live part or film-coated wire, louvers or other openings in the enclosure of a product, and openings in a motor, shall be so designed, located, or baffled as to comply with the requirements specified in Table 2.

7.2 With respect to the requirement in Clause 7.1, insulated brush caps do not require additional enclosure.

7.3 In determining compliance with Clauses 7.1 and 7.2, any doors, covers, or components that are intended to be removed for routine maintenance purposes, or that might be removed, without using a tool, by the user to attach an accessory, to make an operating adjustment, or for other reasons, shall be removed.

7.4 In cord-connected humidifiers where the enclosure of a fan is completed by a drum supporting the evaporating medium, a marking in accordance with Clause 75.20 shall be acceptable.

7.5 The probes illustrated in Figure 2 – Figure 5 shall be applied to any depth that the opening enables and with a force not greater than 4.4 N (1 lbf), and shall be rotated or angled before, during, and after insertion through the opening to any position that is required to examine the product or motor. The probe illustrated in Figure 2 shall be applied in any possible configuration, and, when required, the configuration shall be changed after insertion through the opening.

7.6 With reference to the requirements in Table 2, an indirectly accessible motor is a motor:

a) That is accessible only by removing a part of the outer enclosure of a product, such as a guard or panel, that can be removed without using a tool; or

b) That is located at such a height or is otherwise guarded or enclosed so that it is unlikely to be contacted.

7.7 With reference to the requirements in Table 2 and Table 3, 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 perpendicular to the plane of the opening with a force not greater than 22 N (5 lbf).

7.8 If Table 2 specifies a probe to be used to judge the accessibility of an uninsulated live part or film-coated wire, the probe shall not contact such a part or wire when inserted through an opening in the enclosure of a product or motor as described in Clause 7.5.

7.9 If Table 2 does not specify that a probe is to be used to judge the accessibility of an uninsulated live part or film-coated wire, such a part or wire shall not be:

a) Within "X" mm (inches) of the perimeter of an opening in the enclosure of a product or a motor; or