



UL 399

STANDARD FOR SAFETY

Drinking Water Coolers



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UL Standard for Safety for Drinking-Water Coolers, UL 399

Seventh Edition, Dated August 22, 2008

SUMMARY OF TOPICS

These revisions to ANSI/UL 399 include the following:

- 1. Revision of scope for clarification and reorganization of component requirements, including deletion of component section and appendix A, addition of glossary terms and integration of component requirements into the body of the standard*
- 2. Addition of requirement for water cooler with refrigerated storage compartment*
- 3. Addition of requirements for carbonators*
- 4. Addition of requirements for accessories*
- 5. Revision and addition of requirements for gaskets*
- 6. Revisions, additions and reorganization of requirements for field supply connections and cord connected equipment*
- 7. Revisions and reorganization of requirements for switches and controllers including component requirements and allowing receptacles and similar devices to be used as current interrupting devices*
- 8. Revision and addition of requirements for protective electronic circuits*
- 9. Revision of requirements for heating elements by adding option to comply with construction requirements of UL 499 or UL 1030*
- 10. Revisions to clarify heater control requirements and provide additional options to comply with one of several standards*
- 11. Adding optional requirement for capacitors to comply with UL 810*
- 12. Revisions of requirements for transformers including component references and clarifications*
- 13. Addition of new section for alternate spacings – clearance and creepage distances*
- 14. Revisions for capillary tubing including glossary term and wall thickness for copper and steel tubing*
- 15. Revisions to the Dielectric Voltage-Withstand Test including addition of exception for direct current test potential and editorial correction*
- 16. Revisions for components including clarification and new requirements for refrigerant containing parts, addition of Production Fatigue Test and new requirements for equipment with design pressures that exceed the refrigerant critical pressure*
- 17. Removal of HACR circuit breaker references*

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18. Revision and relocation of Strain Relief Test from the Construction section of the standard to the Performance section

19. Revisions of scope and addition of supplement to address the use of flammable refrigerants

20. Miscellaneous revisions for corrective and clarification purposes

21. Revision and addition of requirements regarding thermoelectric water coolers, including scope clarification, glossary terms, and new and revised sections

22. Revision and addition of requirements regarding ultraviolet (UV) radiation systems

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 revised requirements are substantially in accordance with Proposal(s) on this subject dated November 18, 2012.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

The following table lists the future effective dates with the corresponding reference.

Future Effective Date	Reference
June 15, 2012	Paragraphs 4.1(a), (b), (c), 7.1.2, Sections 17A.5, 44A
January 14, 2013	Paragraphs 4.1(d), 5.4, and 40.2
August 1, 2014	Paragraphs 4.5, 6.1.4, 7.1.4, 8.2.1, 9.2.1, 61.22, 61.23, 210.1 – 210.3, and Section 55A

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ANSI/UL 399-2012

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UL 399

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Fourth Edition – July, 1978
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Sixth Edition – June, 1993

Seventh Edition

August 22, 2008

This ANSI/UL Standard for Safety consists of the Seventh Edition including revisions through July 20, 2012.

The most recent designation of ANSI/UL 399 as an American National Standard (ANSI) occurred on July 19, 2012. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or effective date information. Any other portions of this ANSI/UL standard that were not processed in accordance with ANSI/UL requirements are noted at the beginning of the impacted sections.

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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INTRODUCTION

1 Scope

1.1 These requirements cover self-contained drinking-water coolers employing hermetic refrigerant motor-compressors or thermoelectric water chilling systems and designed for connection to alternating-current circuits rated not greater than 600 volts in accordance with the National Electrical Code, NFPA 70. The following types of water coolers are included within the scope of this Standard:

- a) Those supplying cold water or both cold and hot water;
- b) Battery operated;
- c) Those employing flammable refrigerant as defined in SB SB; and
- d) Those provided with ultraviolet (UV) radiation lamp systems in which the UV wavelengths are 200 nm or greater; however, the effectiveness of the water treatment by the UV radiation is not covered by these requirements.

1.1 revised July 20, 2012

1.2 These requirements do not include additional requirements applicable to equipment designed for use in hazardous locations as defined in the National Electrical Code, NFPA 70.

1.3 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the acceptable level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard cannot be judged to comply with this standard. Where considered appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

2 General

2.1 Components

2.1 deleted July 20, 2012

2.1.1 Deleted July 20, 2012

2.1.2 Deleted July 20, 2012

2.1.3 Deleted July 20, 2012

2.1.4 Deleted July 20, 2012

2.2 Units of measurement

2.2.1 If a value for measurement is followed by value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

2.3 Terminology

2.3.1 The term "product" as used in these requirements refers to all drinking-water coolers or any part thereof covered by these requirements unless specifically noted otherwise.

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.

3 Glossary

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

3.1.1 **ACCESSORY** – An optional electrical device or other component, such as a superstructure, intended for installation in or connection to a water cooler for the purpose of modifying or supplementing the functions of the water cooler. It may be factory installed or intended for installation by the user.

3.1.1 added July 20, 2012

3.2 **BARRIER, ELECTRICAL** – A partition for the isolation of high-voltage electrical components or for separating ignition sources from flammable materials.

3.3 **BARRIER, MECHANICAL** – A rigid partition for the isolation of moving parts and ultraviolet (UV) radiation, or protection of wiring.

3.3 revised July 20, 2012

3.3.1 **BASIC INSULATION** – The insulation applied to live parts to provide protection against electric shock.

3.3.1 added July 20, 2012

3.4 **CABINET** – The part of the product that provides physical protection to insulated wiring, enclosures, moving parts, motors, enclosed electrical parts, refrigeration tubing or other parts that may cause injury to persons.

3.4.1 **CAPILLARY TUBE** – Device made of tubing with an outer diameter of less than 3/16 in. (4.7 mm) and used to reduce the pressure of the refrigerant between the condenser and evaporator. It also regulates the refrigerant flow.

3.4.1 added July 20, 2012

3.5 CIRCUITS, ELECTRICAL:

a) Extra-Low-Voltage – A circuit supplied by:

1) An AC potential of not more than 42.4 volts peak (30 V rms) and power of 100 VA or less; or

2) A DC potential of 30 V supplied by a primary battery; or

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- 3) A Class 2 transformer, as defined by the National Electrical Code, NFPA 70; or
- 4) A combination of an isolating transformer and fixed impedance which, as a unit, complies with all performance requirements for a Class 2 transformer.

b) High-Voltage – A circuit involving a potential of not more than 600 volts and having circuit characteristics in excess of those of an extra-low-voltage circuit.

3.5.1 COMPONENT – A device or fabricated part of the drinking water cooler covered by the scope of a safety standard dedicated to that purpose. If incorporated in a drinking water cooler, a product that is otherwise typically field installed (e.g. luminaire) is considered to be a component. Unless otherwise specified, materials that compose a device or fabricated part, such as aluminum or copper, are not considered components. Generally, components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under specific, limited conditions, such as certain temperatures not exceeding specified limits.

3.5.1 added July 20, 2012

3.5.2 CONTROL, OPERATING – A device or assembly of devices, the operation of which starts or regulates the end product during normal operation. For example, a thermostat, the failure of which a thermal cutout/limiter or another layer of protection would mitigate the potential hazard, is considered an operating control. Operating controls are also referred to as “regulating controls”.

3.5.2 added July 20, 2012

3.5.3 CONTROL, PROTECTIVE – A device or assembly of devices, the operation of which is intended to reduce the risk of electric shock, fire or injury to persons during normal and reasonably anticipated abnormal operation of the appliance. For example, a thermal cutout/limiter, or any other control/circuit relied upon for normal and abnormal conditions, is considered a protective control. Protective controls are also referred to as “limiting controls” or “safety controls” and are investigated under normal and single-fault conditions.

3.5.3 added July 20, 2012

3.5.4 DOUBLE INSULATION – An insulation system comprised of basic insulation and supplementary insulation, with the two insulations physically separated and arranged so that they are not simultaneously subjected to the same deteriorating influences (temperature, contaminants, and the like) to the same degree.

3.5.4 added July 20, 2012

3.6 ENCLOSURE – The part of the product that does one or more of the following:

- a) Isolates ignition sources,
- b) Renders inaccessible all or any parts of the equipment that may otherwise present a risk of electric shock,
- c) Retards propagation of flame initiated by electrical disturbances within.

3.7 FUNCTIONAL PART – A part other than an enclosure or cabinet used to maintain the intended relative physical position of fixed or moving parts, or maintain the integrity of the structure.

3.8 IGNITION SOURCE – Any high-voltage electrical component not located within an enclosure.

3.8.1 MOTOR CONTROLLER – Any device normally used to start and stop a motor, such as a switch, thermostat, pressure limiting control, or the like.

3.8.1 added December 15, 2009

3.9 NONFUNCTIONAL PART – A part of the product that does not perform a specific function.

3.10 NONFUNCTIONAL PART, SMALL – A nonfunctional part that does not occupy a volume greater than 0.12 in³ (2 cm³), does not have a dimension greater than 1.2 inches (3 cm), is located so it cannot propagate flame from one area to another and does not connect a possible source of ignition to other ignitable parts.

3.10.1 PRECOOLER – A heat exchanger within a water cooler intended to remove heat from the inlet water before the inlet water enters the evaporator. Heat is removed from the inlet water by the cooled outlet (waste) water. The precooler has separate passes between water circuits so that the inlet and outlet water cannot mix.

3.10.1 added December 15, 2009

3.10.2 START-TO-DISCHARGE PRESSURE – The pressure at which a relief valve begins to discharge, typically the pressure where the first bubbles can be seen when a valve is immersed in water.

3.10.2 added December 15, 2009

3.10.3 SUPPLEMENTARY INSULATION – An independent insulation provided in addition to the basic insulation to protect against electric shock in case of mechanical rupture or electrical breakdown of the basic insulation.

3.10.3 added July 20, 2012

3.11 TEMPERATURE LIMITING CONTROL – A control which serves only to prevent abnormal temperature and is not intended to function during normal operation.

3.12 TEMPERATURE REGULATING CONTROL – A control which regulates temperature and is intended to function frequently during normal operation.

3.13 ULTIMATE STRENGTH – The highest stress level that a refrigerant-containing component can tolerate without rupture.

3.13.1 ULTRAVIOLET (UV) RADIATION SYSTEM – Equipment that directly generates UV radiation and generally used to enhance purification of the drinking water. The system typically consists of a lamp assembly with UV bulb(s) producing ultraviolet radiation in wavelengths of 200 nm or greater.

3.13.1 added July 20, 2012

3.14 WATER COOLER – A unit that consists of a refrigeration system that is intended to cool potable water.

3.15 WATER COOLER, AGAINST-THE-WALL – Freestanding units intended to be placed in close proximity to a wall.

3.16 WATER COOLER, BOTTLE TYPE – A water cooler which employs a bottle or reservoir for storing potable water that is intended to be cooled and utilizes a faucet or similar means to dispense the chilled water.

3.17 WATER COOLER, BUILT-IN – These are intended to be permanently mounted and enclosed to some degree by structural parts of a building. A wall-insert water cooler is an example of a “built-in” type.

3.18 WATER COOLER, CAFETERIA – Pressure-type coolers intended primarily for use in cafeterias and restaurants for dispensing water rapidly into glasses and pitchers.

3.19 WATER COOLER, COLUMN MOUNT – Remote water coolers intended for installation on a column or post usually at an elevated position above the floor.

3.19.1 WATER COOLER, COUNTER-SUPPORTED – A water cooler that is physically supported by a counter, table or bench during the performance of its intended function.

3.19.1 added January 14, 2011

3.20 WATER COOLER, FREESTANDING – Intended for installations in which the structural parts of a building neither enclose nor functionally obstruct the water cooler.

3.21 WATER COOLER, HOT- AND COLD-TYPE – These include means for heating and dispensing potable water.

3.21.1 WATER COOLER, PRESSURE TYPE – A water cooler intended to be plumbed to a potable water source that is supplied under pressure. The water cooler utilizes a faucet or similar means to dispense the water.

3.21.1 added July 20, 2012

3.22 WATER COOLER, REMOTE – Pressure-type coolers designed for use with remotely installed bubblers or other dispensing means.

3.23 WATER COOLER, SELF-CONTAINED – Completely factory-made and factory-tested assemblies to which no refrigerant-containing parts are connected in the field.

3.23.1 WATER COOLER, THERMOELECTRIC – A water cooler in which the water is chilled using the Peltier Effect such that a direct current supply source is applied to a semiconductor thermoelectric module creating a temperature gradient which transfers heat from one surface to another.

3.23.1 added July 20, 2012

3.24 WATER COOLER, WALL-HUNG – Water coolers intended to be suspended from a wall.

4 Installation And Operating Instructions

4.1 A water cooler shall be provided with installation and operating instructions that contain the following:

- a) Directions and information as deemed by the manufacturer to be necessary for the safe installation, maintenance, and use of the water cooler;
- b) Roughing-in dimensions for electrical connections of permanently connected units and for plumbing connections of pressure-type units;
- c) Guidelines for ensuring protection of the water cooler by means of a ground-fault circuit interrupter; and
- d) For pressure type coolers the maximum water supply line pressure shall be included.

4.1 a), b), c) effective June 15, 2012 and added 4.1 d) effective January 14, 2013

4.2 A copy of the manufacturer's installation and operating instructions, or equivalent information intended to accompany each water cooler, shall be furnished with the sample submitted for investigation. These instructions shall be used as a guide in the examination and test of the water cooler.

4.2 revised December 15, 2009

4.3 If a water cooler is intended for use with a field-installed accessory, instructions for installing the accessory shall be provided on or with the accessory and shall warn the user that:

- a) The water cooler must be disconnected from the source of electrical supply before attempting the installation; and
- b) The accessory is intended for use only with the specific water cooler for which the accessory is marked.

4.3 added July 20, 2012

4.4 A double insulated thermoelectric water cooler provided with a 2-blade, polarized attachment plug shall be provided with the following or equivalent in the manufacturer's installation and operating instructions: "To reduce the risk of electric shock, this appliance has a polarized plug (one blade is wider than the other). This plug will fit in a polarized outlet only one way. If the plug does not fit fully in the outlet, reverse the plug. If it still does not fit, contact a qualified electrician to install the proper outlet. Do not change the plug in any way."

4.4 added July 20, 2012

4.5 A water cooler intended to employ a UV system shall be provided with instructions specifying the following or equivalent:

- a) Information indicating the cover or covers that provide access to the UV radiation system along with the following or equivalent statement: "Caution: UV Light Source – Disconnect the electrical source of supply to the UV radiation before opening cover."
- b) Information for the replacement of the UV lamps which shall include the wattage, voltage, lamp type and the designation number; and
- c) Instructions pertaining to the proper handling and disposal of UV lamps.

Added 4.5 effective August 1, 2014

CONSTRUCTION

5 General

5.1 Ferrous metal parts used to support or retain electrical components in position shall be protected against corrosion by metallic or nonmetallic coatings, such as plating or painting.

5.2 All nonmetallic parts, excluding small nonfunctional parts shall comply with 6.1, 6.2, and Table 32.1.

5.3 In addition to the requirement in 5.2, nonmetallic materials that serve as electrical insulation or that directly support live parts shall comply with the requirements for electric insulation in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

5.4 The hot water dispense device on a hot- and cold-type water cooler shall require at least two distinct operations to dispense hot water.

Added 5.4 effective January 14, 2013

5.5 A component shall:

- a) Comply with the safety standard covering that component;
- 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) Comply with the applicable requirements of this end product standard; and
- e) Not contain mercury.

Exception: 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.*

5.5 added July 20, 2012

5.6 A component that is also required to perform other necessary functions, such as overcurrent 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) covering products that provide those functions.

5.6 added July 20, 2012

6 Nonmetallic Material

6.1 Classification

6.1.1 Materials shall be classified with respect to flammability characteristics that are established by the tests specified in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

6.1.2 Materials shall be assigned flammability ratings based on greatest to least resistance to flame and are identified as: 5VA, 5VB, V-0, V-1, V-2, HF-1, HF-2, HB, and HBF.

6.1.3 In reference to 6.1.2, the assigned flammability rating shall be appropriate for the material-use application in accordance with 6.2 and Table 32.1.

6.1.4 Nonmetallic materials exposed to UV radiation shall comply with the Ultraviolet Light Exposure requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C except that the testing shall be conducted based on the actual UV radiation to which the nonmetallic material is exposed rather than the twin enclosed carbon-arc or xenon-arc conditioning. The test shall be conducted for not less than 1000 hours. Following the UV exposure, the materials shall comply with the tests specified in Table 32.1 based on the use application for each nonmetallic material.

Added 6.1.4 effective August 1, 2014

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6.2 Ignition Sources

6.2.1 Parts formed from nonmetallic materials rated HB or HBF and positioned as shown in Figure 6.2 shall be separated from ignition sources by means of a barrier, extending at least to the boundary surface of the space whenever such parts are located:

- a) Below an ignition source and within Space A; and
- b) Above an ignition source and within Space B; and
- c) In the vertical plane relative to an ignition source and within Space C.

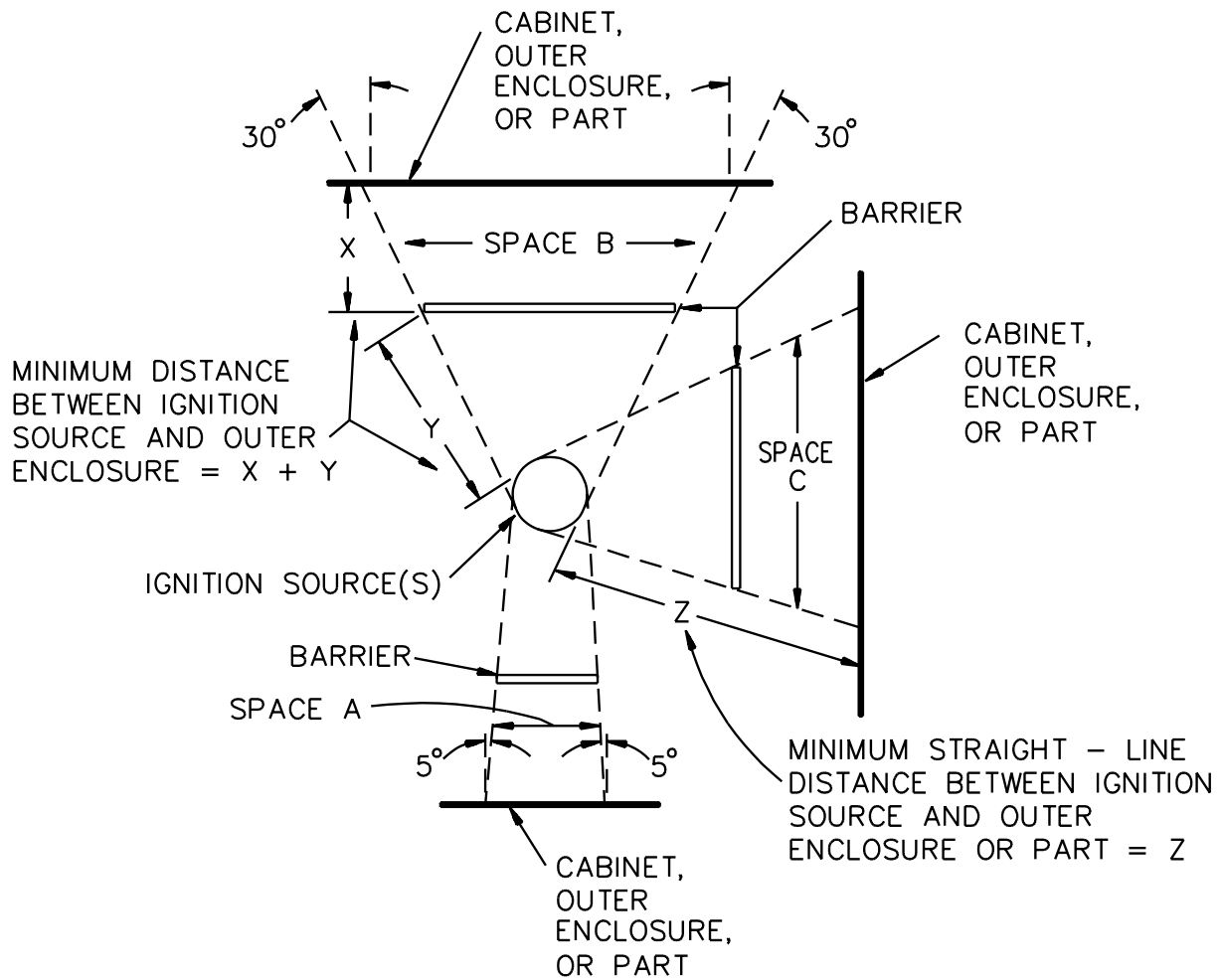
6.2.2 The HB or HBF materials referenced by 6.2.1 shall be located such that the distance between:

- a) High-voltage wiring not employing VW-1 and the HB or HBF materials shall be a minimum of 2 inches (51 mm), and
- b) Any other ignition source and the HB or HBF materials shall be a minimum of 4 inches (102 mm).

6.2.3 In reference to 6.2.2 and Figure 6.2, the minimum distance for materials located:

- a) Above the ignition source shall be as shown in Distance X + Y; and
- b) In the vertical plane relative to the ignition source shall be as shown in straight-line Distance Z.

Figure 6.2
Separation of ignition sources from nonmetallic materials



S2514C

Notes:

Space A – Represents the volume below the ignition source determined by a straight line that moves about the ignition source while remaining at the angle of 5° degrees from the vertical and is always so oriented that the volume is maximum.

Space B – Represents the volume above the ignition source determined in the same manner as Space A, except that the angle is 30° degrees from the vertical.

6.3 Application and Location

6.3.1 Nonmetallic fasteners used as a part of the enclosure shall comply with the Fastener strength test. See 32.3.

6.3.2 The combined total exposed surface area of all small, nonfunctional parts shall not exceed 144 in² (929 cm²).

6.3.3 When thermal insulation is located between a cabinet and inner liner, the product shall comply with both (a) and (b) or it can comply only with (c):

- a) All holes within the cabinet and inner liner shall be closed,
- b) The cabinet surfaces shall be securely fastened such that the maximum spacing between screws, spot welds, or other securement means does not exceed 6 inches (152.4 mm),
- c) The thermal insulation shall be rated HF-1.

7 Assembly

7.1 General

7.1.1 A bottle-type water cooler shall be assembled so that removal and replacement of bottles will not result in damage to electrical components and wiring, or to refrigerant-containing components.

7.1.2 Ozone generating equipment installed on drinking water coolers shall comply with the Standard for Water Treatment Appliances, UL 979 and with the Ozone Test of Section 44A.

Added 7.1.2 effective June 15, 2012

7.1.3 If a drinking water cooler contains a refrigerated storage compartment, the compartment shall comply with the requirements in the Standard for Household Refrigerators and Freezers, UL 250 that apply to refrigerated compartments.

7.1.3 added July 20, 2012

7.1.4 Wiring and electrical components shall not be exposed to UV radiation.

Added 7.1.4 effective August 1, 2014

7.1A Pressurized beverage product system

7.1A added July 20, 2012

7.1A.1 A gas pressure regulator or reducing valve shall comply with the Standard for Compressed Gas Regulators, UL 252.

7.1A.2 A pressure-relief valve complying with 29.3 shall be installed in a pressurized beverage product system. There shall be no shutoff valve between the relief valve and any parts of the system under pressure.

7.1A.3 Pressure relief devices in a pressurized product system shall be positioned, located, or baffled so that moisture discharged through the relief device will not wet uninsulated live parts.

7.1A.4 A pressurized beverage product system shall comply with the tests in 52.6.

7.2 Mechanical protection

7.2.1 Louvers and other openings in the enclosure shall be constructed and located to reduce the risk of unintentional contact with moving parts and with hot surfaces that may cause injury to persons. See 7.2.4 and 7.2.5. Knockouts for entrance of electrical conduit and plumbing may be provided. In determining compliance with the requirements specified in 7.2.2 – 7.2.5, parts such as covers, panels, or grilles used as part of the enclosure are to be removed unless tools are required for their removal.

7.2.2 Moving parts, such as fan blades, shall be guarded or enclosed. Parts required for guarding shall be secured by means dependent upon tools for removal unless functioning of the water cooler requires the guard to be in place.

7.2.3 With reference to 7.2.2, moving parts are considered to be enclosed when the distance from an opening to the moving part is as specified in Table 7.1. For an opening having a minor dimension intermediate between two of the values included in the table, the distance from the opening to the moving part is determined by interpolation between the corresponding values in the right-hand column of the table. The minor dimension of the opening is determined by the largest hemispherically tipped cylindrical probe that can be inserted through the opening with a force of 5 pounds (22.3 N).

Exception No. 1: The following areas are considered to be solid surfaces for the purpose of applying this requirement:

- a) The bottom of a freestanding unit.*
- b) The rear of a wall-hung unit.*
- c) The rear of an against-the-wall unit if, according to the instructions provided with the unit, no gap is allowed between the unit and the wall, and the unit has been tested accordingly.*

Exception No. 2: A moving part is not to be considered if:

- a) The part is unlikely to be contacted through the opening because of the location of fixed components, including baffles, water lines, drain tubes, and the like, or*
- b) The part is made inoperative, when exposed, through the use of interlocking devices.*

If more than one method of routing plumbing lines is specified in the installation instructions, all methods are to be evaluated when determining if such lines, as installed, serve as baffles to prevent contact with moving parts.

Table 7.1
Dimensions of openings

Minor dimensions of opening ^a ,		Minimum distance from opening to moving part ^b ,	
inches	(mm)	inches	(mm)
1/4	(6.4)	1/2	(12.7)
3/8	(9.5)	1-1/2	(38.1)
1/2	(12.7)	2-1/2	(63.5)
3/4	(19.1)	4-1/2	(114.0)
1	(25.4)	6-1/2	(165.0)
^a Openings less than 1/4 inch (6.4 mm) are not to be considered. Openings greater than 1 inch (25.4 mm) shall be designed or located to reduce the risk of unintentional contact with moving parts that may involve injury to persons.			
^b Also applies to thermally hot parts. See Table 36.1.			

7.2.4 When tested in accordance with the provisions of the Temperature and Pressure Test, Section 36, surfaces that exceed the temperature limit of Table 36.1 (d)(3) and (d)(4) shall be guarded in accordance with 7.2.2 and 7.2.3. In determining compliance with this requirement, the handle of the hot water spigot on a hot- and cold-type water cooler is considered to be a surface contacted by persons in the operation of the unit, Table 36.1(d)(3). The hot water spigot itself is exempt from this requirement. Surfaces that are recessed or located away from the front of the water cooler are not considered subject to casual contact, see Table 36.1(d)(4). Examples of such surfaces include a condenser located at the rear of a freestanding unit and a compressor located over an opening in the bottom of a wall-hung unit.

7.2.5 The sheath of a heater element, as installed in a water cooler, shall be protected against mechanical damage. A copper or steel sheath at least 0.016 inch (0.41 mm) thick is considered to provide such protection. In addition, if the temperature of a heater exceeds the limits permitted by Table 36.1 (d)(3) or (d)(4), whichever is appropriate, it shall be guarded in accordance with 7.2.2 and 7.2.3 to protect persons from coming in contact with it.

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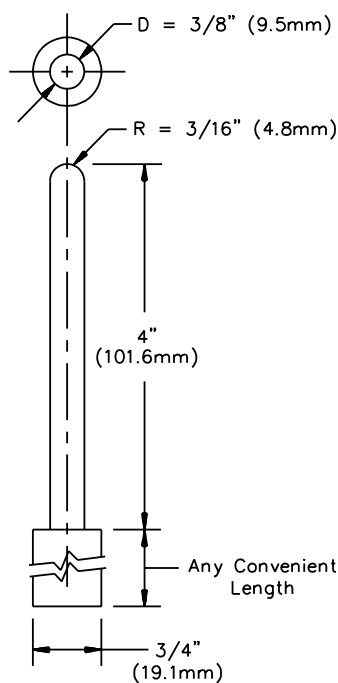


7.3 Electrical protection

7.3.1 Louvers and other openings in the enclosure shall be constructed and located to reduce the risk of unintentional contact with uninsulated high-voltage live parts. Knockouts for entrance of electrical conduit and plumbing may be provided. To determine compliance with this requirement, parts such as covers, panels, or grilles used as part of the enclosure are to be removed unless tools are required for their removal or an interlock is provided. See 9.2.1.

7.3.2 Where an opening in the enclosure will not permit the entrance of a 3/4 inch (19.1 mm) diameter rod, the probe illustrated in Figure 7.1 shall not touch any uninsulated high-voltage live parts and the probe illustrated in Figure 7.2 shall not touch any film-coated wire when inserted through the opening. The probe shall not pass through grilles, screens, louvers, or the like when a force of 5 pounds (22.3 N) is applied.

**Figures 7.1
Probes**



PA170A

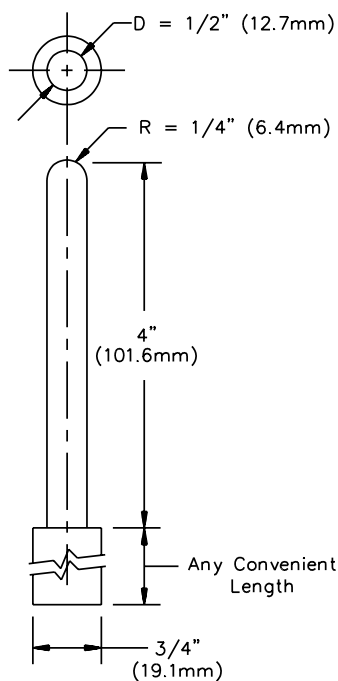
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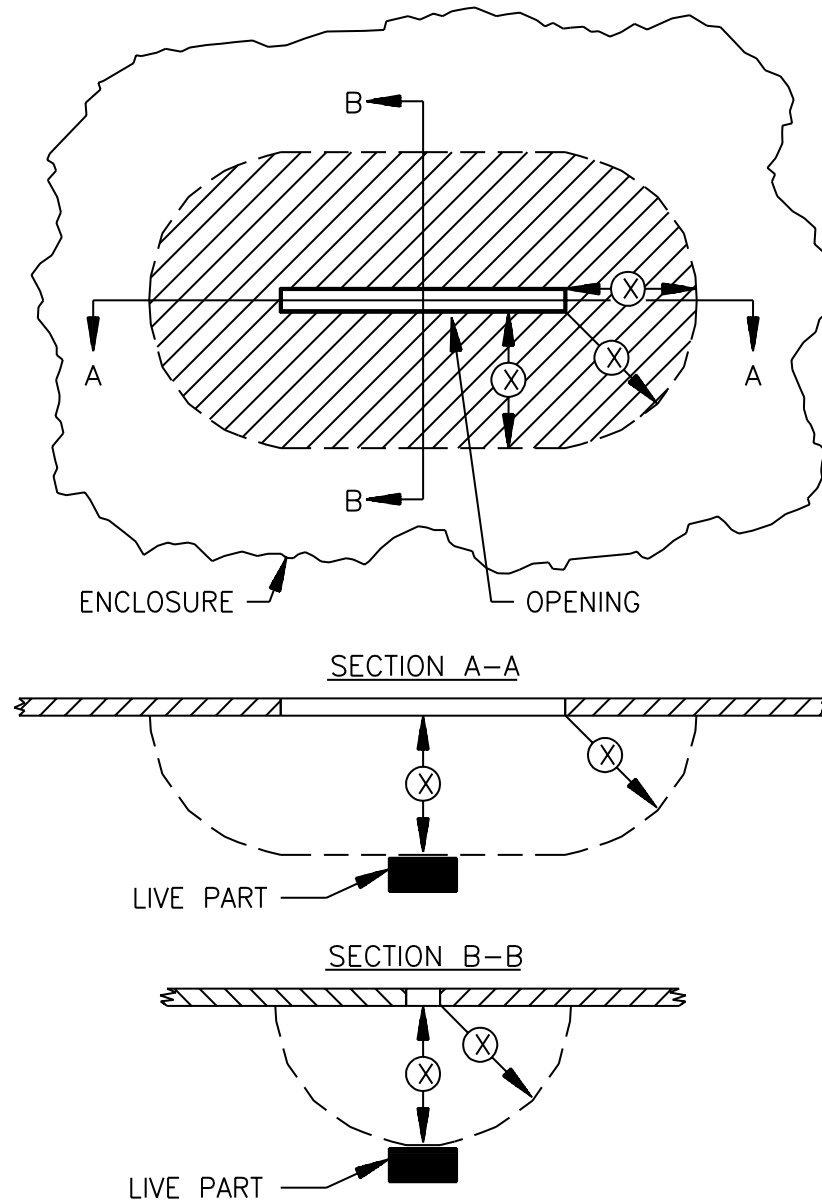
Figure 7.2
Probe



PA170B

7.3.3 Where an opening in the enclosure permits the entrance of a 3/4 inch (19.1 mm) diameter rod, the conditions described in Figure 7.3 shall be used in determining compliance with the requirements. The minor dimension of the opening shall not exceed 1 inch (25.4 mm) in any case.

Figure 7.3
Opening in enclosure



EC100A

The opening is acceptable if, within the enclosure, there is no uninsulated live part or film-coated wire:

- (1) less than X inches from the perimeter of the opening, as well as
- (2) within the volume generated by projecting the perimeter X inches normal to its plane.

X equals five times the diameter of the largest diameter rod which can be inserted through the opening, but not less than 4 inches (102 mm).

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7.3.4 In addition to the requirements of 7.3.2 and 7.3.3, uninsulated high-voltage live parts inside the enclosure which are likely to be contacted by persons performing operations such as replacing fuses, resetting manual-reset devices, oiling motors, or other such normal service operations shall be located, guarded, or enclosed to reduce the risk of unintentional contact unless tools are required to expose the live part. See 61.13.

7.3.5 *Deleted July 20, 2012*

7.3.6 Electrical components shall be located or enclosed so that uninsulated high-voltage live parts will not be wetted by water due to condensation, splashing, or leakage.

7.3.7 On pressure type water coolers, a drain basin shall be constructed so that overflow due to a blocked drain will not wet uninsulated high-voltage live parts or film-coated wire.

7.3.8 A water reservoir on a bottle type water cooler and waste water receptacles on any type water cooler shall be constructed and located so that overflow will not wet uninsulated high-voltage live parts or film-coated wire.

7.3.9 The Overflow Test, Section 40, is to be conducted if it is not evident that the water cooler complies with the provisions of 7.3.7 and 7.3.8.

7.3.10 A bottle type water cooler shall be constructed so that a liquid spill on the top surface of the unit, during removal or installation of water containers will not wet uninsulated live parts or film-coated wire in line-voltage circuits. A Spill Test, Section 41, is to be conducted if it is not evident that the water cooler complies with this requirement.

7.3.11 A switch, attachment-plug receptacle, motor-attachment plug, or similar component shall be secured in position and, except as noted in 7.3.12, shall be prevented from turning. See 7.3.13.

7.3.12 The requirement that a switch be prevented from turning will be waived if the following conditions are met:

- a) The switch is 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 operation of the switch,
- b) Means of mounting the switch make it unlikely that operation of the switch will loosen it,
- c) The spacings are not reduced below the minimum required values if the switch rotates, and
- d) Operation of the switch is by mechanical means rather than direct contact by persons.

7.3.13 With reference to 7.3.11, the means for preventing rotation is to consist of more than friction between surfaces. A toothed lock washer that provides both spring take-up and an interference lock is acceptable as means for preventing a small stem-mounted switch or other device having a single-hole mounting means from turning.

7.3.14 An uninsulated high-voltage live part and its support shall be secured to a mounting surface so that it will be prevented from turning or shifting in position if such motion may result in a reduction of spacings below the minimum acceptable values. See Spacings, High-Voltage Circuits, Section 22. Friction between surfaces is not acceptable as a means to prevent shifting or turning of a live part, but a lock washer as described in 7.3.13 is acceptable.

7.3.15 Flammable or electrically conductive thermal or acoustical insulation shall not contact uninsulated high-voltage live parts. See 49.2.1.

8 Barriers

8.1 A barrier shall be secured to the mounting surface such that tools are required for its removal.

8.2 A barrier shall be formed from one or more of the following:

- a) Metal, minimum 0.005 inch (0.13 mm) thick,
- b) Fiberglass, minimum 0.5 inch (12.7 mm) thick,
- c) A nonmetallic material rated 5VA,
- d) A nonmetallic material evaluated to the 127 mm (5 inch) End Product Flame Test as described in UL 746C,
- e) Any other material or construction determined to be equivalent to items (a) to (d).

8.2.1 In reference to 8.2, a nonmetallic barrier exposed to UV radiation shall comply with 6.1.4.

Added 8.2.1 effective August 1, 2014

8.3 In reference to 8.2, a rigid backing or a mechanical barrier shall be provided behind these materials unless the materials are determined to be suitably rigid.

8.4 A mechanical barrier shall be formed from one or more of the following:

- a) Metal, minimum 0.026 in. (0.66 mm) thick,
- b) A nonmetallic material which shall be considered a part of the cabinet and which shall comply with the cabinet requirements of Table 32.1,
- c) Any other material or construction determined to be equivalent to (a) or (b).

8A Accessories

8A added July 20, 2012

8A.1 A water cooler having provisions for electrical accessories to be attached in the field shall be constructed so that the use of these accessories will not introduce a risk of fire, electric shock, or injury to persons.

8A.2 The water cooler shall comply with all requirements of this standard with or without the accessory installed. Additional requirements for accessories are in 4.3 and 61A.

8A.3 Installation of accessories shall:

- a) Be restricted to an arrangement that can be accomplished by means of receptacles and plug-in connectors; and
- b) Not require the cutting of wiring or the soldering of connections.

8A.4 An accessory strain-relief means shall be provided for the wiring if there is a possibility of transmitting stress to the terminal connections during installation. The strain-relief shall comply with the Strain Relief Test in Section 44B.

8A.5 The accessory wiring connections shall be identified on both the accessory and on the water cooler.

8A.6 The accessory mounting location shall be:

- a) Identified on the water cooler; or
- b) Fixed due to the function of the accessory and its arrangement within the water cooler. In this case, the accessory installation instructions shall specify the mounting location of the accessory.

8A.7 Accessories shall be trial-installed. The factors outlined below shall be considered when evaluating the trial-installation of the accessory:

- a) Feasibility of the accessory installation;
- b) Detailed and correct accessory installation instructions; and
- c) The accessory installation complies with 8A.1 to 8A.6.

9 Enclosures

9.1 General

9.1.1 Enclosures shall be formed and assembled so that they will have the strength and rigidity necessary to resist the abuses to which they may be subjected without increasing the risk of fire or injury to persons due to total or partial collapse with the resulting reduction of spacings, loosening or displacement of parts, or other serious defects. Enclosures for individual electrical components, outer enclosures, and combinations of the two are considered in determining compliance with this requirement.

9.1.2 Among the factors that are taken into consideration when evaluating an enclosure are:

- a) Mechanical strength,
- b) Resistance to impact, and
- c) Resistance to corrosion.

In addition to these factors, a nonmetallic enclosure or part of an enclosure is evaluated for:

- a) Moisture-absorption properties,
- b) Flammability, and
- c) Resistance to distortion at temperatures to which the material may be subjected under conditions of use.

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

9.1.3 Additional flammability tests may be needed on nonmetallic outer enclosure materials if internal wiring is not enclosed by means such as conduit, electric metallic tubing, metal raceways or control boxes. See Internal Wiring and Wiring Methods, Section 11.

9.1.4 The electrical components within the cabinet, such as controls, solenoids, starting relays, motors and switches shall comply with one of the following:

- a) Electrical components shall be enclosed, except for terminals,
- b) The cabinet is arranged such that any failure of an electrical component shall not result in a risk of fire or emission of flame or molten metal, or
- c) Electrical components other than switches or motors shall comply with the Burnout Test – Other Components, Section 46.2.

9.1.5 Compliance with 9.1.4 shall be based on the design and location of the components with respect to openings in the cabinet.

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9.1.6 In reference to 9.1.5, openings in the bottom of the cabinet shall be arranged to prevent glowing or flaming particles from falling out of the cabinet.

9.1.7 Barriers used for compliance with 9.1.6 shall be horizontal and located as indicated in Figure 17.1 with respect to unenclosed electrical components located within the cabinet.

9.1.8 A built-in water cooler shall be constructed and assembled to reduce the risk of the emission of molten metal, burning insulation or flaming particles into the wall space or the area beneath the water cooler.

9.1.9 The requirement of 9.1.8 necessitates the use of totally enclosed fan motors and complete enclosures for controls, starting relays, capacitors, and other electrical components, including the wiring, unless these parts are installed in an overall enclosure provided with the built-in unit. Such an enclosure shall have:

- a) No ventilating openings which will permit the entrance of a 3/8 inch (9.5 mm) diameter rod,
- b) All ventilating openings located or provided with a barrier, baffle, or louver to reduce the risk of the expulsion of molten metal, burning insulation or flaming particles, and
- c) A nonflammable solid bottom without openings. Knockouts for entrance of electrical conduit and plumbing may be provided.

9.1.10 A built-in water cooler shall have necessary ventilating grilles furnished with the water cooler.

9.1.11 A sheet metal enclosure is evaluated with respect to its size, shape, metal thickness and use in the particular application. Sheet steel shall have a thickness of not less than 0.026 inch (0.66 mm) if uncoated or 0.029 inch (0.74 mm) if galvanized. Nonferrous sheet metal shall have a thickness of not less than 0.036 inch (0.91 mm).

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

9.1.13 If threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, or if an equivalent construction is employed, there shall be not less than three nor more than five threads in the metal, and the construction of the device shall be such that a conduit bushing can be properly attached. If threads for the connection of conduit are not tapped all the way through a hole in an enclosure wall, conduit hub, or the like, there shall be not less than 3-1/2 threads in the metal, and there shall be a smooth, rounded inlet hole for the conductors which shall afford protection to the conductors equivalent to that provided by a standard conduit bushing and which shall have an internal diameter approximately the same as that of the corresponding trade size of rigid conduit.

9.1.14 A knockout in a sheet metal enclosure shall be secured in place, but shall be capable of being removed without deformation of the enclosure that would result in damage to electrical components, reduction in electrical spacings, or both.

9.1.15 A knockout shall remain in place when a force of 10 pounds (44.5 N) is applied at right angles to the knockout by a 1/4 inch (6.4 mm) diameter mandrel with a flat end. The mandrel shall be applied at the point most likely to cause movement of the knockout.

9.1.16 A knockout shall be provided with a flat surrounding surface for seating of a conduit bushing and shall be located so that installation of a bushing at any knockout likely to be used during installation will not result in spacings between uninsulated high-voltage live parts and the bushing of less than those required by this standard.

9.1.17 In measuring a spacing between an uninsulated high-voltage live part and a bushing installed in a knockout, it is to be assumed that a bushing having the dimensions indicated in Table 9.1 is in place, in conjunction with a single locknut installed on the outside of the enclosure.

Table 9.1
Knockout or hole sizes and dimensions of bushings

Trade size of conduit,		Knockout or hole diameter,		Bushing dimensions			
				Overall diameter,		Height,	
inches	(mm O.D.)	inches	(mm)	inches	(mm)	inches	(mm)
1/2	(21.3)	7/8	(22.2)	1	(25.4)	3/8	(9.5)
3/4	(26.7)	1-3/32	(27.8)	1-15/64	(31.4)	27/64	(10.7)
1	(33.4)	1-23/64	(34.5)	1-19/32	(40.5)	33/64	(13.1)

9.1.18 Steel enclosures shall be protected against corrosion by metallic or nonmetallic coatings such as plating or painting. See 9.3.1 – 9.3.6.

9.2 Doors and covers

9.2.1 Service covers or panels in the outer enclosure shall require the use of tools for removal or shall be provided with an interlocking mechanism if they give access to unenclosed uninsulated high-voltage live parts, moving parts, or UV radiation.

Revised 9.2.1 effective August 1, 2014

9.2.2 An interlocking mechanism which:

- a) Must be engaged in the closed position of the cover before parts are energized and
- b) Will secure the cover in the closed position when engaged,

is considered to comply with 9.2.1.

9.2.3 A hinged or pivoted panel or cover shall be positioned or arranged so that when it is in an open position to facilitate servicing, it is not subject to falling or swinging due to gravity or vibration so as to cause injury to persons from the panel or cover, from moving parts or from uninsulated high-voltage live parts.

9.2.4 The assembly shall be arranged so that an overcurrent protective device, such as a fuse, can be replaced and manual-reset devices can be reset without removing parts other than a service cover(s) or panel(s), and the cover or door enclosing the device.



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9.2.5 A required protective device shall not be accessible from outside the enclosure without opening a door or cover.

Exception: The operating handle of a circuit breaker, the reset button of a manually resettable motor protector, the reset button of a manually resettable pressure switch, and similar parts may project outside the enclosure.

9.2.6 An opening in an outer enclosure around a handle, reset button, or other control member is acceptable if the clearance between the control member and the edge of the opening is not more than 1/8 inch (3.2 mm) for any setting or position of the control member.

9.2.7 Covers for enclosures of fuses in high-voltage circuits shall be hinged. Covers for manual-reset overload protective device enclosures shall be hinged if it is necessary to open the cover to reset the device.

Exception: A hinged cover is not required where the only fuses enclosed are:

- a) Supplementary type control circuit fuses, provided the fuses and control circuit loads, other than a fixed control circuit load such as a pilot lamp, are within the same enclosure, or*
- b) Supplementary type fuses of 2 amperes or less for small auxiliary resistance heaters, such as crankcase heaters, with a maximum rating of 100 watts (W),*
- c) An extractor-type fuse with its own enclosure, or*
- d) Fuses in low-voltage circuits.*

9.2.8 Hinged covers, where required, shall not depend solely upon screws or other similar means to hold them closed, but shall be provided with a latch or the equivalent.

9.2.9 A spring latch, magnetic latch, dimple, or any other mechanical arrangement that will hold the door in place and will require some effort on the user's part to open it is considered to be a means for holding the door in place as required in 9.2.8. When provided as the sole means for securing the cover or panel, a cover interlocking mechanism as described in 9.2.2 is considered to comply with 9.2.8.

9.2.10 A door or cover giving direct access to fuses in other than low-voltage circuits shall shut closely against a 1/4 inch (6.4 mm) rabbet or shall have either turned flanges for the full length of four edges or angle strips fastened to it. Flanges or angle strips shall fit closely with the outside of the wall of the box proper and shall overlap the edges of the box not less than 1/2 inch (12.7 mm). A special construction, such as a fuse enclosure, located within an outer enclosure, or a flange and rabbet combination which affords the equivalent protection is acceptable.

9.2.11 Strips used to provide rabbets, or angle strips fastened to the edges of a door, shall be secured at not less than two points, not more than 1-1/2 inches (38.1 mm) from each end of each strip and at points between these end fastenings, not more than 6 inches (152.4 mm) apart.

9.3 Enclosures exposed to weather

9.3.1 Sheet steel cabinets and electrical enclosures exposed to the effects of weathering shall be protected against corrosion as specified in Table 9.2 or by other metallic or nonmetallic coatings which provide equivalent protection.

Table 9.2
Protection against corrosion

Type of cabinet and enclosure	0.053 inch (1.35 mm) and heavier as specified by paragraph	Lighter than 0.053 inch (1.35 mm) as specified by paragraph
Outer cabinets which protect motors, wiring, or enclosed current carrying parts	9.3.3	9.3.4
Inner enclosures which protect current carrying parts other than motors	9.3.3	9.3.4
Outer cabinets which are the sole enclosure of current carrying parts	9.3.4	9.3.4

9.3.2 9.3.1 is not applicable to a metal part, such as a decorative grill, which is not required for conformance with this standard.

9.3.3 To comply with 9.3.1, one of the following coatings shall be used:

- a) Hot-dipped, mill-galvanized sheet steel conforming with the Coating Designation G60 or A60 in Table 1 of the Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated Galvannealed by the Hot-Dip Process, ASTM A653/A653M, with not less than 40 percent of the zinc on any side, based on the minimum single spot test requirement in the ASTM Specification. The weight of zinc coating shall be established in accordance with the Standard Test Method for Weight (Mass) of Coating on Iron or Steel Articles with Zinc or Zinc-Alloy Coatings, ASTM A90. An A60 (alloyed) coating shall also comply with 9.3.5.
- b) A zinc coating, other than that provided on hot-dipped, mill-galvanized sheet steel, uniformly applied to an average thickness of not less than 0.00041 inch (0.0104 mm) on each surface with a minimum thickness of 0.00034 inch (0.0086 mm). The thickness of the coating shall be established by the Metallic Coating Thickness Test, Section 56. An annealed coating shall also comply with 9.3.5.
- c) Two coats of an organic finish of the epoxy or alkyd-resin type or other outdoor paint on both surfaces. The corrosion protective coating shall comply with the Salt-Spray (Fog) Test and Moist Carbon Dioxide-Air Test described in the Standard for Organic Coatings for Steel Enclosures for Outdoor Use Electrical Equipment, UL 1332.

9.3.4 To comply with 9.3.1, one of the following coatings shall be used:

- a) Hot-dipped, mill-galvanized sheet steel conforming with the Coating Designation G90 in Table 1 of ASTM/A653-M with not less than 40 percent of the zinc on any side, based on the minimum single spot test requirements in the ASTM Specification. The weight of zinc coating shall be established in accordance with the Test Method of ASTM A90.

b) A zinc coating, other than that provided on hot-dipped, mill-galvanized sheet steel, uniformly applied to an average thickness of not less than 0.00061 inch (0.0155 mm) on each surface with a minimum thickness of 0.00054 inch (0.0137 mm). The thickness of the coating shall be established by the Metallic Coating Thickness Test, Section 56. An annealed coating shall also comply with 9.3.5.

c) A cadmium coating of not less than 0.001 inch (0.025 mm) in thickness on both surfaces. The thickness of coating shall be established by the Metallic Coating Thickness Test, Section 56.

d) A zinc coating conforming with 9.3.3 (a) or (b) with one coat of outdoor paint as specified in 9.3.3(c).

e) A cadmium coating of not less than 0.00075 inch (0.0191 mm) in thickness on both surfaces with one coat of outdoor paint on both surfaces or of not less than 0.0005 inch (0.013 mm) in thickness on both surfaces with two coats of outdoor paint on both surfaces. The thickness of the cadmium coating shall be established by the Metallic Coating Thickness Test, Section 56, and the paint shall be as specified in 9.3.3(c).

9.3.5 An annealed zinc coating which is bent or similarly formed after annealing shall additionally be painted in the bent or formed area if the bending or forming process damages the zinc coating. If flaking or cracking of the zinc coating at the outside radius of the bent or formed section is visible at 25 power magnification, the zinc coating is considered damaged. Simple sheared or cut edges and punched holes are not considered to be formed, but extruded and rolled edges and holes are to conform with this requirement.

9.3.6 With reference to 9.3.1, other finishes, including paints, special metallic finishes, and combinations of the two, may be accepted when comparative tests with galvanized sheet steel without annealing, wiping, or other surface treatment conforming with 9.3.3(a) or 9.3.4(a), as applicable, indicate they provide equivalent protection. Among the factors which are taken into consideration when judging the suitability of such coating systems are exposure to salt spray, moist carbon dioxide-sulphur dioxide-air mixtures, moist hydrogen sulphide-air mixtures, ultraviolet light, and water.

9.3.7 Nonferrous enclosures may be employed without special corrosion protection. See 9.1.2.

9.3.8 If gaskets are required to seal electrical enclosures against the entrance of rain and condensate, they shall:

- a) Comply with 55.1 – 55.5 or with the Standard for Gaskets and Seals, UL 157;
- b) Be held in place by mechanical fasteners or adhesives, except as indicated in 9.3.9; and
- c) Be neoprene, rubber, thermoplastic or other materials with equivalent properties.

9.3.8 revised July 20, 2012

9.3.8.1 Sealing compounds required to seal electrical enclosures shall comply with 55.6.

9.3.8.1 added July 20, 2012

9.3.8.2 Adhesives required to secure gaskets shall comply with 55.7.

9.3.8.2 added July 20, 2012

9.3.9 In reference to 9.3.8 (b), gaskets which are not held in place by mechanical fasteners or adhesives but are intended to be retained in the correct position by some other means shall be prevented from displacement either:

- a) Due to their location within the equipment; or
- b) By the placement of other components in the enclosure so that if the equipment cover is removed, the gasket will be reengaged in the intended manner when the cover is replaced.

9.3.9 revised July 20, 2012

10 Field Supply Connections for Permanently Connected Water Coolers

10 revised July 20, 2012

10.1 General

10.1.1 *Relocated at 21G.5*

10.1.2 *Relocated at 16.5.1*

10.1.1 Water coolers of the following types shall have provision for permanent connection to the power supply in accordance with the National Electrical Code, ANSI/NFPA 70:

- a) Any remote or built-in type.
- b) Any unit which has a total marked rating exceeding a 16-ampere load.
- c) Any unit rated in excess of 250 volts.
- d) All polyphase units.

10.2.1 revised and relocated as 10.1.1 July 20, 2012

10.1.2 With reference to 10.1.1(b), the largest sum of concurrent loads shown on the nameplate shall be used to determine the total marked rating.

10.2.2 revised and relocated as 10.1.2 July 20, 2012

10.1.3 As used in Terminals (10.1A) and Leads (10.1B), field-wiring connections are considered to be the terminals or leads to which power supply, control, or equipment grounding connections will be made in the field when the water cooler is installed.

10.2.3 revised and relocated as 10.1.3 July 20, 2012

10.1.4 A knockout for connection of a field-wiring system to a field-wiring compartment shall accommodate conduit of the trade size determined by applying Table 10.1.

10.2.4 relocated as 10.1.4 July 20, 2012

10.1.5 The location of a terminal box or compartment in which power supply connections are to be made shall be such that these connections may be inspected after the water cooler is installed. The connections are to be accessible without removing parts other than a service cover or panel and the cover of the outlet box or compartment in which the connections are made.

10.2.6 relocated as 10.1.5 July 20, 2012

10.1.6 A terminal compartment intended for the connection of a supply raceway shall be secured in position and shall be prevented from turning.

10.2.7 relocated as 10.1.6 July 20, 2012

10.1.7 The water cooler shall be provided with field-wiring terminals or leads for the connection of conductors having an ampacity of not less than that indicated in 62.11. It is assumed that branch circuit conductors rated 140°F (60°C) will be used.

10.2.8 relocated as 10.1.7 July 20, 2012

10.1A Terminals

10.1A added July 20, 2012

10.1A.1 For field-wiring terminals intended for 8 AWG (8.4 mm²) and larger conductors, pressure wire connectors shall be used. For field-wiring terminals intended for 10 AWG (5.3 mm²) and smaller conductors, the parts to which wiring connections are made may consist of clamps or wire binding screws with cupped washers, terminal plates, or the equivalent to hold the wire in position.

10.2.10 revised and relocated as 10.1A.1 July 20, 2012

10.1A.2 Size 14 AWG (2.1 mm²) wire shall be considered as being the smallest wire that can be used for branch circuit wiring and at a terminal intended for the connection of the power supply leads.

10.2.12 revised and relocated as 10.1A.2 July 20, 2012

10.1A.3 Upturned lugs or a cupped washer shall be capable of retaining a conductor of the size mentioned in 10.1.7 and 62.11, but no smaller than 14 AWG (2.1 mm²), under the head of the screw or the washer.

10.2.15 revised and relocated as 10.1A.3 July 20, 2012

10.1A.4 Wiring terminals for use with all alloys of copper, aluminum, or copper-clad aluminum conductors, shall comply with 10.1A.5 – 10.1A.10 or with the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

10.1A.4 added July 20, 2012

10.1A.5 A field-wiring terminal shall be prevented from turning or shifting in position by means other than friction between surfaces. This may be accomplished by such means as two screws or rivets; by square shoulders or mortises; by a dowel pin, lug, or offset; or by a connecting strap or clip fitted into an adjacent part.

10.2.9 relocated as 10.1A.5 July 20, 2012

10.1A.6 A wire binding screw at a field-wiring terminal shall not be smaller than 8 AWG (4.2 mm diameter), except that a 6 AWG (3.5 mm diameter) screw may be used for the connection of one 14, 16, or 18 AWG (2.1, 1.3, or 0.82 mm²) conductor.

10.2.11 relocated as 10.1A.6 July 20, 2012

10.1A.7 A terminal plate for a wire binding screw shall be of metal not less than 0.030 inch (0.76 mm) in thickness for a 14 AWG (2.1 mm²) or smaller wire and not less than 0.050 inch (1.27 mm) in thickness for a wire larger than 14 AWG, and in either case there shall be not less than two full threads in the metal.

10.2.13 relocated as 10.1A.7 July 20, 2012

10.1A.8 A terminal plate formed from stock having the minimum required thickness may have the metal extruded at the tapped hole for the binding screw to provide two full threads, except that two full threads are not required if a lesser number of threads results in a connection in which the threads will not strip with normal tightening torque in accordance with the values indicated in the Standard for Wire Connectors, UL 486A-486B.

10.2.14 relocated as 10.1A.8 July 20, 2012

10.1A.9 A wire binding screw shall thread into metal.

10.2.16 relocated as 10.1A.9 July 20, 2012

10.1A.10 A field-wiring terminal intended for the connection of a grounded conductor shall be of a metal or plated with a metal distinguishable from the other terminals, or proper identification of that terminal shall be shown in some other manner, such as on an attached wiring diagram.

10.2.17 revised and relocated as 10.1A.10 July 20, 2012

10.1B Leads

10.1B added July 20, 2012

10.1B.1 Leads intended for connection to any external high-voltage circuit or to an external extra-low-voltage circuit that contain one or more of the components specified in 23.3 shall comply with all of the following:

- a) Be one of the types of wiring specified in 11.1.1;
- b) Be 6 inches (152 mm) or more in length, as measured from the lead end to the strain relief means, unless the use of a shorter lead is required to prevent damage to the lead insulation;
- c) Be provided with strain relief if stress on the lead may be transmitted to terminals, splices, or internal wiring. Leads shall comply with 44B.1 when subjected to a direct pull of 20 pounds-force (89 N);
- d) Not be connected to wire binding screws or pressure wire connectors located in the same compartment as the lead ends (that are intended for spliced connections to the field-wiring) unless the screws or connectors are rendered unusable for field-wiring connections or the lead ends are insulated; and
- e) Be insulated at the free end, if the lead will not be used in every installation and if the end can reduce spacings below the minimum acceptable values specified in Section 22 for high-voltage circuits or Section 23 for extra-low-voltage circuits.

10.1B.2 A lead intended for the connection of a grounded conductor shall be finished to show a white or gray color, shall be distinguishable from other leads, and no other lead shall be so identified.

10.2 Permanently connected water coolers

10.2.1 Revised and relocated at 10.1.1

10.2.2 Revised and relocated at 10.1.2

10.2.3 Revised and relocated at 10.1.3

10.2.4 Revised and relocated at 10.1.1

10.2.5 Revised and relocated at 10.1.4

Table 10.1
Trade size of conduit (mm O.D.)

Wire size, AWG (mm ²)		Number of wires, inches (mm OD)									
		2		3		4		5		6	
14	(2.1)	1/2	(21.3)	1/2	(21.3)	1/2	(21.3)	1/2	(21.3)	1/2	(21.3)
12	(3.3)	1/2	(21.3)	1/2	(21.3)	1/2	(21.3)	3/4	(26.7)	3/4	(26.7)
10	(5.3)	1/2	(21.3)	1/2	(21.3)	1/2	(21.3)	3/4	(26.7)	3/4	(26.7)
8	(8.4)	3/4	(26.7)	3/4	(26.7)	3/4	(26.7)	1	(33.4)	1	(33.4)

NOTE – This table is based on the assumption that all conductors will be of the same size and there will be no more than six conductors in the conduit. If more than six conductors will be involved or if all of them are not of the same size, the internal cross-sectional area of the smallest conduit that may be used is determined by multiplying by 2.5 the total cross-sectional area of the wires, based on the cross-sectional area of Type THW wire.

10.2.6 Revised and relocated at 10.1.5

10.2.7 Revised and relocated at 10.1.6

10.2.8 Revised and relocated at 10.1.7

10.2.9 Revised and relocated at 10.1A.5

10.2.10 Revised and relocated at 10.1A.1

10.2.11 Revised and relocated at 10.1A.6

10.2.12 Revised and relocated at 10.1A.2

10.2.13 Revised and relocated at 10.1A.7

10.2.14 Revised and relocated at 10.1A.8

10.2.15 Revised and relocated at 10.1A.3

10.2.16 Revised and relocated at 10.1A.9

10.2.17 *Revised and relocated at 10.1A.10*

10.2.18 *Deleted July 20, 2012*

10.2.19 *Deleted July 20, 2012*

10.2.20 *Deleted July 20, 2012*

10.3 Cord connected water coolers

10.3 revised and relocated at 10A July 20, 2012

10.3.1 *Revised and relocated at 10A.1*

10.3.2 *Relocated at 10A.3*

10.3.3 *Revised and relocated at 10A.4*

Table 10.2 Attachment plugs

Table 10.2 relocated as Table 10A.1 July 20, 2012

10.3.4 *Revised and relocated at 10A.5*

10.3.5 *Relocated at 10A.6*

10.3.6 *Revised and relocated at 10A.7*

10.3.7 *Relocated at 10A.8*

10.3.8 *Revised and relocated at 10A.9*

10.3.9 *Deleted July 20, 2012*

10.3.10 *Relocated at 10A.11*