UL 399

ISBN 1-55989-432-6

Drinking Water Coolers

Underwriters Laboratories Inc. (UL)
333 Pfingsten Road
Northbrook, IL 60062-2096

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

Sixth Edition, Dated June 25, 1993

Revisions: This Standard contains revisions through and including December 1, 1998.

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

The revisions dated December 1, 1998 include a reprinted title page (page 1) for this Standard.

The revisions dated December 1, 1998 were issued to correct flammable material designations, replace obsolete standards references, add a flexible cord type for outdoor use and correct editorial errors. The references to the Standard for Thermal Protectors for Motors, UL 547 and Impedance – Protected Motors, UL 519, were changed to Overheating Protection for Motors, UL 2111. The flexible cord type "W" for outdoor use was added based on a 1996 NEC Code revision.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

The master for this Standard at UL's Northbrook Office is the official document insofar as it relates to a UL service and the compliance of a product with respect to the requirements for that product and service, or if there are questions regarding the accuracy of this Standard.

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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that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

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

This Standard consists of pages dated as shown in the following checklist:

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1	June 25, 1993 (Reprinted: December 1, 1998)
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2B	June 11, 1997
3	March 3, 1994
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10 – 12, 12A, 12B, 13	December 1, 1998
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JUNE 25, 1993
(Title Page Reprinted: December 1, 1998)

American National Standard

ANSI/UL 399-1992

1

UL 399

Standard for

Drinking-Water Coolers

First Edition – December, 1956
Second Edition – November, 1968
Third Edition – September, 1972
Fourth Edition – July, 1978
Fifth Edition – July, 1987

Sixth Edition

June 25, 1993

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated June 25, 1993. These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

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

Approved as ANSI C33.82-1972, July 19, 1972
Approved as ANSI/UL 399-1979, April 26, 1979
Approved as ANSI/UL 399-1986, September 19, 1986
Approved as ANSI/UL 399-1992, March 31, 1992

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

ISBN 1-55989-432-6

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FOREWORD

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

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

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

D. A product employing materials or having forms of construction which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of or reliance upon this Standard.

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

Paragraph D revised December 1, 1998

INTRODUCTION

1 Scope

1.1 These requirements cover self-contained drinking-water coolers which employ hermetic refrigerant motor-compressors and which are designed for connection to alternating-current circuits rated not greater than 600 volts in accordance with the National Electrical Code, NFPA 70. The requirements also apply to water coolers which supply both hot and cold water.

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.

1.3 revised December 1, 1998

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.1.2 A component need not comply with a specific requirement that:

a) Involves a feature or characteristic not needed in the application of the component in the product covered by this standard or

b) Is superseded by a requirement in this standard.

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

2.1.4 Specific components are recognized as being 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 for which they have been recognized.

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.

3.2 AGAINST-THE-WALL WATER COOLERS – Freestanding units intended to be placed in close proximity to a wall.

3.3 BUILT-IN WATER COOLERS – 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.

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

3.5 CIRCUITS, ELECTRICAL:

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

b) Low-Voltage – A circuit involving a potential of not more than 30 volts rms alternating current, 42.4 volts by peak or direct current, and supplied by:

1) A primary battery,

2) A standard Class 2 National Electrical Code, ANSI/NFPA 70-1993, transformer, or

3) A combination of a transformer and fixed impedance which, as a unit, complies with all performance requirements for a Class 2 transformer.

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

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

3.8 HOT- AND COLD-TYPE WATER COOLERS – These include means for heating and dispensing potable water.

3.9 REMOTE WATER COOLERS – Pressure-type coolers designed for use with remotely installed bubblers or other dispensing means.

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

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.

3.14 WALL-HUNG WATER COOLERS – 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 shall contain such directions and information as deemed by the manufacturer to be necessary for the safe installation, maintenance, and use of the water cooler. These instructions shall include roughing-in dimensions for electrical connections of permanently connected units and for plumbing connections of pressure-type units.

4.2 A copy of the manufacturer's installation and operating instructions, or equivalent information intended to accompany each water cooler, is to be furnished with the sample submitted for investigation. These instructions are to be used as a guide in the examination and test of the water cooler. For this purpose, a printed edition is not required initially if rough draft instructions or information as to what the instructions will include are submitted for review as part of the investigation.

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.

Exception: This requirement does not apply to parts such as washers, screws, bolts, and the like, where corrosion of such unprotected parts would not affect compliance with the requirements of this standard.

6 Assembly

6.1 General

6.1.1 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.

6.2 Mechanical protection

6.2.1 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 6.2.4 and 6.2.5. Knockouts for entrance of electrical conduit and plumbing may be provided. In determining compliance with the requirements specified in 6.2.2 – 6.2.5, parts such as covers, panels, or grilles used as part of the enclosure are to be removed unless tools are required for their removal.

6.2.2 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.

6.2.3 With reference to 6.2.2, moving parts are considered to be enclosed when the distance from an opening to the moving part is as specified in Table 6.1. 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 6.1
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 33.1.

6.2.4 When tested in accordance with the provisions of the Temperature and Pressure Test, Section 33, surfaces that exceed the temperature limit of Table 33.1(d)(3) and (d)(4) shall be guarded in accordance with 6.2.2 and 6.2.3. 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 33.1(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 33.1(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.

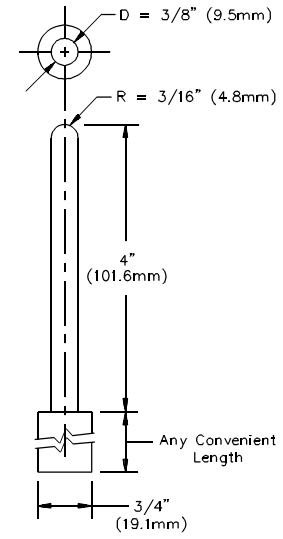
6.2.5 The sheath of a heater element, as installed in a water cooler, shall be protected against mechanical damage. A copper or steel sheath at least 0.016 inch (0.41 mm) thick is considered to provide such protection. In addition, if the temperature of a heater exceeds the limits permitted by Table 33.1 (d)(3) or (d)(4), whichever is appropriate, it shall be guarded in accordance with 6.2.2 and 6.2.3 to protect persons from coming in contact with it.

6.3 Electrical protection

6.3.1 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 7.2.1.

Figures 6.1
Probes

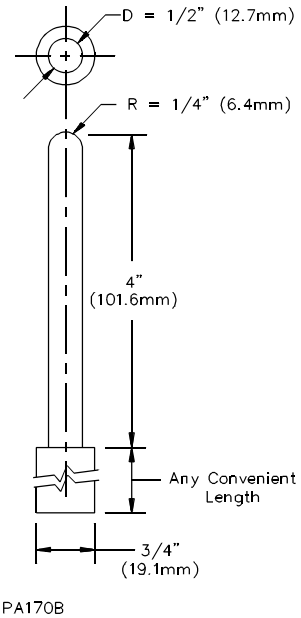
Figure 6.1 revised December 1, 1998



PA170A

Figure 6.2
Probe

Figure 6.2 revised December 1, 1998



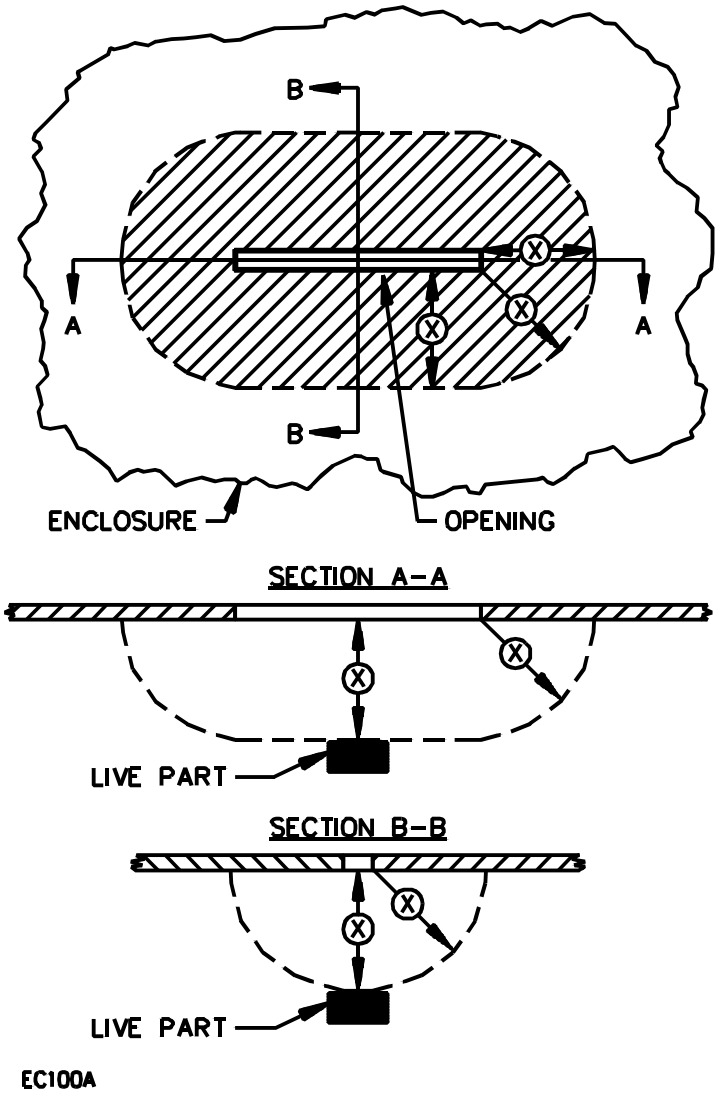
PA170B

6.3.2 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 6.1 shall not touch any uninsulated high-voltage live parts and the probe illustrated in Figure 6.2 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.

6.3.3 Where an opening in the enclosure permits the entrance of a 3/4 inch (19.1 mm) diameter rod, the conditions described in Figure 6.3 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 6.3
Opening in enclosure

Figure 6.3 revised December 1, 1998



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).

6.3.4 In addition to the requirements of 6.3.2 and 6.3.3, 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 57.11.

6.3.5 A fuseholder shall be constructed, installed, or protected so that adjacent uninsulated high-voltage live parts, other than the screw shell of a plug fuseholder, cartridge fuse clips, or wiring terminals to the fuseholder, will not be exposed to contact by persons removing or replacing fuses. A barrier of vulcanized fiber or similar material employed as a guard for high-voltage live parts shall be not less than 1/32 inch (0.8 mm) in thickness. A separation less than 4 inches (102 mm) is considered to be adjacent.

6.3.6 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.

6.3.7 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.

6.3.8 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.

6.3.9 The Overflow Test, Section 37, is to be conducted if it is not evident that the water cooler complies with the provisions of 6.3.7 and 6.3.8.

6.3.9.1 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 37A, is to be conducted if it is not evident that the water cooler complies with this requirement.

Added 6.3.9.1 effective March 24, 1998

6.3.10 A switch, attachment-plug receptacle, motor-attachment plug, or similar component shall be secured in position and, except as noted in 6.3.11, shall be prevented from turning. See 6.3.12.

6.3.11 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.

6.3.12 With reference to 6.3.10, 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.

6.3.13 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 20. 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 6.3.12 is acceptable.

6.3.14 Flammable or electrically conductive thermal or acoustical insulation shall not contact uninsulated high-voltage live parts. See 45.2.1.

7 Enclosures

7.1 General

7.1.1 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.

7.1.2 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.

7.1.2.1 A nonmetallic outer enclosure or part of an outer enclosure shall have a flame spread index (FSI) of not more than 200 when tested in accordance with the Standard for Tests for Surface Burning Characteristics of Building Materials, UL 723.

Exception No. 1: If the total unbroken surface area is 25 square feet (2.32 m^2) or less, a material having a FSI of not more than 200 when tested in accordance with the radiant panel method in the Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source, ASTM E162-1990 can be used.

Exception No. 2: If the total unbroken surface area is 10 square feet (0.93 m^2) or less, a material having a flammability rating of HB, V-0, V-1, V-2, or 5V in accordance with the Standard for Tests for Flammability of Plastics Materials for Parts in Devices and Appliances, UL 94, can be used.

7.1.2.1 revised December 1, 1998

7.1.2.2 For the purpose of the requirement in 7.1.2.1, the surface area is considered to be broken if there is an air gap at least 12 inches (305 mm) wide or a metallic material at least 12 inches wide between sections of nonmetallic material.

7.1.2.2 added September 24, 1996

7.1.2.3 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 9.

7.1.2.3 added September 24, 1996

7.1.3 The enclosure(s) of a water cooler shall prevent mechanical damage to wiring, electrical components, and refrigerant tubing.

7.1.4 The enclosure shall reduce the risk of molten metal, burning insulation or flaming particles, falling through bottom openings onto flammable material, including surfaces over which the water cooler is mounted.

7.1.4.1 Electrical components, such as controls, solenoids, starting relays, and switches, shall be individually enclosed, except for terminals, unless it can be determined that failure of a component will not result in a risk of fire. See Burnout Test – Components, Section 42.

7.1.4.1 added September 24, 1996

7.1.5 In accordance with 7.1.4, openings in the bottom of a water cooler are to be located or provided with barriers or baffles to reduce the risk of molten metal, burning insulation or flaming particles from falling out of the enclosure. Also see 9.3.2 and 15.14 – 15.16.

Exception No. 1: Small openings are exempt from this requirement if:

a) No such opening has an area greater than 0.049 square inch (31.6 mm^2),

b) Such openings are not located within 2 inches (50.8 mm) of each other, and

c) The total area of such openings does not exceed 1 percent of the bottom surface area.

Exception No. 2: Openings in finned tube refrigeration coils that form part or all of the bottom closure of the water cooler are exempt from this requirement if the density and configuration of the fins are such that the coil will not permit passage of a 3/32-inch (2.4-mm) diameter rod.

7.1.6 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.

7.1.7 The requirement of 7.1.6 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.

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

7.1.9 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).

7.1.10 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.

7.1.11 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.

7.1.12 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.

7.1.13 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.

7.1.14 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.

7.1.15 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 7.1 is in place, in conjunction with a single locknut installed on the outside of the enclosure.

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Table 7.1
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)

7.1.16 Steel enclosures shall be protected against corrosion by metallic or nonmetallic coatings such as plating or painting. See 7.3.1 – 7.3.6.

7.2 Doors and covers

7.2.1 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 or moving parts.

7.2.2 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 7.2.1.

7.2.3 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.

7.2.4 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.

7.2.5 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.

7.2.6 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.

7.2.7 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.

7.2.8 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.

7.2.9 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 7.2.8. When provided as the sole means for securing the cover or panel, a cover interlocking mechanism as described in 7.2.2 is considered to comply with 7.2.8.

7.2.10 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.

7.2.11 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.

Table 7.2
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	7.3.3	7.3.4
Inner enclosures which protect current carrying parts other than motors	7.3.3	7.3.4
Outer cabinets which are the sole enclosure of current carrying parts	7.3.4	7.3.4

7.3 Enclosures exposed to weather

7.3.1 Sheet steel cabinets and electrical enclosures exposed to the effects of weathering shall be protected against corrosion as specified in Table 7.2 or by other metallic or nonmetallic coatings which provide equivalent protection.

7.3.2 7.3.1 is not applicable to a metal part, such as a decorative grill, which is not required for conformance with this standard.

7.3.3 To comply with 7.3.1, 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 for Steel Sheet, Zinc-Coated by the Hot-Dip Process, ASTM A525-91, 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 may be determined by any suitable method, but in case of question, the weight of coating shall be established in accordance with the Test Method of the Standard for the Weight of Coating on Zinc-Coated Iron or Steel Articles, ASTM A90-81. An A60 (alloyed) coating shall also comply with 7.3.5.

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 52. An annealed coating shall also comply with 7.3.5.

c) Two coats of an organic finish of the epoxy or alkyd-resin type or other outdoor paint on both surfaces. The suitability of the paint may be determined by consideration of its composition or by corrosion tests.

7.3.4 To comply with 7.3.1, 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 A525-90 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 may be determined by any suitable method, but in case of question, the weight of coating shall be established in accordance with the Test Method of ASTM A90-81.

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 52. An annealed coating shall also comply with 7.3.5.

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 52.

d) A zinc coating conforming with 7.3.3 (a) or (b) with one coat of outdoor paint as specified in 7.3.3 (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 52, and the paint shall be as specified in 7.3.3 (c).

7.3.5 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.

7.3.6 With reference to 7.3.1, 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 7.3.3(a) or 7.3.4(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.

7.3.7 Nonferrous enclosures may be employed without special corrosion protection. See 7.1.2.

7.3.8 Where gaskets are required to seal electrical enclosures against the entrance of rain and condensate, they shall be held in place by mechanical fasteners or adhesives, except as indicated in 7.3.9, and shall comply with the requirements of 51.1 – 51.5. Sealing compounds required to seal electrical enclosures shall comply with the requirements of 51.6. Adhesives required to secure gaskets shall comply with the requirements of 51.7. Gaskets shall be neoprene, rubber, or thermoplastic. Other materials may be used if they have equivalent properties.

7.3.9 Gaskets which are prevented from displacement either by their location or placement of other components in the enclosure when the cover is removed and which would be reengaged in the intended manner when the cover is replaced are not required to beheld by mechanical fasteners or adhesives. Consideration shall be given in the intended mounting of the gasket in the application.

8 Field Supply Connections

8.1 General

8.1.1 A plug fuseholder in a water cooler intended to be connected to a 125- or a 125/250-volt, 3-wire circuit shall be wired in the unidentified (ungrounded) conductor with the screw shell connected toward the load.

8.1.2 A single-pole switching device shall not be connected to the identified (grounded) conductor.

Exception: An automatic control which does not have a marked OFF position is not required to comply with this requirement.

8.2 Permanently connected water coolers

8.2.1 Water coolers of the following types shall have provision for permanent connection to the power supply:

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.

8.2.2 With reference to 8.2.1(b), the largest sum of concurrent loads shown on the nameplate is used to determine the total marked rating.

8.2.3 As used in 8.2.4 – 8.2.20, 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.

8.2.4 A water cooler shall have provision for connection of one of the wiring systems that in accordance with the National Electrical Code, ANSI/NFPA 70-1993, would be acceptable for it.

8.2.5 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 8.1.

Table 8.1
Trade size of conduit (mm O.D.)

Wire size,		Number of wires, inches (mm OD)									
AWG	(mm^2)	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 of 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.

8.2.6 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.

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

8.2.8 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 58.11. It is assumed that branch circuit conductors rated 140EF (60EC) will be used.

8.2.9 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.

8.2.10 For No. 8 AWG (8.4 mm^2) conductors, pressure wire connectors shall be used. For No. 10 AWG (5.3 mm^2) 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.

8.2.11 A wire binding screw at a field-wiring terminal shall not be smaller than No. 8 (4.2 mm diameter), except that a No. 6 (3.5 mm diameter) screw may be used for the connection of one No. 14, 16, or 18 AWG (2.1, 1.3, or 0.82 mm^2) conductor.

8.2.12 It should be noted that according to the National Electrical Code, ANSI/NFPA 70-1993, No. 14 AWG (2.1 mm^2) is the smallest conductor which the installer may use for branch circuit wiring and thus is the smallest conductor that may be anticipated at a terminal for the connection of a power supply wire.

8.2.13 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 No. 14 AWG (2.1 mm^2) or smaller wire and not less than 0.050 inch (1.27 mm) in thickness for a wire larger than No. 14 AWG, and in either case there shall be not less than two full threads in the metal.

8.2.14 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 and Soldering Lugs for Use With Copper Conductors, UL 486A.

8.2.15 Upturned lugs or a cupped washer shall be capable of retaining a conductor of the size mentioned in 8.2.8 and 58.11, but no smaller than No. 14 AWG (2.1 mm^2), under the head of the screw or the washer.

8.2.16 A wire binding screw shall thread into metal.

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

8.2.18 The length of a lead inside an outlet box or wiring compartment shall be 6 inches (152 mm) or more if the lead is intended for field connection to an external circuit.

Exception: The lead may be less than 6 inches (152 mm) in length if it is evident that the use of a longer lead might result in damage to the lead insulation.

8.2.19 Leads intended for connection to an external circuit shall be provided with strain relief if stress on the lead may be transmitted to terminals, splices, or internal wiring. See 8.3.8.

8.2.20 Leads provided for spliced connections to an external high-voltage circuit shall not be connected to wire binding screws or pressure wire connectors located in the same compartment as the splice unless the screws or connectors are rendered unusable for field-wiring connections or the leads are insulated at the unconnected ends.

8.3 Cord connected water coolers

8.3.1 Equipment intended for cord connection to the supply shall be provided with:

a) A non-detachable power supply cord for connection to the supply by means of a plug, or

b) An appliance inlet for connection of a detachable power supply cord and either a detachable power supply cord or instructions for selection of a suitable detachable power supply cord.

8.3.1. revised September 24, 1996

8.3.2 The marked rating of a cord connected water cooler, see 59.1, is not to exceed 80 percent of the rating of the attachment plug.

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8.3.3 Cord-connected water coolers shall employ grounding-type attachment-plugs. Refer to Table 8.2 for configurations that comply with ANSI.

Exception: Equipment rated 250 Volts or less and intended for connection to circuits rated:

a) Other than 60 hertz;

b) Other than the voltages specified in the first column of Table 30.1; or

c) Both,

may employ a grounding-type attachment plug acceptable for the circuit involved.

8.3.3 revised September 24, 1996

8.3.4 A cord connected water cooler may employ Type S, SO, ST, STO, SJ, SJO, SJT, SJTO, SP-3, or SPT-3 power supply cord rated for use at a voltage not less than the rated voltage of the water cooler. The ampacity of the cord as given in the National Electrical Code, ANSI/NFPA 70-1993, shall be not less than that required by the ampere input measured in the Temperature and Pressure Test, Section 33.

Table 8.2
Grounding-type attachment plugs

Attachment-plug rating, amperes	Attachment-plug rating, volts	ANSI designation[a]
15	125	C73.11-1972
20	125	C73.12-1972
15	250	C73.20-1972
20	250	C73.51-1972

[a] As part of the standard for plugs and receptacles, C73-1973 series.

8.3.5 A power supply cord for an outdoor-use water cooler shall be Type SO, SJO, or equivalent cords which are resistive to the effects of sunlight and low temperatures. Such cords are identified by suffix letters "W" or "W-A" following their type designation.

8.3.5 revised December 1, 1998

8.3.6 The length of the power supply cord shall be not more than 10 feet nor less than the lengths indicated below.

a) Not less than 6 feet (1.83 m) for bottle-type water coolers.

b) Not less than 4 feet (1.22 m) for freestanding, pressure-type water coolers.

c) Not less than 1-1/2 feet (457 mm) for wall-hung, pressure-type water coolers.

The length is measured between the attachment plug and any point at which the cord exits the water cooler cabinet or the last strain relief, whichever is shorter.

Revised 8.3.6 effective March 24, 1998

8.3.7 The power supply cord shall be provided with strain relief means so that a stress on the cord will not be transmitted to terminals, splices, or internal wiring. If a metallic strain relief means is provided, it shall not contact uninsulated high-voltage live parts or reduce spacings within the enclosure if the cord is moved inward. The cord shall not be subject to damage by moving parts if it can be moved inward.

8.3.8 To determine the adequacy of the strain relief means required by 8.2.19 or 8.3.7, a 35 pounds-mass (15.9 kg) weight is to be suspended on the lead or cord, as applicable, and supported by the water cooler so that the strain relief means will be stressed from any angle which the design of the water cooler permits. The load is to be applied for 1 minute. The strain relief is not acceptable if there is such movement of the lead or cord as to indicate that stress would have resulted on the connections.

8.3.9 The edges of the entry hole for the power supply cord, including the cord entry hole in a bushing, shall be smooth and rounded without burrs, fins, or sharp edges which might damage the cord insulation. The power supply cord shall be routed to prevent damage to the cord insulation.

8.4 Grounding

8.4.1 A water cooler shall be provided with means for grounding:

a) In a permanently connected water cooler, an equipment grounding terminal or lead.

b) In a cord-connected water cooler, an equipment grounding conductor shall be in the cord.

8.4.2 On a permanently connected water cooler, a terminal solely for connection of an equipment grounding conductor shall be capable of securing a conductor of the size required for the particular application in accordance with the National Electrical Code, ANSI/NFPA 70-1993.

8.4.3 A soldering lug, a push-in, a screwless connector, or a quick connect or similar friction fit connector shall not be used for a grounding terminal intended for the connection of field supply connections or for the grounding wire in a supply cord.

8.4.4 On a permanently connected water cooler, a wire binding screw intended for the connection of an equipment grounding conductor shall have a green colored head that is hexagonal, slotted, or both. Except as indicated in 8.4.5, a pressure wire connector intended for connection of such a conductor shall be plainly identified such as by being marked G, GR, GROUND, or GROUNDING, or by a marking on a wiring diagram provided on the water cooler. The wire binding screw or pressure wire connector shall be secured to the frame or enclosure of the water cooler and shall be located so that it is unlikely to be removed during normal service operations such as replacing fuses, resetting manual-reset devices, or oiling motors.

8.4.5 If a pressure wire connector intended for grounding is located where it could be mistaken for the neutral conductor of a grounded supply, it shall be identified by a marking EQUIPMENT GROUND and/or with a green color identification.

8.4.6 On a permanently connected water cooler, the surface of an insulated lead intended solely for the connection of an equipment grounding conductor shall be finished in a continuous green color or a continuous green color with one or more yellow stripes, and no other lead shall be so identified.

8.4.7 On a cord connected water cooler, the grounding conductor of the flexible cord shall be finished with a continuous green color or with a continuous green color with one or more yellow stripes, and no other conductor shall be so identified. The grounding conductor shall be secured to the frame or enclosure of the water cooler by a positive means, see 11.5, that is not liable to be removed during any servicing operation not involving the power supply cord. The grounding conductor shall be connected to the grounding blade of the attachment plug.

9 Internal Wiring And Wiring Methods

9.1 General

9.1.1 A water cooler shall employ conductors of not less than No. 18 AWG (0.82 mm^2) size except for short integral leads of small electrical components, such as relay coils and clock motors.

9.1.2 Wiring which is color coded green or green with one or more yellow stripes shall be used only for grounding conductors. Wiring used for other purposes shall not be identified with the above color codes.

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9.1.3 Wire insulation shall be rated for the potential involved and for the temperature to which it may be subjected in use. The required temperature rating for wiring shall be based on the temperatures measured in the Temperature and Pressure Test, Section 33.

9.1.4 Wires or cords connected to fan motors and other auxiliary motors shall employ oil resistant insulation, such as Type SJO, SJT, SPT-3, or appliance wiring materials having oil resistant insulation.

9.1.5 Parallel conductor appliance wiring material of the integral type shall not be ripped more than 3 inches (76.2 mm) unless the minimum wall thickness of the conductor insulation after ripping is at least 0.058 inch (1.47 mm) in thickness. If the material has conductor insulation not less than 0.028 inch (0.71 mm) after ripping and is within a separate metal enclosure, conduit, electrical metallic tubing, or metal raceway, the length of rip is not limited.

9.1.6 If any failure of low-voltage wiring may cause malfunctioning of a pressure-limiting device, motor overload protective device, or other protective device, such wiring shall be:

a) Enclosed as indicated in 9.2.1,

b) Types SPT-2 or SP-2 cord, or

c) One of the types indicated in Group B or C of Table 9.1.

Wires of types specified in Group A of Table 9.1 or low-energy safety control wire may be used if such wiring is located in a cavity or compartment of the water cooler and is shielded from damage.

Table 9.1
Typical wiring materials

Group	Type of wire, cord, or cable	Wire size, No. AWG	Wire size, (mm^2)	Insulation thickness, inch	Insulation thickness, (mm)
A	AC, ACL, ACT, RF-2, FF-2, FFH-2, TF, TFF, TFN, TFFN, SF-2, SFF-2, RH, RHH, RHW, THW, XHHW, MTW, THW-MTW, THWN, PF, PGF, PFF, PGFF, TW, or thermoplastic appliance wiring material, with insulation thicknesses shown at the right corresponding to wire sizes indicated	10 and smaller	(5.3)	2/64	(0.8)
		8	(8.4)	3/64	(1.2)
B	SO, ST, SPT-3, SJO, SJT, or appliance wiring material[a] having thermoplastic or neoprene insulation with insulation thicknesses shown at right corresponding to the wire sizes indicated	18	(0.82)	4/64	(1.6)
		16	(1.3)	4/64	(1.6)
		14	(2.1)	5/64	(2.0)
		12	(3.3)	5/64	(2.0)
		10	(5.3)	5/64	(2.0)
		8	(8.4)	6/64	(2.4)
C	S, SJ, SP-3, or appliance wiring material[a] with rubber insulation	Same as group B			

[a] Appliance wiring material recognized for refrigeration use.

9.1.7 All wires and cords used in a water cooler shall be routed and supported to prevent damage due to:

a) Sharp edges,

b) Surfaces and parts which operate at temperatures in excess of that for which the wire insulation is rated,

c) Moving parts, and

d) Parts which can be expected to vibrate such as motors, motor-compressors, refrigerant lines, and the like.

Clamping means are to have smooth, rounded surfaces.

Exception: Wires and cords may contact a vibrating part provided:

a) The wiring is securely fastened to the part at the point of contact so as to restrict movement,

b) The part does not have burrs, fins, or sharp edges which might abrade the insulation, and

c) Vibration does not place a strain on the wiring or wiring connections.

9.1.8 A wiring enclosure shall provide a smooth wireway with no sharp edges or projecting screws which might damage the insulation.

9.1.9 To prevent abrasion of insulation, holes for passage of wires or cords through walls, panels, or barriers shall have smooth, rounded surfaces or shall be provided with smoothly rounded bushings. Bushings shall be fabricated from materials such as ceramic, phenolic, cold-molded composition, or fiber.

9.1.10 All wires and cords shall be routed and supported so that they will not be immersed in water unless the insulation is specifically intended for this purpose. The wiring arrangement shall prevent water caused by condensation or rain exposure (if intended for outdoor use) from entering wiring enclosures and electrical enclosures.

Exception: Water may enter an enclosure providing:

a) The point of entrance is not in proximity to live electrical parts and

b) The live parts are not wetted.

9.1.11 All splices and connections shall be mechanically secured and electrically bonded. A soldered connection shall be made mechanically secure before being soldered.

9.1.12 Splices shall be located within the water cooler enclosure. They shall be secured in position or located in a separate enclosure so that they are not subject to flexing, motion or vibration due to air movement, or the like. Strain relief shall be provided on the conductors if the wiring is liable to be moved during normal service operation, such as replacing fuses, resetting manual-reset devices, or oiling motors.

9.1.13 A splice shall be provided with electrical insulation equivalent to that of the conductors if permanence of spacing between the splice and other metal parts is not assured. Thermoplastic tape wrapped over a sharp edge is not acceptable.

9.1.14 Splicing devices, such as wire connectors, may be employed if they provide mechanical security and employ electrical insulation rated for the voltage to which they are subjected.

9.1.15 Quick connecting assemblies are to form a secure electrical connection, such as by detents in the mating parts, and are to be capable of carrying the current involved.

9.1.16 Wire binding screws shall thread into metal. At terminals, stranded conductors shall be secured by soldered or pressure-type terminal connectors, or the conductors shall be soldered or otherwise assembled to prevent loose strands after assembly. Soldered connections shall be made mechanically secure before being soldered. Open-slot type connectors shall not be used unless they are constructed to prevent disconnection resulting from loosening of the clamping means. The shanks of terminal connectors shall be protected by electrical insulation if the spacings may be reduced below the minimum acceptable values by slight loosening of the clamping means. The insulating material shall be secured in position. The thickness of the insulation on the shanks shall be not less than 0.028 inch (0.71 mm) except as permitted by 20.7.

9.2 Permanently connected water coolers

9.2.1 Wiring shall be of the type indicated in Table 9.1, Group A, and enclosed such as by means of conduit, electrical metallic tubing, metal raceways, or control boxes. Fittings shall be constructed for use with the type of wiring enclosure employed in the application. See also 9.2.2.

9.2.2 Cords or appliance wiring material of a type indicated in Group A or B of Table 9.1 may be employed provided the wiring is enclosed by the cabinet to reduce the risk of (1) damage of wiring, (2) ignition of flammable material, or (3) emission of flame or molten metal through openings in the cabinet.

9.2.2 revised September 24, 1996

9.2.3 With reference to 9.2.2, the wiring is considered to be enclosed when the cabinet or compartment enclosing the wiring conforms to the following:

a) There are no openings in the top of the compartment unless barriers or baffles are placed between the wiring and the openings.

b) There are no openings in the bottom unless a U-shaped channel or trough is located under the wiring, and the wires do not project through the plane of the top of the trough or channel.

c) Louvers or openings, other than those permitted by (b), will not permit entrance of a rod having a diameter of 1/2 inch (12.7 mm).

d) Openings are not closer than 6 inches (152 mm) to the wiring unless barriers or baffles are placed between the wiring and the openings. A nonmetallic material employed as a barrier or baffle shall be investigated for use as an enclosure. See 7.1.2.

e) Where flammable material, other than electrical insulation, is located within the compartment, the wiring is separated from such material or the material has characteristics as described in 9.2.4.

Exception: Wiring need not be isolated as indicated above if it complies with the VW-1 flame test or the vertical flame test described in the reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581.

Paragraph 9.2.3 revised August 2, 1993

9.2.4 With reference to 9.2.3 (e), plastic materials shall be classified as Type V-0, V-1, V-2, 5V, HF-1, or HF-2 in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94. Other nonmetallic materials shall have equivalent characteristics.

9.2.4 revised December 1, 1998

9.2.5 With reference to 9.2.1 and 9.2.2, if the compartment enclosing the wiring has no openings other than for conduit or piping and contains no flammable material other than electrical insulation, the cord or appliance wiring material referenced in Table 9.1, Group C, may be employed.

9.2.6 Conductors of motor circuits having two or more thermal- or overcurrent-protected motors wired for connection to one supply line shall withstand the Limited Short-Circuit Test, Section 46.

Exception: A conductor that complies with one or more of the following is acceptable without test:

a) A conductor that has an ampacity of not less than one-third the ampacity of the branch circuit conductors as determined in 8.2.8, or

b) A conductor that is No. 18 AWG (0.82 mm^2) or larger and not more than 4 feet (1.2 m) in length, provided that the circuit is protected by a fuse or an "HACR Type" circuit breaker rated not more than 60 amperes, or

c) A conductor that serves as a jumper lead between controls, provided that either the length of each lead does not exceed 3 inches (76.2 mm) or the conductor is located in an electrical control enclosure.

9.3 Cord-connected water coolers

9.3.1 A cord-connected water cooler shall be wired by either of the following means or combinations of the two:

a) Cords or appliance wiring material as referenced in Table 9.1, Group B or C.

b) Wiring material as referenced in Table 9.1, Group A, enclosed in conduit, electrical metallic tubing, metal raceways, or control boxes.

Exception: Wiring material in Group A of Table 9.1 need not be enclosed as indicated above, if it is cabled, routed, located or secured to reduce the likelihood of damage to the wiring during routine servicing such as replacing fuses, adjusting the settings of controls, or the like.

9.3.1 revised September 24, 1996

9.3.2 With reference to 9.3.1(a), the wiring (not including the power supply cord) shall be arranged so that burning insulation or molten material will not fall onto flammable material within the enclosure unless the material has characteristics as described in 9.2.4. if wiring is routed over openings in the bottom of the enclosure, barriers or baffles shall be provided in accordance with 7.1.5. There shall be no openings in the top of the enclosure unless the risk of damage to wiring is reduced by means such as barriers, baffles, or the like. Such protective means is acceptable if the wiring cannot be contacted by a 1/2 inch (12.7 mm) diameter, 10 inch (254 mm) long rod inserted through the top openings.

Exception: Wiring need not be isolated or enclosed as indicated in 9.3.1(a) and (b) if it complies with the VW-1 flame test or the vertical flame test described in the reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581.

9.3.1 revised September 24, 1996

10 Separation of Circuits

10.1 Unless provided with insulation rated for the highest voltage involved, insulated conductors of different circuits, for example, internal wiring including wires in a wiring compartment, shall be separated by barriers or shall be segregated, and shall, in any case, be separated or segregated from uninsulated live parts connected to different circuits. Segregation of insulated conductors may be accomplished by clamping, routing, or other means that provides permanent separation from insulated or uninsulated live parts of a different circuit.

10.2 Field-installed conductors of any circuit shall be segregated or separated by barriers from field-installed and factory-installed conductors connected to any other circuit unless the conductors of both circuits are, or will be, insulated for the maximum voltage of either circuit.

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10.3 Field-installed conductors of a high-voltage circuit or a low-voltage circuit with Class 1 National Electrical Code, ANSI/NFPA 70-1993, wiring shall be segregated or separated by barriers as follows:

a) From uninsulated live parts connected to a different circuit, other than wiring terminals, and

b) From any uninsulated live parts of electrical components, such as a pressure-limiting device, motor overload protective device, or other protective device, where short-circuiting or grounding may result in a risk of fire, electric shock, or injury to persons.

Exception: Segregation or separation by barriers is not required at terminals.

10.4 Field-installed conductors of a low-voltage circuit with Class 2 National Electrical Code, ANSI/NFPA 70-1993, wiring shall be segregated or separated by barriers as follows:

a) From uninsulated live parts connected to a high-voltage circuit, and

b) From wiring terminals and any other uninsulated live parts of low-voltage electrical components, such as a pressure-limiting device, motor overload protective device, or other protective device, where short-circuiting or grounding may result in a risk of fire, electric shock, or injury to persons.

10.5 If a barrier is used to provide separation between the wiring of different circuits, it shall be of metal or of a rigid insulating material secured in place.

11 Bonding for Grounding

11.1 A water cooler shall have provision for the grounding of all exposed or accessible noncurrent carrying metal parts which are likely to become energized and which may be contacted by the user or by service personnel during service operations which are likely to be performed when the water cooler is energized.

11.2 Uninsulated metal parts, such as cabinets, electrical enclosures, motor frames and mounting brackets, controller mounting brackets, heater element sheaths, capacitors and other electrical components, interconnecting tubing and piping, valves and plumbing accessories, and refrigerant-containing parts shall be bonded for grounding if they may be contacted by the user or serviceman.

Exception: Metal parts described as follows need not be grounded:

a) Adhesive-attached, metal-foil markings, screws, handles, and the like, that are located on the outside of enclosures or cabinets and isolated from electrical components or wiring by grounded metal parts to reduce the risk that they will become energized.

b) Isolated metal parts, such as motor controller magnet frames and armatures or small assembly screws, that are separated from wiring and uninsulated live parts.

c) Cabinets, panels, and covers that do not enclose uninsulated live parts if wiring is separated from the cabinet, panel, or cover to reduce the risk that it will become energized.

d) Panels and covers which are insulated from electrical components and wiring by an insulating barrier of vulcanized fiber, varnished cloth, phenolic composition, or similar materials not less than 1/32 inch (0.8 mm) in thickness, 0.028 inch (0.71 mm) minimum, and secured in place. If material having a lesser thickness is used, consideration is to be given to such factors as its electrical, mechanical, and flammability properties when compared with materials in thicknesses specified above.

11.3 Metal-to-metal hinge bearing members for a door or cover are considered to be acceptable means for bonding a door or cover for grounding if a multiple-bearing pin-type hinge(s) is employed.

11.4 A separate component bonding conductor shall be of copper, a copper alloy, or other material suitable for use as an electrical conductor. Ferrous metal parts in the grounding path shall be protected against corrosion by metallic or nonmetallic coatings such as enameling, galvanizing, or plating. A separate bonding conductor or strap shall:

a) Be protected from mechanical damage or be located within the confines of the outer enclosure or frame, and

b) Not be secured by a removable fastener used for any purpose other than bonding for grounding unless the bonding conductor is unlikely to be omitted after removal and replacement of the fastener.

11.5 The bonding shall be by a positive means such as clamping, riveting, bolted or screwed connection, welding, or soldering and brazing materials having a softening or melting point greater than 455EC (850EF). The bonding connection shall penetrate nonconductive coatings such as paint or vitrous enamel. Bonding around a resilient mount shall not depend on the clamping action of rubber or other nonmetallic material except as indicated in 11.8.

11.6 With reference to 11.5, a bolted or screwed connection that incorporates a star washer under the screwhead or a serrated screwhead is acceptable for penetrating nonconductive coatings. If the bonding means depends upon screw threads, two or more screws or two full threads of a single screw shall engage the metal.

11.7 An internal connection for bonding internal parts to the enclosure for grounding may employ a quick connect terminal of the specified dimensions provided the connector is not liable to be displaced and provided the component is limited to use on a circuit having a branch circuit protective device rated as specified in Table 11.1.

Table 11.1
Bonding wire conductor size

Rating of overcurrent device, amperes	Size of bonding conductor[a]			
	Copper wire,		Aluminum wire,	
	AWG	(mm^2)	AWG	(mm^2)
15	14	(2.1)	12	(3.3)
20	12	(3.3)	10	(5.3)
30	10	(5.3)	8	(8.4)
40	10	(5.3)	8	(8.4)
60	10	(5.3)	8	(8.4)
100	8	(8.4)	6	(13.3)

[a] Or equivalent cross-sectional area.

11.8 A connection that depends upon the clamping action exerted by rubber or other nonmetallic material may be acceptable if it complies with the provisions of the Current Overload Test, Section 44, and the Limited Short-Circuit Test, Section 46, under any normal degree of compression permitted by a variable clamping device and also following exposure to the effects of oil, grease, moisture, and thermal degradation which may occur in service. Also, the effect of assembling and disassembling, for maintenance purposes, such a clamping device is to be considered with particular emphasis on the likelihood of the clamping device being reassembled in its intended fashion.

11.9 On a cord connected water cooler, a bonding conductor or strap shall have a cross-sectional area not less than that of the grounding conductor of the supply cord except as permitted by 11.12 and 11.13.

11.10 On a permanently connected water cooler, the size of a conductor employed to bond an electrical enclosure or motor frame shall be based on the rating of the branch circuit overcurrent device to which the equipment will be connected. Except as indicated in 11.12 and 11.13, the size of the conductor or strap shall be in accordance with Table 11.2.

Table 11.2
Internal terminal connections for bonding

Terminal dimensions,		Rating of protective device,
inches	(mm)	amperes
0.020 by 0.187 by 0.250	(0.51 by 4.75 by 6.4)	20 or less
0.032 by 0.187 by 0.250	(0.81 by 4.75 by 6.40)	20 or less
0.032 by 0.205 by 0.250	(0.81 by 5.2 by 6.4)	20 or less
0.032 by 0.250 by 0.312	(0.81 by 6.4 by 7.9)	60 or less

11.11 A conductor, such as a clamp or strap, used in place of a separate wire conductor as indicated in 11.10, is considered acceptable provided the minimum cross-sectional conducting area is equivalent to the wire sizes indicated in Table 11.2.

11.12 A smaller conductor may be used if the bonding conductor and connection comply with the provisions of the Current Overload Test, Section 44, and the Limited Short-Circuit Test, Section 46.

11.13 A bonding conductor to a motor or other electrical component need not be larger than the size of the motor-circuit conductors or the size of the conductors supplying the component.

11.14 Splices shall not be employed in wire conductors used to bond electrical enclosures, motor frames, or other electrical components.

11.15 If more than one size branch circuit overcurrent device is involved, the size of the bonding conductor is to be based on the rating of the overcurrent device intended to provide ground-fault protection for the component bonded by the conductor. For example, if a motor is individually protected by a branch circuit overcurrent device smaller than other overcurrent devices used with the equipment, a bonding conductor for that motor is sized on the basis of the overcurrent device intended for ground-fault protection of the motor.

ELECTRICAL COMPONENTS

12 Current-Carrying Parts

12.1 All current-carrying parts of a water cooler shall be of silver, copper, a copper alloy, or other corrosion resistant material.

Exception: Multimetallic thermal elements and heater elements of a thermal protector need not comply with this requirement.

12.2 Aluminum may be used as a current-carrying part if investigated and found to be treated to resist oxidation and corrosion.

12.3 Iron or carbon steel, if provided with a corrosion resistant coating, or stainless steel may be used for a current-carrying part:

a) If permitted in accordance with 2.1.1 or

b) Within a motor,

but the use of iron or carbon steel for current-carrying parts elsewhere in the water cooler is not acceptable.

13 Insulating Material

13.1 Material for the mounting of uninsulated live parts shall be porcelain, phenolic composition, or other material with consideration given to its electrical and mechanical properties.

13.2 Vulcanized fiber may be used for insulating bushings, washers, separators, and barriers, but not as the sole support for uninsulated live parts where shrinkage or warpage may reduce electrical spacings. Plastic materials may be used for the sole support of uninsulated live parts if found to have adequate mechanical strength and rigidity, resistance to heat, resistance to flame propagation, dielectric voltage- withstand, and other factors involved under conditions of intended service. All of these factors are considered with respect to thermal aging.

14 Switches And Controllers

14.1 Except as indicated in 14.3 and 14.4, a motor controller(s) shall be provided for all water coolers incorporating:

a) Two or more motors or

b) A motor(s) and other load(s) intended for connection to the same power supply.

14.2 A motor "controller" is defined as any device normally used to start and stop a motor, such as a switch, thermostat, pressure limiting control, or the like.

14.3 The attachment plug and receptacle may serve as the controller on a cord connected water cooler if the marked ampere rating does not exceed the values shown in Table 14.1 for the voltage indicated.

Table 14.1
Ampere rating

Amperes	Voltage
7.2	115
4.0	208
3.6	230

14.4 A motor controller is not required for any supply circuit of a permanently connected water cooler which supplies:

a) Two or more motors or

b) A motor(s) and other load(s)

if, in either case, the marked maximum size of the supply circuit overcurrent protection device for that circuit does not exceed 20 amperes at 125 volts or less or 15 amperes at 600 volts or less, and if the rating of any motor in the circuit does not exceed 1 horsepower (746 W) and 6 full load amperes.

14.5 A cord-connected water cooler shall be provided with a motor controller which will shut off the complete water cooler or any motor load exceeding the values shown in 14.3.

14.6 If a switch or other control device has a marked OFF position and is accessible without requiring the use of tools, it shall de-energize all loads in the water cooler when placed in the OFF position. If such a device does not de-energize all loads, a marking shall be used to indicate which load is controlled, such as compressor, heater, fan motor, or the like.

Exception: The off position of the switching devices or the main disconnect switch on cord connected equipment may be identified by the "OFF" symbol illustrated in Figure 14.1.

14.6 revised September 24, 1996

14.7 On a cord connected water cooler, a manually operated switch with a marked off position that controls a hermetic refrigerant motor-compressor with or without other loads shall have a current rating that is at least 115 percent of the sum of:

a) The motor-compressor's rated load current and

b) The rated current for other controlled loads.

See 15.5.

14.8 If a branch-circuit selection current is marked on a permanently connected water cooler, a controller for a hermetic refrigerant motor-compressor shall have a full-load current rating not less than this marked value plus any additional loads controlled.

14.9 On a permanently connected water cooler, a manually operated switch with a marked off position that controls a hermetic refrigerant motor-compressor with or without other loads shall have a current rating that is at least 115 percent of the sum of:

a) The motor-compressor's rated load current or branch-circuit selection current, whichever is greater, and

b) The rated current for other controlled loads, as shown on the water cooler nameplate. See 15.5.

14.10 A switch or other control device shall be rated for the load which it controls as determined by the Temperature and Pressure Test, Section 33.

14.11 A switch provided for the control of an inductive load, such as a transformer, shall have a current rating of not less than twice the total marked current ratings of the transformer, or other equipment which it controls.

14.12 A switching device which may be called upon to break a motor load under locked-rotor conditions shall have a current interrupting capacity not less than the locked-rotor current of the motor.

14.13 If a switching device controls a compressor motor and fan motor and/or other load, it shall have a current interrupting capacity not less than the locked-rotor load of the compressor motor plus the full load of the fan motor and/or other load.

14.14 A switching device that interrupts the main power supply circuit to a heater of a permanently connected water cooler shall be such that, when open, the device will disconnect all ungrounded conductors of the power supply circuit if the switching device itself or the pilot device that controls the switching device has a marked ON or OFF position.

Exception: Both the on and off positions of the switching devices or the main disconnect switch may be identified by the symbols illustrated in Figure 14.1.

14.14 revised September 24, 1996

Figure 14.1
On and off symbols

Figure 14.1 revised December 1, 1998

S3486

IEC Publication 417, Symbols 5007 and 5008

14.15 Coil windings of switching devices shall be impregnated, dipped, varnished, or otherwise treated to resist absorption of moisture.

14.16 Switching devices shall be housed within an enclosure which will protect coils and contacts against mechanical damage, dirt, and moisture. The enclosure of the switching device may be provided by its method of mounting within the water cooler enclosure, by inherent construction of the component, or by means of a separate enclosure.

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15 Motors and Motor Overload Protection

15.1 Except as indicated in 15.9, all motors shall be protected by thermal or overcurrent protective devices.

15.2 For a motor other than a hermetic refrigerant motor compressor, the requirement in 15.1 is considered to be complied with if the protection is provided by a separate overcurrent device that is responsive to motor current, and is rated or set to trip at no more than the percentage of the motor nameplate full-load current rating as specified in Table 15.1. See 15.3.

Table 15.1
Overload relay size

	Maximum percentage protection	
	A	B
Motor with a marked service factor no less than 1.15	125	140
Motor with a marked temperature rise no more than 40EC	125	140
Any other motor	115	130

15.3 For an overload relay, if the percentage protection indicated in column A of Table 15.1 does not correspond to the percentage value resulting from selection of a standard size relay, the next higher size of the device may be used, but not higher than will provide the percentage protection indicated in column B of that paragraph.

15.4 For a hermetic motor-compressor, the requirement in 15.1 is considered to be complied with if the protection conforms with (a), (b), (c), or (d) below.

a) A separate overload relay that is responsive to motor-compressor current and will trip at no more than 140 percent of the rated-load current of the motor-compressor marked on the water cooler nameplate.

b) A thermal protector integral with the motor-compressor that:

1) Complies with the Standard for Hermetic Refrigerant Motor-Compressors, UL 984, and

2) Will not permit a continuous current in excess of 156 percent of the rated-load current of the motor-compressor (or 156 percent of the branch-circuit-selection current if the latter value is marked), except that this limitation does not apply to units as described in 15.6.

The values of rated-load current and branch-circuit-selection current referred to are the values marked on the water cooler nameplate. See 47.1.

c) A fuse or circuit breaker responsive to motor current, and rated at no more than 125 percent of the rated-load current of the motor-compressor marked on the water cooler nameplate. The water cooler shall be capable of starting and operating normally with the fuse or circuit breaker provided.

d) A protective system that:

1) Complies with the Standard for Hermetic Refrigerant Motor-Compressors, UL 984, and

2) Will not permit a continuous current in excess of 156 percent of the rated load current of the motor-compressor (or 156 percent of the branch-circuit-selection current if the latter value is marked) except that this limitation does not apply to units as described in 15.6.

The values of rated-load current and branch-circuit-selection current referred to are the values marked on the water cooler nameplate. See 47.1.

15.5 For a cord-connected water cooler or a permanently connected water cooler marked with a single-ampere rating, the rated-load current of the motor-compressor is the current drawn by the motor-compressor during the Temperature and Pressure Test, Section 33.

15.6 Hermetic motor-compressors with thermal protective devices employed in equipment intended for connection to a 15- or 20-ampere, 120-volt or a 15-ampere, 208- or 240-volt, single-phase branch circuit are not required to meet the 156 percent limitation specified in 15.4(b)(2) or (d)(2).

15.7 All components of the "protective system" mentioned in 15.4(d) shall be provided as part of the water cooler.

15.8 Thermal protective devices used with nonhermetic motors are to comply with the Standard for Overheating Protection for Motors, UL 2111.

Exception: Motors, such as direct-drive fan motors, which are not subjected to overloads and which are determined to be protected against overheating due to locked-rotor current by a thermal or overcurrent protective device may be accepted under this requirement provided it is determined that the motor will not overheat under actual conditions of use.

15.8 revised December 1, 1998

15.9 Direct-drive motors employing impedance protection and which comply with the locked-rotor requirements for motor operated appliances as specified in the Standard for Overheating Protection for Motors, UL 2111, may be used provided it is determined that the motor will not overheat under actual conditions of use.

15.9 revised December 1, 1998

15.10 Three-phase motors shall be provided with overcurrent protection as follows:

a) Three properly rated overcurrent units, see 15.2 and 15.4, shall be employed, or

b) Thermal protectors, combinations of thermal protectors and overcurrent units, or other methods of protection may be employed where the specific protective arrangement has been investigated and found to provide protection under primary single-phase failure conditions when supplied from transformers connected wye-delta or delta-wye. Assemblies so investigated shall be marked as described in 58.16.

15.11 Fuses shall not be used as motor overload protective devices unless the motor is protected by the largest size fuse which can be inserted in the fuseholder.

15.12 Overcurrent protective devices and thermal protective devices for motors shall comply with applicable short-circuit requirements for the class of protective device and shall, in addition, comply with the requirements of the Limited Short-Circuit Test, Section 46.

15.13 Nonhermetic motors are to comply with the Standard for Electric Motors, UL 1004. Hermetic motor-compressors are to comply with the Standard for Hermetic Refrigerant Motor-Compressors, UL 984.

15.14 Motors having openings in the enclosure or frame shall be arranged to prevent particles from falling out of the motor onto flammable material within or under the assembly. For built-in water coolers, also see 7.1.6 and 7.1.7.

15.15 The requirement in 15.14 will necessitate the use of a barrier of nonflammable material under an open-type motor unless:

a) The structural parts of the motor or of the water cooler, such as the bottom closure, provide the equivalent of such a barrier,

b) The motor protective overload device provided with a motor is such that no burning insulation or molten material falls to the surface that supports the water cooler when the motor is energized under each of the following fault conditions applicable to the motor type:

1) Open main winding,

2) Open starting winding,

3) Starting switch short-circuited,

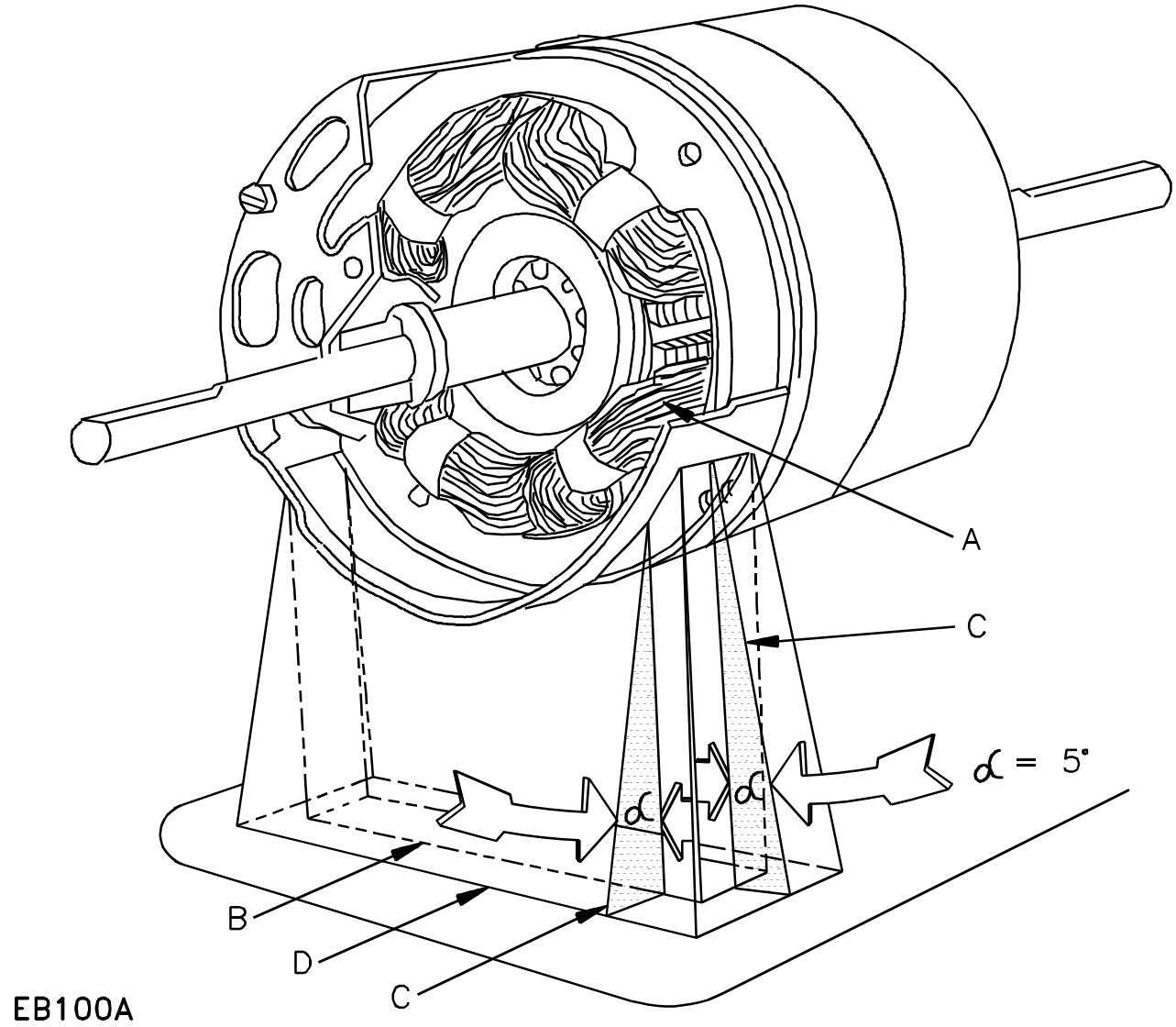
4) Capacitor shorted, permanent split capacitor type, or

c) The motor is provided with a thermal motor protector (a protective device that is sensitive to temperature and current) that will prevent the temperature of the motor windings from becoming more than 275EF (125EC) under the maximum load under which the motor will run without causing the protector to cycle and from becoming more than 302EF (150EC) with the rotor of the motor locked.

15.16 The barrier mentioned in 15.15 shall be horizontal, shall be located as indicated in Figure 15.1, and shall have an area not less than that described in that illustration. Openings for drainage, ventilation, and the like, may be employed in the barrier provided that such openings would not permit molten metal, burning insulation, or the like, to fall on flammable material.

Figure 15.1
Location and extent of barrier

Figure 15.1 revised December 1, 1998



A – Motor winding to be shielded by barrier. This is to consist of the entire motor winding if it is not otherwise shielded, and is to consist of the unshielded portion of a motor winding which is partially shielded by the motor enclosure or equivalent.

B – Projection of outline of motor winding on horizontal plane.

C – Inclined line which traces out minimum area of the barrier. When moving, the line shall be always tangent to the motor winding, five degrees from the vertical, and so oriented that the area traced out on a horizontal plane is maximum.

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

16 Electric Water Heaters

16.1 Heater elements

16.1.1 A heater in a hot- and cold-type water cooler shall be an encased assembly constructed of materials which will not be damaged by the temperature to which they will be subjected in the water cooler.

16.1.2 Metal tubing forming a heater element enclosure shall be constructed of corrosion resistant material or shall be plated, dipped, or coated to resist external corrosion and shall be acceptable for the temperatures to which it is subjected. See 16.1.3.

16.1.3 Uncoated copper tubing may be employed for temperatures of 392EF (200EC) and lower; metallic coated copper tubing is acceptable for temperatures below the melting temperature of the coating. Uncoated or oxide-coated steel tubing is not considered acceptable as a heater sheath. Plated steel tubing may be employed if the coating is determined to be corrosion resistant and will withstand the temperatures

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to which it may be subjected. Aluminum tubing may be employed if the alloy withstands a burnout test without melting or other failure. Stainless steel tubing of the austenitic grades such as ASTM Type 304 is generally acceptable for heater sheaths.

16.1.4 Insulating materials, such as washers and bushings, which are integral parts of a heating element shall be of a moisture resistant material which will not be damaged by the temperatures to which they will be subjected in the water cooler.

16.1.5 Insulating material employed in a heating element shall be acceptable as the sole support of live parts. Materials such as magnesium oxide may be used in conjunction with other insulating materials if located and protected so that mechanical damage is prevented and if not subjected to the absorption of moisture. When it is necessary to investigate a material, consideration is to be given to such factors as mechanical strength, dielectric voltage withstand, insulation resistance, see 45.1.1 – 45.1.5, heat resistant qualities, and the degree to which it is enclosed or protected. All of these factors are considered with respect to thermal aging.

16.1.6 To comply with the requirements of 16.1.1, a heater case or a terminal seal of rubber, neoprene, or thermoplastic materials shall have acceptable aging properties for temperatures measured during heating tests. See Accelerated Aging Test – Electric Heaters, Section 49.

16.1.7 An electric heater assembly shall be sealed to prevent entrance of moisture. See Insulation Resistance Test, Section 45. Molded seal caps, vulcanized to the heater leads and heater sheath, shall have a wall thickness equivalent to that required for the heater leads.

16.1.7 revised September 24, 1996

16.2 Water temperature regulating controls

16.2.1 *Deleted September 24, 1996*

16.3 Water heater protective device

16.3.1 If failure could result in a risk of fire or electric shock, an electric heater in a hot- and cold-type water cooler shall be provided with a temperature limiting control or a replaceable thermal cutoff. See Water Heating Controls Tests, Section 41, and Burnout Test, Section 42.

16.3.2 Thermal cutoffs are to comply with the requirements for thermal cutoffs for use in electrical appliances and components, UL 1020.

16.3.3 A thermal cutoff shall be secured in place and located so that it will be accessible for replacement without damaging other connections or internal wiring.

16.3.4 Wiring connected to a thermal cutoff shall be secured so that replacement of the thermal cutoff will not result in displacement or disturbance of internal wiring other than leads to the cutoff itself or to a heating element assembly on which the cutoff is mounted.

17 Valves and Solenoids

17.1 An electrically operated valve or solenoid shall comply with the requirements of the Burnout Test, Section 42.

17.2 If a valve must be cleaned periodically, the arrangement shall permit this operation to be performed without damage to the electrical parts of the valve or wiring.

17.3 Coil windings of electrically operated valves or solenoids shall be impregnated, dipped, varnished, or otherwise treated to resist absorption of moisture.

18 Capacitors

18.1 A motor starting or running capacitor shall be housed within an enclosure or container which will protect the plates against mechanical damage and which will prevent the emission of flame or molten material resulting from failure of the capacitor. The container shall be of metal providing the strength and protection not less than that of uncoated steel having a thickness of 0.020 inch (0.51 mm).

Exception: The individual container of a capacitor may be of sheet metal having a lesser thickness or may be of material other than metal if the capacitor is mounted within the enclosure of the water cooler or within an enclosure which houses other parts of the water cooler.

18.2 If exposed to the effects of weathering, ferrous metal capacitor enclosures shall be protected against corrosion in accordance with 7.3.1. See 7.1.16.

18.3 If the container of an electrolytic capacitor is metal, the container shall be considered to be a live part and shall be provided with moisture-resistant electrical insulation to isolate it from dead metal parts and to prevent contact during servicing operations. The insulating material shall be not less than 1/32 inch (0.8 mm) thick except as indicated in 20.7.

18.4 A capacitor employing a liquid dielectric medium more combustible than askarel shall be protected against expulsion of the dielectric medium when tested in accordance with the applicable performance requirements of this standard, including faulted overcurrent conditions based on the circuit in which it is used. See Limited Short-Circuit Test, Section 46.

Exception: If the available fault current is limited by other components in the circuit, such as a motor start winding, the capacitor may be tested using a fault current less than the test current specified in Table 46.1 but not less than the current established by dividing the circuit voltage by the impedance of the other component(s).

19 Transformers

19.1 A power transformer shall have a secondary rating not less than the connected load, except the load may be greater than the marked rating if the transformer does not exceed the maximum allowable temperature during the Temperature and Pressure Test, Section 33.

19.2 A power transformer which supplies a motor load shall not result in a risk of fire if the motor locks or fails to start. A power transformer will be considered to comply with this requirement if the primary circuit is protected by an overcurrent device rated or set at not more than 250 percent of the full-load primary current of the transformer.

19.3 A transformer designed to furnish power to a low-voltage circuit shall be of the two-coil insulated type.

19.4 A transformer that directly supplies a National Electrical Code, ANSI/NFPA 70-1993, Class 2 circuit shall, in accordance with the Standard for Class 2 and Class 3 Transformers, UL 1585, either limit the output current (inherently limited transformer) or be equipped with an overcurrent device (not inherently limited transformer).

SPACINGS

20 High-Voltage Circuits

20.1 The following electrical spacing requirements apply to high-voltage circuits, as defined in 3.5(a).

20.1 revised May 14, 1996

20.2 Unless specifically noted otherwise, the spacings between uninsulated live parts of opposite polarity and between an uninsulated live part and a dead metal part shall be not less than the values indicated in Table 20.1.

20.2 revised May 14, 1996

Table 20.1
Electrical spacings in refrigerated and/or air-handling compartments

Ratings volt-amperes	Volts	Minimum spacing					
		Through air,		Over surface[a],		To enclosure[c],	
		inch	(mm)	inch	(mm)	inch	(mm)
2000 or less	300 or less	1/8[b]	(3.2)	1/4	(6.4)	1/4	((6.4)
2000 or less	301 – 600	3/8	(9.5)	1/2	(12.7)	1/2	(12.7)
More than 2000	150 or less	1/8[b]	(3.2)	1/4	(6.4)	1/2	(12.7)
	151 – 300	1/4	(6.4)	3/8	(9.5)	1/2	(12.7)
	301 – 600	3/8	(9.5)	1/2	(12.7)	1/2	(12.7)

[a] At points other than field-wiring terminals, the spacings for heater elements only may be as indicated below provided the elements are not subject to moisture, such as may result from condensation on cooled surfaces:

1/16 inch (1.6 mm) through air and over surface for heaters rated 0 – 300 volts.

1/4 inch (6.4 mm) through air and over surface for heaters rated 301 – 600 volts.

[b] The spacings between wiring terminals of opposite polarity or between a wiring terminal and ground shall be not less than 1/4 inch (6.4 mm), except that if short-circuiting or grounding of such terminals will not result from projecting strands of wire, spacing need not be greater than that given in the above table. Wiring terminals are those connected in the field and not factory wired.

[c] Includes fittings for conduit or metal-clad cable.

Table 20.1 revised May 14, 1996

20.3 The Through-air and Over-surface spacings given in Tables 20.1 and 20.2 at an individual component part are to be based on the total volt-ampere consumption of the load or loads which the component controls. For example, the spacings at a component which controls only the compressor motor are based on the volt-amperes of the compressor motor. The spacings at a component which controls loads in addition to the compressor motor are based on the sum of the volt-amperes of the loads so controlled, except that spacings at a component which independently controls separate loads are based on the volt-amperes of the larger load. The volt-ampere values for the loads referred to above are to be determined by the marked rating of the loads, except that for loads which are not required to have a marked rating, the measured input is to be used in determining the volt-ampere values.

20.3 revised May 14, 1996

20.4 All uninsulated live parts connected to different circuits shall be spaced from one another as though they were parts of opposite polarity in accordance with the requirements indicated above and shall be based on the highest voltage involved.

20.5 With reference to 20.2 and 20.3, the "To-Enclosure" spacings given in Table 20.1 are not to be applied to an individual enclosure of a component part within an outer enclosure or cabinet.

20.5 revised May 14, 1996

20.5.1 The spacings indicated in Table 20.2 are applicable only to electrical components mounted in totally enclosed nonrefrigerated and/or nonair handling compartments which are free of moisture, including that caused by condensation. At wiring terminals and for circuits over 250 volts or over 2000 volt-amperes, spacings in Table 20.1 apply.

20.5.1 added May 14, 1996

Table 20.2
Spacings in non-refrigerated and/or non-air handling compartments

Ratings,		Minimum spacing					
		Through air,		Over surface,		To enclosure[b],	
volt-amperes	volts	inches	(mm)	inches	(mm)	inches	(mm)
0 – 2000	0 – 125	1/16	(1.6)	1/16	(1.6)	1/4	(6.4)
	126 – 250	3/32	(2.4)	3/32	(2.4)	1/4	(6.4)

NOTE – See 20.5A.

[a] Includes fittings for conduit or metal-clad cable.

Table 20.2 added May 14, 1996

20.6 If higher than rated potential is developed in a motor circuit through the use of capacitors, the rated voltage of the system shall be employed in applying the spacings indicated in this section.

Exception: If the developed steady-state potential is determined in the Temperature and Pressure Test, Section 33, exceeds 500 volts; in which case, the developed potential is to be used in determining the spacings for the parts affected.

20.6 revised May 14, 1996

20.6.1 The above spacing requirements do not apply to the inherent spacings of a component part of the equipment, such as a hermetic motor-compressor, motor, snap switch, controller, attachment-plug cap, and the like, for which spacing requirements are given in a standard for the component. However, the electrical clearance resulting from the assembly of a component into the complete machines, including clearance to dead metal or enclosures, shall be as indicated herein.

20.6.1 added May 14, 1996

20.7 An insulating liner or barrier of fiber or similar material employed where spacings would otherwise be less than the required values shall be no less than 1/32 inch (0.8 mm) in thickness and shall be so located or of such material that it will not be adversely affected by arcing.

Exception No. 1: Fiber no less than 1/64 inch (0.4 mm) in thickness may be used in conjunction with an air spacing of no less than 50 percent of the spacing required for air alone.

Exception No. 2: Material having a lesser thickness may be used if it has equivalent insulating, mechanical, and flammability properties when compared with materials in thicknesses specified above.

20.7 revised May 14, 1996

20.8 The spacing between uninsulated live terminals of the components in an electric-discharge lamp circuit and a dead metal part or enclosure shall be not less than 1/2 inch (12.7 mm) if the potential is 600 volts or less and not less than 3/4 inch (19.1 mm) if the potential is 601 – 1000 volts.

20.8 added May 14, 1996

21 Low-Voltage Circuits

21.1 The following electrical spacing requirements apply to low-voltage circuits, as defined in 3.5(b).

21.1 revised May 14, 1996

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

21.3 The spacings for low-voltage electrical components installed in a circuit which includes a pressure-limiting device, motor overload protective device, or other protective device, where a short or grounded circuit may result in unsafe operation of the equipment, shall comply with the following:

a) The spacing between an uninsulated live part and the wall of a metal enclosure including fittings for the connection of conduit or metal-clad cable shall be not less than 1/8 inch (3.2 mm).

b) The spacing between wiring terminals regardless of polarity and between the wiring terminal and a dead metal part, including the enclosure and fittings for the connection of conduit, which may be grounded when the device is installed, shall be not less than 1/4 inch (6.4 mm).

c) The spacing between uninsulated live parts regardless of polarity and between an uninsulated live part and a dead metal part, other than the enclosure, which may be grounded when the device is installed, shall be not less than 1/32 inch (0.8 mm) provided that the construction of the parts is such that spacings will be maintained.

21.3 revised May 14, 1996

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21.4 The spacings in low-voltage circuits which do not contain devices such as indicated in 21.3 are not specified.

REFRIGERATION SYSTEM

22 Refrigerant

22.1 The kind of refrigerant intended for use with the cooler shall comply with the Standard for Refrigerants, UL 2182.

22.1 revised October 30, 1997

22.2 *Deleted October 30, 1997*

23 Pump-Down Capacity

23.1 This section of a water cooler designed to receive the refrigerant charge during a pump-down shall have the capacity to receive the charge without the liquid occupying more than 90 percent of the volume of the section when the temperature of the refrigerant is 90EF (32.2EC).

24 Refrigerant Tubing and Fittings

24.1 Copper or steel tubing used to connect refrigerant-containing components shall have a wall thickness not less than indicated in Table 24.1.

Exception: Capillary tubing which is protected against mechanical damage by the cabinet or assembly shall have a wall thickness not less than 0.020 inch (0.51 mm).

Table 24.1
Minimum wall thickness for copper and steel tubing

Outside diameter,		Copper				Steel	
		Protected[a]		Unprotected			
inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)
1/4	(6.4)	0.0245	(0.622)	0.0265	(0.673)	0.025	(0.64)
5/16	(7.9)	0.0245	(0.622)	0.0265	(0.673)	0.025	(0.64)
3/8	(9.5)	0.0245	(0.622)	0.0265	(0.673)	0.025	(0.64)
1/2	(12.7)	0.0245	(0.622)	0.0285	(0.724)	0.025	(0.640)
5/8	(15.9)	0.0315	(0.800)	0.0315	(0.800)	0.032	(0.81)
3/4	(19.1)	0.0315	(0.800)	0.0385	(0.978)	0.032	(0.81)
7/8	(22.2)	0.0410	(1.041)	0.0410	(1.041)	0.046	(1.17)
1	(25.4)	0.0460	(1.168)	0.0460	(1.168)	–	–

NOTE – Nominal wall thickness of tubing will have to be greater than the thickness indicated to maintain the minimum wall thickness.

[a] Within the product.

24.2 Tubing shall be constructed of corrosion resistant material, such as copper, or shall be plated, dipped, coated, or otherwise treated to resist external corrosion. Aluminum may be used where the material is not subject to galvanic corrosion.

24.3 Tubing forming part of components, such as evaporators or condensers, where protection is afforded by inherent construction shall be judged in accordance with the requirements of the Strength Tests – Pressure Containing Components, Section 48. The wall thickness of copper and steel tubing shall be not less than 0.016 inch (0.41 mm), except that finned copper tubing may be less than 0.016 inch provided the assemblies:

a) Are subjected to 100 percent production pressure tests in accordance with 54.3,

b) Have inlet and outlet tube connections with wall thickness not less than 0.016 inch, and

c) Have hairpin turns and return bends protected from damage after installation in the water cooler and from damage during assembly unless the pressure tests in 54.3 are conducted after such assembly.

24.4 Special alloys or constructions used in refrigerant-containing components, including tubing with a wall thickness less than indicated in 24.1 and 24.3, may be acceptable. Among the factors taken into consideration when judging the acceptability are its:

a) Resistance to mechanical abuse,

b) Strength against internal pressure,

c) Resistance to corrosion,

d) Protection against refrigerant contamination, and

e) Conformity with requirements of safety codes, such as the Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-92, as compared to tubing of the minimum wall thicknesses indicated in Table 24.1.

24.5 Tubing connections shall be made by means of flare-type fittings with steel or forged brass nuts, by soldering or brazing, or by equivalent means. Flare-type fittings shall conform to the Standard for Refrigeration Flare-Type Fittings, ANSI/SAE J513f.

25 Refrigerant-Containing Parts

25.1 The parts of a water cooler subjected to refrigerant pressure shall withstand, without failure, the pressures indicated in the Strength Tests – Pressure Containing Components, Section 48.

25.2 The parts of a water cooler subjected to refrigerant pressure shall be constructed of corrosion resistant material, such as copper or stainless steel, or shall be plated, dipped, coated, or otherwise treated to resist external corrosion.

25.3 Pressure vessels, as referred to in this standard, are any refrigerant-containing parts other than compressors, controls, evaporators, each separate section of which does not exceed 1/2 cubic foot (0.01 m^3) of refrigerant-containing volume, evaporator and condenser coils, headers, pipe, and pipe fittings.

25.4 Pressure vessels over 6 inches (152 mm) inside diameter shall be constructed, tested, and stamped in accordance with Section VIII of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, ASME-1992, for a working pressure in compliance with the Performance section of this standard.

25.5 Pressure vessels bearing the ASME Code "U" symbol complying with 25.4 are considered acceptable without tests.

25.6 Pressure vessels bearing the ASME Code "UM" symbol are to be tested to determine compliance with the requirements of the Strength Tests – Pressure Containing Components, Section 48. The manufacturer is to submit evidence of compliance of these vessels with Section VIII of the Boiler and Pressure Vessel Code, ASME-1992.

26 Pressure-Limiting Device

26.1 A pressure-limiting device designed to automatically stop the operation of the compressor shall be installed on all water coolers with a system containing more than 22 pounds-mass (10 kg) of refrigerant.

26.1 revised June 11, 1997

26.2 The adjustable cutout pressure setting of a pressure-limiting device shall not exceed one-third of the ultimate strength of high-side refrigerant-containing parts provided this setting does not exceed 90 percent of the setting of the pressure-relief device.

26.2 revised June 11, 1997

26.3 *Deleted June 11, 1997*

26.4 There shall be no stop valves between the pressure-limiting device and the compressor.

26.4 revised June 11, 1997

27 Pressure Relief

27.1 General

27.1.1 A water cooler shall be constructed so that pressure due to fire, or other abnormal conditions, will be safely relieved. Pressure-relief devices, fusible plugs, soldered joints, or special terminals may be employed for this purpose. See 27.2.1.

27.1.1 revised June 11, 1997

27.1.2 A pressure-relief device is a pressure-actuated valve or rupture member designed to relieve excessive pressures automatically.

27.1.3 Fusible plugs and rupture members shall comply with the Standard for Nonelectrical Refrigerant-Containing Components and Accessories, UL 207.

27.1.4 A water cooler with a pressure vessel over 3 inches (76.2 mm) inside diameter, but not exceeding 3 cubic feet (0.08 m^3), internal gross volume, shall be protected by a pressure-relief device or fusible plug.

27.1.5 A water cooler with a pressure vessel exceeding 3 cubic feet (0.08 m^3), but less than 10 cubic feet (0.28 m^3) internal gross volume, shall be protected by a pressure-relief device.

27.1.6 There shall be no stop valve between the pressure-relief means and the parts or section of the system protected.

27.1.6 revised June 11, 1997

27.1.7 All pressure-relief devices shall be connected as close as practicable or directly to the pressure vessel or parts of the system protected. They shall be connected above the liquid refrigerant level, installed so that they are readily accessible for inspection and repair, and arranged so that they cannot readily be rendered inoperative.

27.1.8 Fusible plugs may be located above or below the liquid refrigerant level.

27.2 Required discharge capacity

27.2.1 Calculation of the minimum required discharge capacity and the rated discharge capacity of a rupture member or fusible plug shall be in accordance with the Mechanical Refrigeration Code, ANSI/ASHRAE 15-1994.

Revised 27.2.1 effective June 11, 1998

27.3 Relief valves

27.3.1 Pressure-relief valves shall comply with the requirements of Section VIII of the Boiler and Pressure Vessel Code, ASME-1992. Valves of 1/2 inch iron pipe size (ips) and larger shall bear the authorized Code "UV" symbol together with the set pressure and capacity. Valves of less than 1/2 inch ips shall be similarly marked, except that where the size does not permit a nameplate, the code symbol may be omitted and the set pressure and capacity may be stamped on the valve or on a metal plate attached to it. Manufacturers of valves which do not bear the code symbol shall provide evidence of certification of the valve and its pressure and capacity rating by proper code authorities.

27.3.2 Pressure-relief valves shall be sealed at a start-to-discharge pressure not exceeding the marked working pressure of the pressure vessel protected or not exceeding one-fifth of the ultimate strength of pressure vessels which do not have a marked working pressure.

27.3.3 The marked discharge capacity shall be not less than the minimum required discharge capacity as computed from 27.2.1.

27.4 Fusible plugs or rupture members

27.4.1 *Deleted June 11, 1997*

WATER SYSTEM

28 Pressure Relief

28.1 A hot- and cold-type water cooler with an unvented hot-water storage tank, shall have provision for the connection of a pressure-relief device during installation.

PERFORMANCE

29 General

29.1 Instrumentation

29.1.1 Temperature measurements

29.1.1.1 Temperatures are to be measured by thermocouples, except that the change-in-resistance method may be used to measure the temperature of motor windings or of coils. See 33.7. The thermocouples are to consist of No. 24 – 30 AWG (0.21 – 0.05 mm^2) wires. The thermocouples and related instruments are to be accurate and calibrated. The thermocouple wire is to conform to the requirements for "special thermocouples" as listed in the Table of Limits of Error of Thermocouples in the Standard for Temperature Measurement Thermocouples, ANSI MC96.1-1982.

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

29.1.1.3 If thermocouples are used in the determination of temperatures in connection with the heating of electrical equipment, it is a standard practice to employ thermocouples consisting of No. 30 AWG (0.05 mm^2) iron and constantan wires and a potentiometer type of indicating instrument. This equipment will be used whenever referee temperature measurements by means of thermocouples are necessary.

29.1.2 Pressure measurements

29.1.2.1 Pressure gauges are to be attached in such a manner as to prevent leakage. Special fittings for direct connection to the system or minimum lengths of 1/8 inch (3.2 mm) outside diameter commercial capillary tubing may be employed for gauge connections. The volume of the pressure-measuring gauge and lines is to be held to a minimum. All joints in the gauge system are to be tested for leakage.

29.1.2.2 Opening of the gauge line valves shall not cause a significant change in the electrical input of the system that would prevent the equipment from performing in its intended manner. High-side gauges and lines may be heated above the saturation temperature corresponding to the expected pressure or may be precharged with a liquid refrigerant of the same type as used in the system to minimize the effect of opening the gauge line valves.

29.2 Additional test

29.2.1 In addition to the following tests, the water cooler shall be tested in accordance with the requirements of 8.3.8.

30 Test Voltage

30.1 Water coolers are to be tested 60 hertz (Hz) voltages maintained at the water cooler supply connections in accordance with Table 30.1.

Exception: Water coolers rated at frequencies other than 60 Hz are to be tested at their rated voltages and frequencies.

Table 30.1
Test voltages

Nameplate voltage rating	Test voltage[a]
110 to 120	120
208	208
220 to 240	240
254 to 277	277
440 to 480	480
550 to 600	600

[a] These voltages are nominal for the Rain Test, Section 38, Condenser Fan Motor Failure Test, Section 35, and Condenser Water Failure Test, Section 36.

31 Leakage Current Test – Cord Connected Water Coolers

31.1 The leakage current of a cord connected water cooler rated 250 volts or less when tested in accordance with 31.6 and 31.7 shall be no more than 0.75 milliamperes.

31.2 Leakage current refers to all currents, including capacitively coupled currents, which may be conveyed between exposed conductive surfaces of a water cooler and ground or other exposed conductive surfaces.

31.3 All exposed conductive surfaces are to be tested for leakage currents. The leakage currents from these surfaces are to be measured to the grounded supply conductor individually as well as collectively and from one surface to another where simultaneously accessible. Parts are considered to be exposed surfaces unless guarded by an enclosure considered suitable for protection against shock hazard as defined in 6.3.2 and 6.3.3. Surfaces are considered to be simultaneously accessible when they can be readily contacted by one or both hands of a person at the same time. These measurements do not apply to terminals operating at voltages which are considered to be low-voltage.

31.4 If a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using metal foil with an area of 3.9 by 7.8 inches (10 by 20 cm) in contact with the surface. Where the surface is less than 3.9 by 7.8 inches, the metal foil is to be the same size as the surface. The metal foil is not to remain in place long enough to affect the temperature of the water cooler.

31.5 The measurement circuit for leakage current shall be as shown in Figure 31.1. The measurement instrument is defined in (a) - (c) and, unless it is being used to measure leakage from one part of a water cooler to another, the meter is to be connected between the accessible parts and the grounded supply conductor. The meter which is actually used for a measurement need only indicate the same numerical value for a particular measurement as would the defined instrument. The meter used need not have all of the attributes of the defined instrument.

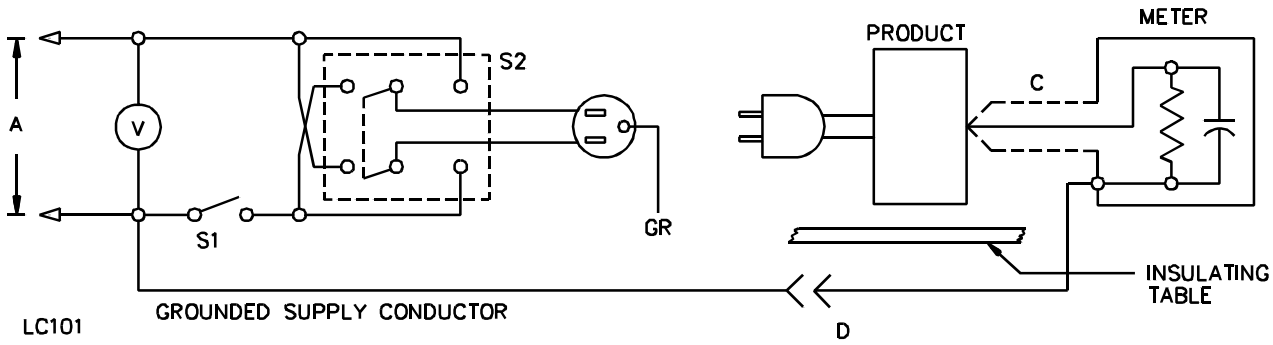
a) The meter is to have an input impedance of 1500 ohms resistive shunted by a capacitance of 0.15 microfarad.

b) The meter is to indicate 1.11 times the average of the full-wave rectified composite waveform of voltage across the resistor or current through the resistor.

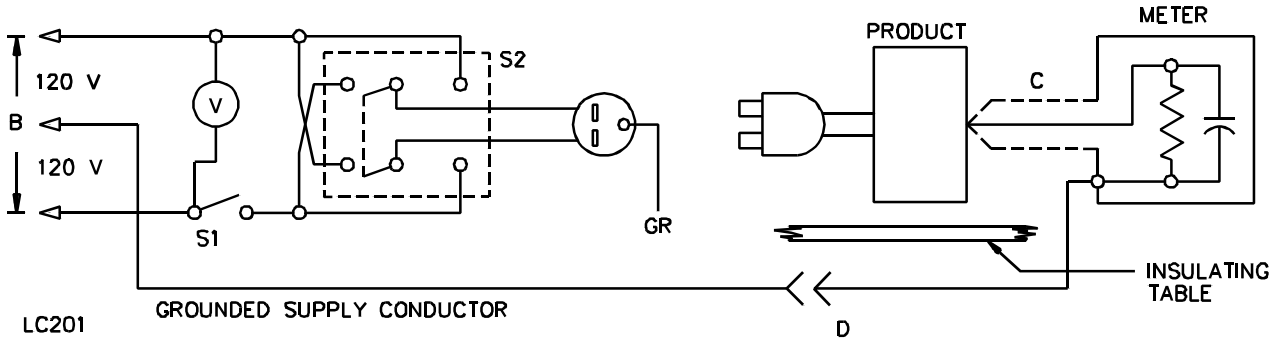
c) Over a frequency range of 0 – 100 kilohertz, the measurement circuitry is to have a frequency response (ratio of indicated to actual value of current) that is equal to the ratio of the impedance of a 1500-ohm resistor shunted by a 0.15-microfarad capacitor to 1500 ohms. At an indication of 0.75 milliamperes, the measurement is to have an error of not more than 5 percent.

Figure 31.1
Leakage current measurement circuits

Figure 31.1 revised December 1, 1998



A. Product intended for connection to a 120 or 208 volt power supply.



B. 240- or 208-volt products intended for connection to a 3-wire, grounded neutral power supply, as illustrated above.

C. Probe with shielded lead – Under some circumstances where higher frequency components are present, shielding of measuring instrument and its leads may be necessary.

D. Separated and used as clip when measuring currents from one part of a product to another.

31.6 A sample of the water cooler is to be prepared and conditioned for leakage current measurement as follows:

a) The sample is to be representative of the wiring methods, routing, components, component location, installation, and the like, of the production unit.

b) The grounding conductor is to be open at the attachment plug and the test water cooler isolated from ground.

c) The sample is to be conditioned in an ambient temperature of 70 – 80EF (21.1 – 26.7EC) and approximately 50 percent relative humidity for not less than 8 hours.

d) The test is to be conducted at the ambient conditions specified by (c).

e) The supply voltage is to be adjusted to the voltage indicated in 30.1.

f) Water lines and water storage tanks are to be filled with water.

g) Water coolers employing water-cooled condensers are to be tested with water flowing through the condenser at the rate required for operation of the system.

Note – Caution should be exercised to avoid grounding the unit through water connections.

31.7 The leakage current test sequence, with reference to the measuring circuit of Figure 31.1, is to be as follows. During any of the following tests, if the compressor stalls during positioning of switch S2, the test is to be conducted in its entirety in one polarity. The polarity is then to be reversed and the test repeated.

a) With switch S1 open, the water cooler is to be connected to the measurement circuit. Leakage current shall be measured using both positions of switch S2. All manual switching devices shall then be operated in their normal manner, and leakage currents will be measured using both positions of switch S2.

b) With the water cooler switching devices in their normal operating position, switch S1 shall then be closed, energizing the water cooler, and within a period of 5 seconds, the leakage current shall be measured using both positions of switch S2. All manual switching devices shall then be operated in their normal manner, and leakage currents measured using both positions of switch S2.

c) The water cooler switching devices are then to be returned to their normal operating positions and the water cooler allowed to run until thermal equilibrium is obtained. Leakage current is to be monitored continuously. For this test, thermal equilibrium is defined as that condition where leakage current is found to be constant or decreasing in value. Both positions of switch S2 are to be used in determining this measurement. Thermal equilibrium may involve cycling caused by an automatic control in the cooling and heating mode. This cycling shall be observed in both positions of switch S2.

d) Immediately following the above test, any single-pole switch or thermostat on the water cooler is to be opened, and the leakage current monitored until constant or decreasing values of leakage current are recorded. Readings are to be taken in both positions of switch S2.

32 Input Test

32.1 The measured ampere input to a cord connected water cooler shall not exceed the total rating marked on the water cooler nameplate by more than 10 percent when tested as described in the Temperature and Pressure Test, Section 33.

32.2 The measured input to a permanently connected water cooler shall not exceed the individual rating of each load or group of loads or the total rating as marked on the nameplate by more than 10 percent when tested as described in the Temperature and Pressure Test, Section 33.

32.3 The test sample is to be operated until stabilized input conditions are obtained.

33 Temperature and Pressure Test

33.1 The temperature rises measured on the components of a water cooler shall not exceed those specified in Table 33.1.

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33.2 The maximum pressure developed in a water cooler, tested as described in 33.3 – 33.12, shall be used as a basis for the requirements of the Strength Tests – Pressure Containing Components, Section 48.

33.3 The water cooler is to be installed in accordance with the manufacturer's instructions, see 4.1 and 4.2, and operated under the conditions specified in 33.4 – 33.12, as applicable. The test potential is to be as indicated in 30.1.

Table 33.1
Maximum temperature rises

Device or material	EC	(EF)
A. MOTORS		
1. Class A insulation systems on coil windings of alternating-current motors having a frame diameter of 7 inches (178 mm) or less (not including hermetic motor-compressors)[a]		
a. In open motors –		
Thermocouple or resistance method	75	(135)
b. In totally enclosed motors –		
Thermocouple or resistance method	80	(144)
2. Class A insulation systems on coil windings of alternating-current motors having a frame diameter of more than 7 inches (178 mm) (not including hermetic motor-compressors)[b]		
a. In open motors –		
Thermocouple method	65	(117)
Resistance method	75	(135)
b. In totally enclosed motors –		
Thermocouple method	70	(126)
Resistance method	80	(144)
3. Class B insulation systems on coil windings of alternating-current motors having a frame diameter of 7 inches (178 mm) or less (not including hermetic motor-compressors)		
a. In open motors –		
Thermocouple or resistance method	95	(171)
b. In totally enclosed motors –		
Thermocouple or resistance method	100	(180)
4. Class B insulation systems on coil windings of alternating-current motors having a frame diameter of more than 7 inches (178 mm) (not including hermetic motor-compressors)		
a. In open motors –		
Thermocouple method	85	(153)
Resistance method	95	(171)
b. In totally enclosed motors –		
Thermocouple method	90	(162)
Resistance method	100	(180)

(Continued)

Table 33.1 (Cont'd)

Device or material	EC	(EF)
B. COMPONENTS		
1. Capacitors		
Electrolytic type[c]	40	(72)
Other types[d]	65	(117)
2. Field wiring	35	(63)
3. Hermetic motor compressor enclosures[e]	150	(302)
4. Relay, solenoid, and, other coils (except motor coil windings) with:[b]		
a. Class 105 insulated winding –		
Thermocouple method	65	(117)
Resistance method	85	(153)
b. Class 130 insulation –		
Thermocouple method	85	(153)
Resistance method	105	(189)
5. Solid contacts	65	(117)
6. Transformer enclosures – with		
a. Class 2 transformers	60	(108)
b. Power transformers	65	(117)
7. Wood or other flammable material	65	(117)
C. INSULATED CONDUCTORS		
1. Flexible cords and wires with rubber, thermoplastic, or neoprene insulation unless recognized as having special heat-resistant properties as follows:		
Temperature rating		
EC (EF)		
60 (140)	35	(63)
75 (167)	50	(90)
80 (176)	55	(99)
90 (194)	65	(117)
105 (221)	80	(144)
D. SURFACES[a]		
1. Surfaces of water cooler at points of zero clearance to test enclosure	90	(194)
2. Surfaces of test enclosure where clearance to flammable material is specified	90	(194)
3. Surfaces of water cooler contacted by persons in operating it (control knobs, pushbuttons, levers, and the like)		
Metal	60	(140)
Nonmetallic	85	(185)

(Continued)

Table 33.1 (Cont'd)

Device or material	EC	(EF)
4. Surfaces of water cooler subjected to casual contact by persons (enclosure, grille, and the like)		
Metal	70	(158)
Nonmetallic	90	(194)
E. ELECTRICAL INSULATION – GENERAL		
1. Fiber used as electrical insulation or cord bushings	65	(117)
2. Phenolic composition used as electrical insulation or as parts where a failure will result in a hazardous condition	125	(225)
3. Thermoplastic material. Rise based on temperature limits of material.	–	–

[a] Thermocouple applied directly to the integral insulation of the coil conductor.

[b] Thermocouple applied as in (1) or applied to conventional coil wrap.

[c] For an electrolytic capacitor which is physically integral with or attached to a motor, the temperature rise on insulating material integral with the capacitor enclosure may be not more than 65EC (117EF).

[d] A capacitor which operates at a temperature higher than a 65EC (117EF) rise may be judged on the basis of its marked temperature rating.

[e] Tabulated temperatures for surfaces indicated in subitems 1, 2, 3, and 4 of item D are maximum temperatures – not temperature rises.

33.4 A water cooler of the built-in type is to be tested with the appliance placed in an enclosure simulating actual conditions of use. The enclosure is to consist of 3/8-inch (9.5-mm) thick plywood placed closely around the cooler and/or in accordance with the installation instructions, but in no case shall the clearance between normally enclosed surfaces of the unit and the test enclosure exceed 1 inch (25.4 mm). Units designed to receive and discharge ventilating air are to use the manufacturer's grills provided with the unit.

33.5 A water cooler of the wall-hung or against-the-wall type is to be tested with the unit placed near or against a simulated wall in accordance with the installation instructions if proximity to the wall will affect operation of the unit.

33.6 The assembly is to "pulldown" under the following test conditions. Pulldown will be effected when the assembly runs continuously at approximately constant electrical input and low-side pressure. An automatic-reset protective device may cycle provided pulldown is obtained within 8 hours. A manual-reset protective device shall not trip during the starting or operating period.

33.7 For this test, a representative water cooler is to be fitted with pressure gauges on the high- and low-pressure sides of the refrigeration system. Thermocouples are to be secured to various surfaces and electrical components, including the compressor-motor enclosure, fan-motor windings, starting-relay coil, capacitors, and wiring insulation. The temperature of motor windings or of coils may be measured by the resistance method, but the primary method of temperature measurement is to be the thermocouple method. The electrical input is to be measured with voltmeter and ammeter. The cold-water thermostat is to be electrically bypassed or shunted during the test.

33.8 The test conditions to be maintained during the Temperature and Pressure Test are as shown in Table 33.2.

33.9 In testing a bottle-type water cooler, the cooler and the filled bottle are to be brought to room temperature 104EF (40EC), and the cooler then started and run continuously until constant temperature and pressure conditions are reached. During the test, water is to be drawn continuously at the specified flow rate.

33.9 revised September 24, 1996

33.10 In testing an air-cooled, pressure type water cooler, the unit is to be placed in a room maintained at 104EF (40EC) for a period of not less than 4 hours, then started and run continuously. Inlet water is to be maintained at 80EF (26.7EC), 35 psig (0.244 Pa) (nominal). There is to be complete diversion of spillage from the precooler. The drinking water flow rate is to be established by adjusting the flow through the unit to provide 60EF (15.6EC) outlet water. This flow rate will be considered stabilized if, after at least 2 hours of operation, the average of four subsequent outlet-water temperature measurements taken at 15-minute intervals, is 60 ±1EF (15.6 ±0.6EC) and provided each of the four readings is within the range of 58 – 62EF (14.4 – 16.1EC). Water temperature measurements are to be made as near as practicable to the inlet and outlet fittings of the water cooler. After the above preliminary flow rate has been established, the unit is to be de-energized and permitted to come to room temperature. It is then to be restarted and operated continuously with the water-flow rate set at the value obtained above, except for minor adjustments necessary to provide 60EF (15.6EC) outlet water under stabilized conditions during the input and temperature-pressure tests.

33.11 In testing a water-cooled, pressure-type water cooler, the unit may be at any convenient test ambient. The cooler is to be operated with the condenser water controlled as specified in 33.8. A preliminary flow rate for potable water is to be established and the test conducted as indicated in 33.10.

33.12 In testing a water cooler of the hot-and-cold type, the hot water temperature regulating control is to be set in the hottest position, and the heating system is to be energized concurrently with the cooling system. The water heater is to be operated until the temperature regulating control opens, at which time one-fourth of the water is to be drawn off and replaced from the supply. The water heater is to be allowed to heat again until the temperature regulating control opens, at which time temperatures are to be measured again.

33.13 The water cooler is to comply with the Dielectric Voltage-Withstand Test, Section 34, following the foregoing tests.

Table 33.2
Test conditions

	EF	(EC)
Bottle-type cooler		
Ambient temperature	104	(40)
Drinking water in	104	(40)
Test flow rate (minimum)	1 gph (3.8 liters/hour)	
Pressure-type cooler – air cooled[a]		
Ambient temperature	104	(40)
Drinking water in	80	(26.7)
Drinking water out	60	(15.6)
Pressure-type cooler – water cooled[a]		
Ambient temperature	Convenient	
Drinking water in	80	(26.7)
Drinking water out	60	(15.6)
Condenser water in	80	(26.7)
Condenser water out	100[b]	(37.8)
Hot- and cold-type cooler	c	

[a] See 33.10 or 33.11.

[b] Where this condition cannot be attained due to design, the unit is to be tested at 80EF (26.7EC) inlet condenser water temperature and 35 psig (0.24 MPa) nominal pressure.

[c] Heating system operated concurrently as described in 33.12 while cooling system operated under the conditions specified above.

34 Dielectric Voltage-Withstand Test

34.1 A complete water cooler and all electrical components shall be capable of withstanding for a period of 1 minute, without breakdown, a test potential of 1000 volts plus twice rated voltage between high-voltage live parts and dead metal parts and between live parts of high voltage and low-voltage circuits. The test potential shall be at any frequency between 40 and 70 hertz.

Exception No. 1: For motors rated at not more than 1/2 horsepower (373 W output) the test potential shall be 1000 volts.

Exception No. 2: If the steady-state voltage developed in a motor circuit through the use of capacitors exceeds 500 V, as measured during the temperature and pressure test, the test potential for the parts affected shall be 1000 V plus twice the developed capacitor voltage.

34.1 revised May 14, 1996

34.2 *Revised and combined with 34.1 May 14, 1996*

34.3 A water cooler employing a low-voltage circuit shall be capable of withstanding for 1 minute, without breakdown, a test potential of 500 volts applied between low-voltage live parts and dead metal parts. The test potential shall be at any frequency between 40 and 70 hertz. Where components specified in 21.3 are employed in the low-voltage circuit, the dielectric voltage withstand test, shall also be conducted between live parts of opposite polarity.

34.3 revised May 14, 1996

34.4 With reference to 34.3, the test between low-voltage parts of opposite polarity is to be conducted on magnet coil windings of the transformer after breaking the inner coil lead where it enters the layer. This opposite polarity test may be waived on the complete assembly provided the components have been separately subjected to this test condition.

34.4 revised May 14, 1996

34.5 A 500 volt-ampere or larger transformer, the output voltage of which is essentially sinusoidal and can be varied, is to be used to determine compliance with 34.1 and 34.3. The applied potential is to be increased gradually from zero until the required test value is reached and is to be held at that value for 1 minute.

Exception: The requirement of a 500 volt-ampere or larger transformer can be waived if the high potential testing equipment used is such that it maintains the specified high potential voltage at the equipment during the duration of the test.

34.5 added May 14, 1996

34.6 If the charging current through a capacitor or capacitor or capacitor-type filter connected across the line, or from line to earth ground, is large enough to make it impossible to maintain the required alternating-current test potential, the capacitors and capacitor-type filters may be tested as described in the next paragraph.

34.6 added May 14, 1996

34.7 The capacitors and capacitor-type filters mentioned in the previous paragraph are to be subjected to a direct-current test potential of 1414 volts for equipment rated 250 volts or less or 1414 volts plus 2.828 times the rated circuit voltage for equipment rated at more than 250 volts. The direct-current test potential is to be maintained for 1 minute without breakdown.

34.7 added May 14, 1996

34.8 Components providing a d.c. path in parallel with the insulation to be tested, such as discharge resistors for filter capacitors and voltage limiting devices (transient voltage suppressors), may be disconnected during the test.

34.8 added May 14, 1996

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35 Condenser Fan Motor Failure Test

35.1 A water cooler shall not leak refrigerant nor develop pressures or temperatures in excess of those indicated in (a) and (b), below, if the condenser fan motor locks or fails to start.

a) The refrigeration system shall not rupture or develop leaks during the test. The maximum high- and low-side pressures are to be recorded as reference values for requirements of the Strength Tests – Pressure Containing Components, Section 48. An assembly employing a pressure-limiting device conforming with 26.2 or 26.3, as applicable, is considered to comply with the high-side pressure requirement.

b) The maximum temperature of the compressor enclosure, of the fan motor winding (open type) or of the fan motor enclosure (enclosed type) shall not exceed 302EF (150EC). Compressors and condenser fan motors equipped with thermal protective devices as specified in Motors and Motor Overload Protection, Section 15, are considered to comply with this requirement.

35.2 A sample of the assembly is to be fitted with a pressure gauge on the high-pressure side of the refrigeration system and provided with thermocouples on the compressor enclosure and condenser fan motor winding (open type) or condenser fan motor enclosure (enclosed type). When evaluating low-side components for compliance with the strength requirements of 48.10 or 48.11, a pressure-gauge is to be fitted on the low-side of the system. The low-side pressure is to be recorded while the compressor is operating and after shutdown. If the water cooler is provided with means to relieve discharge pressure into the low-side of the system, the low-side pressure is to be recorded while:

a) The compressor is operating, the pressure relief means is open and the low-side pressure is increasing and

b) After shutdown of the compressor.

The controls are to be set for maximum cooling and the water cooler is operated with the condenser fan motor locked until stabilized temperatures and pressures are reached. The compressor motor overload device and/or the fan motor overload device may operate during this test. The test ambient temperature is to be approximately 77EF (25EC). The potential is maintained as indicated in 30.1. Where two or more condenser fan motors are employed, the test is to be conducted with one motor locked.

36 Condenser Water Failure Test

36.1 A water-cooled water cooler shall not leak refrigerant nor develop pressures or temperatures in excess of those indicated in (a) and (b), below, during water failure.

a) The refrigeration system shall not rupture or develop leaks during the test. The maximum high- and low-side pressures are to be recorded as reference values for requirements of the Strength Tests – Pressure Containing Components, Section 48.

b) The maximum temperature of the compressor enclosure shall not exceed 302EF (150EC). Compressors equipped with a thermal protective device(s) as specified in Motors and Motor Overload Protection, Section 15, are considered to comply with this requirement.

36.2 A sample of the assembly is to be fitted with a pressure gauge on the high-pressure side of the refrigeration system and provided with thermocouples on the compressor enclosure. When evaluating low-side components for compliance with the strength requirements of 48.10 or 48.11, a pressure gauge is to be fitted on the low side of the system. The low-side pressure is to be recorded as specified in 35.2. The water cooler is to be operated with the condensing water shut off and also with the condensing water restricted until maximum stabilized temperatures are reached or until representative maximum temperatures are attained under cycling load. If the water cooler cycles on a motor-overload protective device, the test is to continue until the maximum pressure during the protective device operation is obtained. The room ambient is to be approximately 70EF (25EC). The potential is to be maintained as indicated in 30.1.

36.3 The test is not to result in damage to electrical parts.

36.4 The test need not be conducted to determine compliance with 36.1 if a pressure-limiting device is provided. The maximum cutout pressure to which the pressure-limiting device may be readily adjusted by the adjusting means provided shall be employed in determining compliance with 36.1. See 48.4 and 48.8.

37 Overflow Test

37.1 With reference to 6.3.9, a water cooler in which water may overflow shall not allow the water to wet live parts or the windings of motors or coils.

37.2 The water cooler is to be positioned as intended in operation and any drains provided in drain basins, water reservoirs and/or waste water receptacles are to be blocked. The basin, reservoir or receptacle is to be filled to its capacity. Water is then to be added at a rate of 1 ounce per second (0.030 L/s) until the overflowing water accumulates in the bottom of the unit or on the floor beneath it.

37.3 Compliance with 37.1 is to be determined by visual examination, except that where visual examination is not practical, an insulation resistance and dielectric voltage withstand test is to be conducted immediately after overflow has occurred. The water cooler shall have an insulation resistance of not less than 50,000 ohms measured between current carrying parts and noncurrent carrying parts and shall comply with requirements of the Dielectric Voltage-Withstand Test, Section 34.

37A Spill Test

Added Section 37A effective March 24, 1998

37A.1 External spillage of liquid on a bottle type water cooler shall not result in wetting of uninsulated live parts or film-coated wire in line-voltage circuits. See 6.3.9.1.

37A.2 The water cooler is to be positioned as intended in use. Four hundred-forty four millimeters (15 oz) of water are to be poured on the top surface of the unit and at a rate of approximately 30 mL/s (1 oz per second).

37A.3 Compliance with 37A.1 shall be determined within 30 minutes after the water is poured on the top of the water cooler by visual examination, dielectric voltage-withstand, or insulation resistance, except that windings of motors that are exposed to spillage shall (1) have an insulation resistance of not less than 50,000 ohms and (2) comply with the Dielectric Voltage-Withstand Test, Section 34.

38 Rain Test

38.1 A water cooler exposed to weather shall be subjected to a rain exposure without creating a risk of electric shock, see 38.4, due to current leakage or insulation breakdown.

38.2 The water cooler is to be installed in accordance with the manufacturer's instructions and subjected to the rain exposure under conditions most likely to cause entrance of water into or on the electrical components. The duration of exposure is to be 1 hour.

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38.3 The rain test apparatus is to consist of three spray heads mounted in a water supply pipe rack as shown in Figure 38.1. Spray heads are to be constructed in accordance with the details shown in Figure 38.2. The water pressure for all tests is to be maintained at 5 psig (34 kPa) at each spray head. The distance between the center nozzle and the water cooler is to be approximately 5 feet (1.5 m). The water cooler is to be brought into the focal area of the three spray heads in such a position and under such conditions that the greatest quantity of water will enter it. The spray is to be directed at an angle of 45 degrees to the vertical toward the louvers or other openings closest to current carrying parts. The water cooler is to be operated so that electrical components are energized.

38.4 Following the rain test exposure, the water cooler shall have an insulation resistance of not less than 50,000 ohms measured between current carrying parts and noncurrent carrying parts, and shall withstand the Dielectric Voltage-Withstand Test, Section 34. The assembly shall also comply with 38.5 after the test.

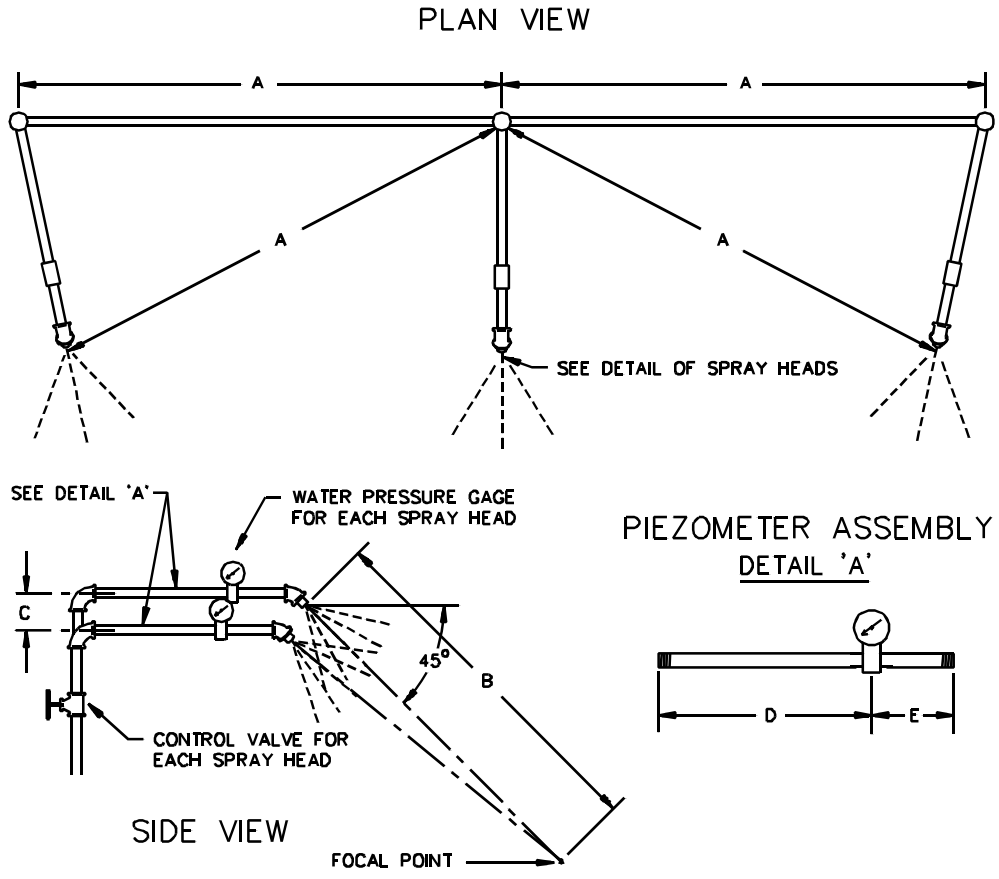
38.5 The test is not to result in the entrance of water into enclosures above the lowest live part or in the wetting of live parts, except as follows:

a) Motor windings may be judged on the basis of the insulation resistance and by the Dielectric Voltage-Withstand Test, Section 34, provided the motors are within the cabinet and are shielded from openings in the top of the cabinet.

b) Water may enter an enclosure above the lowest live electrical part providing the point of entrance is not in proximity to live electrical parts and live parts are not wetted during the rain exposure.

Figure 38.1
Rain-test spray-head piping

Figure 38.1 revised December 1, 1998

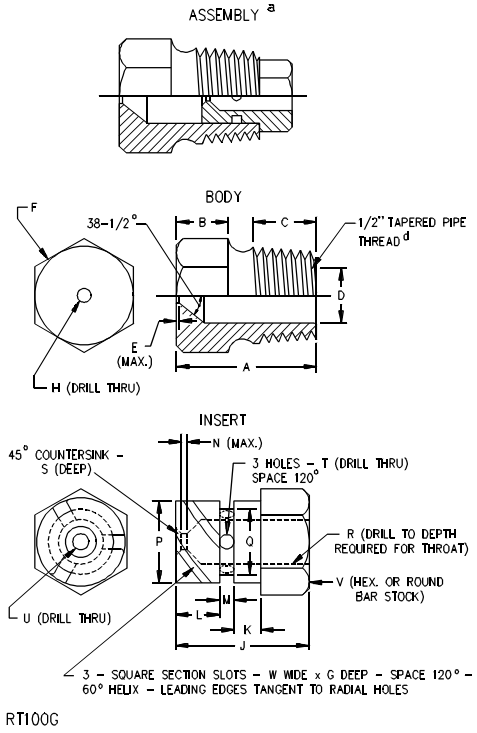


Item	inch	mm
A	28	710
B	55	1400
C	2–1/4	55
D	9	230
E	3	75

RT101E

Figure 38.2
Rain-test spray head

Figure 38.2 revised December 1, 1998



Item	inch	(mm)	Item	(inch)	(mm)
A	1-7/32	(31.0)	N	1/32	(0.80)
B	7/16	(11.0)	P	.575	(14.61)
C	9/16	(14.0)		.576	(14.63)
D	.578	(14.68)	Q	1453	(11.51)
	.580	(14.73)		454	(11.53)
E	1/64	(0.40)	R	1/4	(6.35)
F	c	c	S	1/32	(0.80)
G	.06	(1.52)	T	No. 35[b]	(2.80)
H	No. 9[b]	(5.0)	U	No. 40[b]	(2.50)
J	23/32	(18.3)	V	5/8	(16.0)
K	5/32	(3.97)	W	0.06	(1.52)
L	1/4	(6.35)			
M	3/32	(2.38)			

[a] Nylon Rain-test spray heads are available from Underwriters Laboratories

[b] ASME B94.11 (1993), Twist Drills

[c] Optional – To serve as a wrench grip

[d] ASME B1.20.1 (1983) (R1992), Pipe Threads, General Purpose (Inch).

39 Stability Test

39.1 A freestanding water cooler shall be stable when tested in accordance with 39.2. A water cooler having a supporting base such that both the width and depth dimensions are greater than the height is considered to comply with the requirement.

39.2 The water cooler is to be supported by its base including any legs or leveling screws which may be provided. Other means of support, such as plumbing connections or conduit connections, shall not be relied on for the purpose of the test. If leveling screws are provided, they are to be adjusted equally to raise the

unit to the maximum height permitted but not more than 1 inch (25.4 mm) above floor level. The unit is to be tested empty and if it is provided with any doors, they are to be closed. The water cooler is considered to comply with the requirement if it does not overturn when placed on a plane surface inclined at an angle of 10 degrees.

40 Static Loading Test

40.1 A wall-hung water cooler and a column mounted water cooler shall withstand the test described in 40.2 without:

a) Collapse of the mounting means and

b) Severance of its securement to the mounting means when fastened to a wall or column, as applicable.

40.2 A representative water cooler is to be installed with its mounting hardware in accordance with the manufacturer's instructions. A load equal to three times the weight of the unit, acting vertically downward, is to be applied uniformly to the water cooler.

41 Water Heating Controls Test

41.1 Endurance test

41.1.1 A control for an electric water heater shall be capable of withstanding an endurance test under the load which it controls for the number of cycles indicated in 41.1.2. There shall be no electrical or mechanical failure of the control nor undue burning, pitting, or welding of the contacts.

41.1.2 The number of cycles for the test is to be as follows:

a) An automatic-reset temperature regulating control which operates during each heating cycle is to withstand 100,000 cycles of operation under load.

b) An automatic-reset temperature limiting control which opens only in response to abnormal temperature is to withstand 100,000 cycles of operation under load if its short-circuiting results in a hazard, as defined in 42.1.2 and 42.1.3. The test may be omitted if its short-circuiting does not result in such hazards.

c) A manual-reset temperature limiting control which opens only in response to abnormal temperature is to withstand 1000 cycles of operation under load plus an additional 5000 cycles without load. The test may be omitted if its short-circuiting does not result in a hazard, as defined in 42.1.2 and 42.1.3.

41.1.3 The test is to be conducted with the device connected either to the heater element load or to an equivalent noninductive load. The frame of the device is to be connected through a 15 ampere fuse to ground or to the grounded conductor of the supply circuit.

41.1.4 If the device "fails safe" in the open position before the end of the test, it is not to be considered a failure provided the "fail safe" feature is inherent in the design.

41.2 Calibration test

41.2.1 A water temperature regulating control, see 41.1.2 (a), and a temperature limiting control, see 41.1.2, (b) or (c), shall comply with the Standard for Electrical Temperature-Indicating and -Regulating Equipment, UL 873, pertaining to the calibration of temperature limiting controls.

42 Burnout Test

42.1 Water heater

42.1.1 The water heater of a hot- and cold-type water cooler shall not result in a risk of fire or electric shock if operated dry.

42.1.2 A risk of fire is considered to exist if there is any emission of flame or molten metal from the water cooler or glowing or flaming of flammable material.

42.1.3 A risk of electric shock is considered to exist if the insulation resistance of the water cooler is less than 50,000 ohms.

42.1.4 Opening of the supply circuit fuse or opening of the heater element is not considered to be a failure if the risk of fire and electric shock does not exist. If the heater element opens, three samples are to be tested to determine that the heater is designed to function in this manner.

42.1.5 The test is to be conducted with the water heater operating dry. If an automatic-reset type of temperature limiting control is used to protect the heater, the test is to terminate when the temperatures of components and materials such as conductor insulation, electrical insulation, thermal insulation, and flammable materials near the heater element have stabilized. If a manual-reset type of temperature limiting control is employed, the test is to terminate when the limit control opens the heater circuit. The temperature regulating control shall be shorted out of the circuit during this test.

42.1.6 If a replaceable thermal cutoff is employed, the test is to be conducted five times using different samples of the thermal cutoff in each test. The thermal cutoff is to open the circuit in the intended manner without causing the short-circuiting of live parts and without causing live parts to become grounded to the enclosure. During the test the enclosure is to be connected through a 3 ampere fuse to ground, and any thermally operated control devices in the heater circuit other than the thermal cutoff are to be short-circuited.

42.2 Other components

42.2.1 A water cooler shall not result in a risk of fire or electric shock when operated under the conditions as described in 42.2.2 – 42.2.6.

42.2.2 To determine if a risk of fire or electric shock exists, a burnout test is to be conducted on components such as an intermittent-duty relay, solenoid, electrically-operated valve or others which the design of the water cooler indicates may present a risk of fire or electric shock. The tests should be made with the component installed as intended in the water cooler. The water cooler is to be connected to a supply circuit maintained as indicated in 30.1. Each ungrounded conductor in the supply circuit is to be provided with a fuse of the maximum rating which may be used. For cord connected water coolers, the supply circuit fuses are to correspond in size to the rating of the attachment plug, except that 20 amperes is the minimum size for water coolers rated 150 volts or less.

42.2.3 A risk of fire is considered to exist if there is any emission of flame or molten metal from the water cooler or glowing or flaming of flammable material. Opening of the supply circuit fuse is not considered to be a failure if a risk of fire does not exist.

42.2.4 A risk of electric shock is considered to exist if the insulation resistance of the water cooler is less than 50,000 ohms.

42.2.5 If a single component failure may result in an intermittent-duty relay or solenoid being continuously energized, a risk of fire or electric shock shall not result from such failure. The test is to be conducted with the relay or solenoid continuously energized until the ultimate result is determined.

42.2.6 If a relay, solenoid, or electrically operated valve becomes blocked in the de-energized position, a risk of fire or electric shock shall not result. The component is to be blocked in the position assumed when it is de-energized and then energized continuously until the ultimate result is determined.

43 Overvoltage and Undervoltage Tests

43.1 An electromagnet, as employed on a relay or solenoid, shall be able to withstand 10 percent above rated voltage without damage to the coil and to operate at 15 percent below rated voltage. The test voltages are to be as indicated in Table 43.1.

Table 43.1
Test voltages

Rated voltage	Overvoltage	Undervoltage
110 – 120	132	102
208	229	177
220 – 240	264	204
254 – 277	305	235
440 – 480	528	408
550 – 600	660	510

43.2 A relay or solenoid that has been separately investigated for the voltage and operating conditions involved, including ambient temperature conditions, is not required to be tested in the water cooler to determine if it complies with the requirement in 43.1.

43.3 If a relay or other control is used in combination with the compressor controller to prevent automatic recycling of the compressor due to the operation of a protective device, the components involved shall comply with 43.1 under any condition which might result from operation of the protective device and de-energizing the circuit.

43.4 Relays and solenoids are to be connected to a supply source maintained at the overvoltage condition until the coils of the relays and solenoids reach constant temperature. The potential is then reduced to the test voltage specified in 30.1, and each relay and solenoid is to operate at this voltage. The potential is maintained at this test voltage until the coils reach constant temperatures. The potential is then reduced to the undervoltage condition, and each relay and solenoid is to operate at this voltage. If relays and solenoids are energized through a transformer, the voltage adjustments described are to be made at the transformer primary. A relay or solenoid which will not be subject to continuous operation is to be energized at the overvoltage condition and at the normal test voltage for the maximum time permitted by its duty cycle or until constant temperature is reached, whichever occurs first.

44 Current Overload Test – Bonding Conductors and Connections

44.1 When required by 11.8 or 11.12, bonding conductors and connections shall carry, without opening, twice the current equal to the rating of the branch circuit overcurrent-protection device for the interval indicated in Table 44.1.

Table 44.1
Current overload test

Rating of overcurrent protection device amperes	Minimum duration of current flow minutes
30 or less	2
31 – 60	4
60 – 100	6

45 Insulation Resistance Test

45.1 Water heaters

45.1.1 An electric heater of the metallic sheath or encased type which is exposed to moisture shall maintain an insulation resistance of not less than 50,000 ohms when cycled in the presence of water and shall not break down in the Dielectric Voltage-Withstand Test, Section 34.

45.1.2 If an encased heater or heater terminal seal is in contact with water as it is used in the water cooler, a test is to be conducted by cycling the heater for 30 days, submerged in water.

45.1.3 In the test the water is to be maintained at a temperature not less than that measured on the heater terminal seal or case material during heater operation, nor more than 194EF (90EC). The heater is to be cycled four times per hour with an ON time of approximately 1-1/2 minutes and an OFF time of approximately 13-1/2 minutes.

45.1.4 If the electric heater is not wetted but is exposed to moisture in the water cooler, a test is to be conducted by cycling the heater assembly or terminal seal in an atmosphere of not less than 98 percent relative humidity.

45.1.5 For the test indicated in 45.1.4, the heater is cycled in a humidity controlled test chamber. The cycle is to be initiated by a time switch and terminated by a control set to disconnect the heater when a temperature rise on the sheath or case is equivalent to the rise measured during the heater operation. The rate of cycling is to be maintained from 3 to 10 cycles per hour for 1000 cycles.

45.2 Thermal and/or acoustical insulating material

45.2.1 A water cooler employing insulating material likely to absorb moisture under conditions of use shall have an insulation resistance of not less than 50,000 ohms between high-voltage live parts and interconnected dead metal parts after exposure for 24 hours to moist air having a relative humidity of 85 ±5 percent at a temperature of 90 ±4EF (32 ±2EC).

46 Limited Short-Circuit Test

46.1 General

46.1.1 The following components shall withstand short-circuiting when protected by a branch-circuit overcurrent device of the size required for the water cooler:

a) Motor overload protective devices which are connected in the motor circuit.

b) Motor circuit conductors and connections as required by 9.2.6.

c) Bonding conductors and connections as required by 11.8 and 11.12.

46.1.2 For a cord-connected unit, the protection specified in 46.1.1 is to be provided by a fuse having a rating not less than the rating of the unit's attachment plug. The minimum fuse size for cord-connected water coolers is to be 20 amperes for units rated 125 volts or less and 15 amperes for units rated 126 – 250 volts.

46.1.3 For a permanently-connected unit, the protection specified in 46.1.1 is to be provided by either a device that is recognized for branch-circuit protection and located in the unit, or a branch-circuit protective device of the type and maximum rating specified on the product nameplate.

46.1.4 A permanently-connected water cooler having more than one motor wired for connection to one supply line shall withstand short-circuiting when protected by a branch-circuit overcurrent device rated at 225 percent of the rated-load current of the largest hermetic motor of the group plus an amount equal to
the sum of any additional loads supplied. If a hermetic motor is not supplied, the branch-circuit overcurrent protective device is to be rated 400 percent of the full-load current of the largest motor of the group plus an amount equal to the sum of any additional loads supplied.

Exception: If the unit incorporates a branch-circuit overcurrent device as described in 46.1.3 (1), the test is to be conducted with that device.

46.1.5 With regard to branch-circuit overcurrent protective devices and for the purpose of these tests, fuses of the same rating are considered to be interchangeable and "HACR Type" circuit breakers of the same rating are considered to be interchangeable. Fuses and circuit breakers are not considered to be interchangeable. Circuit breakers of other than "HACR Type" are not considered interchangeable with each other nor are they interchangeable with "HACR Type" circuit breakers.

46.1.6 The component is to be connected in a test circuit having a capacity based on the rated-load current and voltage rating of the water cooler. See Table 46.1. When the rated-load current is between two values in the table, the larger value is to be used in determining the circuit capacity. If the water cooler nameplate shows individual loads, the rated-load current is to be the total of all individual loads that may occur simultaneously. If more than one simultaneous load condition is possible, the condition resulting in the maximum total current is to be used as a basis for determining the capacity of the test circuit. The voltage for the test circuit is to be an alternating current supply, and the circuit capacity is to be measured without the component in the circuit. The power factor of the test circuit is to be 0.9 – 1.0 unless a lower power factor is agreeable to those concerned.

46.1.7 Three samples of each component or conductor under test are to be subjected to each test condition and a new protective device is to be used for each test. Consideration is to be given to both short-circuit and ground-fault conditions.

Table 46.1
Short-circuit test currents

Full-load amperes[a]				Circuit capacity, amperes
Single phase				
115 V	208 V	230 – 240 V	277 V	
9.8 or less	5.4 or less	4.9 or less	–	200
9.9 – 16.0	5.5 – 8.8	5.0 – 8.0	6.65 or less	1000
16.1 – 34.0	8.9 – 18.6	8.1 – 17.0	–	2000
34.1 – 80.0	18.7 – 44.0	17.1 – 40.0	–	3500
Over 80.0	Over 44.0	Over 40.0	Over 6.65	5000
Three phase				
208 V	220 – 240 V	440 – 480 V	550 – 600 V	
2.12 or less	2.0 or less	–	–	200
2.13 – 3.7	2.1 – 3.5	1.8 or less	1.4 or less	1000
3.8 – 9.5	3.6 – 9.0	–	–	2000
9.6 – 23.3	9.1 – 22.0	–	–	3500
Over 23.3	Over 22.0	Over 1.8	Over 1.4	5000

[a] Water cooler.

46.2 Motor overload protective devices

46.2.1 There shall be no ignition of cheesecloth surrounding the enclosure of a motor protective device when samples are subjected to the test.

46.2.2 If a thermally protected motor or a separately enclosed motor overload protective device is within an outer cabinet, and if the assembly is constructed so that flame and molten metal will be confined within the cabinet and there is no flammable material except electrical insulation with the cabinet, the short-circuit test may be waived.

46.3 Bonding conductors and connections

46.3.1 Bonding conductors and connections shall not open when samples are subjected to this test.

46.4 Motor circuit conductors and connections

46.4.1 Motor circuit conductors and connections shall not be damaged when samples are subjected to this test.

47 Protective Devices – Maximum Continuous Current Test

47.1 To determine if a thermal protector complies with the requirement in 15.4(b)(2) or if a protective system complies with the requirement in 15.4(d)(2), the water cooler is to be tested in accordance with 47.2, unless the motor-compressor has been separately tested as described in 47.4.

47.2 Except as indicated in 47.3, the water cooler is to be connected to a circuit of rated voltage and operated under the conditions described in Table 47.1 for at least 1 hour or until stable conditions have been reached, whichever is longer. The voltage applied to the water cooler is then to be reduced to 90 percent of its rated voltage (if it will operate at that voltage) and operated until stable conditions exist. The voltage applied to the water cooler is then to be reduced in steps of 2 percent of rated voltage (to the nearest integral volt). Operation is to be allowed to become stable after each reduction in voltage before the next reduction is made, and readings of current input to the motor-compressor are to be noted after stable operation is obtained subsequent to each voltage reduction. This procedure is to be continued until the protective device opens the circuit. If the motor-compressor protective device trips at 90 percent of rated voltage, the voltage applied to the water cooler is to be increased to the rated voltage and the unit operated until stable operation is obtained. The voltage is then to be reduced in the 2 percent steps described above until the protective device opens. The motor-compressor current input at the lowest voltage step during which continuous operation occurs (the lowest voltage preceding the voltage at which the protective device opens the circuit) is to be used as a basis for judging compliance with the requirements in 15.1 and 15.4(b)(2) or (d)(2).

Table 47.1
Test conditions for calibration of thermal protectors and protective systems in water coolers

Location	EF	(EC)
Air temperature surrounding unit[a]	104	(40)
For bottle type air-cooled unit:		
Air temperature entering condenser	104	(40)
Drinking water temperature entering unit	104	(40)
Drinking water flow rate (minimum)	1 gph (3.8 liters/hour)	
For pressure type air-cooled unit:		
Air temperature entering condenser	104	(40)
Drinking water temperature entering unit	80	(26.7)
Drinking water temperature leaving unit	60	(15.6
For pressure type water-cooled unit:		
Condenser water temperature entering unit	80	(26.7)
Condenser water temperature leaving unit	100	(37.8)[b]
Drinking water temperature entering unit	80	(26.7)
Drinking water temperature leaving unit	60	(15.6)

[a] For convenience and if agreeable to all concerned, the test ambient air temperature for water-cooled units may be 77EF (25EC) to permit testing under the same conditions as the temperature and pressure test, Section 33.

[b] Where this condition cannot be attained due to design, the unit is to be tested at 80EF (26.7EC) inlet condenser water temperature and 35 psig nominal pressure.

47.3 With reference to 47.2, initial operation may be at such voltage that the current input is 156 percent of the rated current. The voltage is then to be reduced by 2 percent of rated voltage (to the nearest integral volt) to establish that the protective device opens at 156 percent of rated current or less. The voltage may be reduced to the motor-compressor only, with the other components in the water cooler maintained at rated voltage or higher if the results of the test under these conditions indicate compliance with 15.4(b)(2) or (d)(2). The rated voltage referred to is the highest of the rated voltages for dual-voltage-rated units. Stable operation is considered to be obtained when two consecutive readings, 15 minutes apart, of the temperature on top of the motor-compressor shell do not change more than 1EF (0.6EC).

47.4 The motor-compressor, with its protective system as employed in the water cooler, may be separately tested as described in 47.2 and 47.3 under the conditions described in Table 47.2. This separate test may be used as a basis for judging compliance with the requirements in 15.1 and 15.4(b)(2) or (d)(2).

Table 47.2
Test condition for calibration of thermal protectors and protective systems separately from water coolers

Location	EF	(EC)
Return gas:		
Saturated vapor temperature	53.5	(12)
Superheat	26.5	(14.7)
Discharge gas:		
Saturated vapor temperature	154	(68)
Ambient air:		
Temperature	115	(46.5)
Velocity	400 fpm[a]	(2.0 m/s)

[a] The velocity specified is the horizontal air velocity in the test chamber without the compressor installed. The actual velocity across the compressor may be different from this value, depending on the shape of the compressor and its effect on the air-flow pattern. A higher velocity may be employed if the results of the test with the higher air velocity indicate compliance with item B(2) or D(2) of 15.4.

48 Strength Tests – Pressure Containing Components

48.1 Parts exposed to high-side refrigerant pressure shall withstand, without failure (as defined in 48.14 and 48.15), a pressure equal to five times the pressure measured in the Temperature and Pressure Test, Section 33, and to five times the high-side factory test pressure specified in the Manufacturing and Production Tests, Section 54, for the refrigerant.

48.2 ASME pressure vessels bearing the Code "U" symbol with a working pressure not less than indicated in 48.1 are considered to comply with this requirement.

48.3 A pressure vessel having a marked working pressure shall withstand, without failure, a pressure equal to five times the working pressure.

48.4 High-side parts of water coolers provided with a pressure-limiting device required for compliance with 26.1 shall withstand, without failure, not less than three times the maximum cutout pressure permitted by adjustment of the pressure-limiting device. See 26.2.

48.4 revised June 11, 1997

48.5 High-side parts and low-side pressure vessels that are protected by a pressure-relief device shall withstand, without failure, a pressure equal to five times the start-to-discharge pressure of the relief valve or to five times the set pressure of the rupture member.

48.6 High-side parts of an air-cooled water cooler shall withstand, without failure, a pressure equal to three times the high-side pressure measured in the Condenser Fan Motor Failure Test, Section 35.

48.7 High-side parts of a water-cooled water cooler which is not provided with a pressure-limiting device, see 26.1, shall withstand, without failure, a pressure equal to five times the pressure measured in the Condenser Water Failure Test, Section 36.

48.7 revised June 11, 1997

48.8 If a pressure-limiting device which is not required by 26.1 is provided on a water-cooled water cooler, the high-side parts shall withstand, without failure, a pressure equal to three times the maximum adjustable setting of the pressure-limiting device.

48.8 revised June 11, 1997

48.9 High-side parts and low-side pressure vessels that are protected by a fusible plug shall withstand, without failure, a pressure equal to 2-1/2 times the vapor pressure of the refrigerant used at the relief temperature of the fusible plug or at the critical temperature of the refrigerant used, whichever is the smaller.

48.10 Parts exposed to low-side refrigerant pressure shall withstand, without failure, a pressure equal to five times the vapor pressure of the refrigerant at 70EF (21.1EC).

48.11 Low-side parts of a water cooler shall withstand, without failure, a pressure equal to three times the low-side pressure measured in the Condenser Fan Motor Failure Test, Section 35, or the Condenser Water Failure Test, Section 36, while the discharge pressure is relieved into the low-side of the system.

48.12 The minimum strength of low-side parts is 350 psig (2.4 MPa) for Refrigerant 12; 612.5 psig (4.2 MPa) for Refrigerant 22; 430 psig (3.0 MPa) for Refrigerant 500; and 685 psig (4.7 MPa) for Refrigerant 502. For other refrigerants, refer to saturated vapor temperature-pressure tables.

48.13 With reference to 48.1 – 48.10, sections of the refrigerant system constructed of continuous tubing or of lengths of tubing connected by hard-soldered, brazed, or welded joints will be considered as meeting the above requirements provided the tubing employed in the assembly conforms with 24.1.

48.14 Two samples of each refrigerant-containing part are to be tested to determine compliance with these requirements. The test samples are to be filled with water to exclude air and are to be connected in a hydraulic pump system. The pressure is to be raised gradually until the required pressure is reached. This pressure is to be maintained for 1 minute, during which time the samples are not to burst or leak except as indicated in 48.15.

48.15 Where gaskets are employed in components of water coolers containing Refrigerant 12, 22, 134a, 500, or 502, leakage at gaskets will not be considered a failure provided the leakage occurs at a pressure greater than 40 percent of the required pressure.

48.15 revised June 11, 1997

48.16 In reference to 48.15, the component is to be capable of withstanding the required strength test pressure even though leakage occurs at the gaskets or seals.

48.17 Pressure-actuated refrigeration controllers rated for the application are exempt from the requirements of this section.

48.18 Except as specified in 48.19, an unvented water-heating tank of a hot- and cold-type water cooler shall withstand a hydrostatic pressure of 300 psig (2.07 MPa) for a period of 15 minutes without leakage or permanent distortion.

48.19 As an alternative to 48.18, a small unvented water-heating tank, not exceeding 2-1/2 gallons (9.5 liters) in capacity, shall withstand a hydrostatic pressure of 500 psig (3.45 MPa) for a period of 1 minute without leakage or rupture.

49 Accelerated Aging Test – Electric Heaters

49.1 The following requirement applies to the cases of heater assemblies and terminal seals of metallic sheath heaters.

49.2 Rubber, neoprene, or thermoplastic compounds used as a heater casing or for the seal of terminals shall withstand accelerated aging as indicated in Table 49.1 for the maximum temperature rise measured on the device during a temperature test conducted in an ambient from 77 to 104EF (25 to 40EC) without deteriorating to a degree which will affect its use.

Table 49.1
Accelerated aging test criteria

Measured temperature rise		Material	Test program
EC	(EF)		
35	(63)	Rubber or neoprene	70-hour air oven aging test at 100EC ±2EC (212EF ±3.6EF)
35	(63)	Thermoplastic	7 days in an air-circulating oven at 100EC (212EF)
50	(90)	Rubber or neoprene	168-hour air oven aging test at 100EC ±2EC (212EF ±3.6EF)
50	(90)	Thermoplastic	10 days in an air-circulating oven at 100EC (212EF)
55	(99)	Rubber, neoprene, or thermoplastic	7 days in an air-circulating oven at 113EC (235.4EF)
65	(117)	Rubber or neoprene	10 days in an air-circulating oven at 121EC (249.8EF)
65	(117)	Thermoplastic	7 days at 121EC (249.8EF) or 60 days at 97EC (206EF) in an air-circulating oven
80	(144)	Rubber, neoprene, or thermoplastic	7 days in an air-circulating oven at 136EC (276.8EF)
100	(180)	Rubber, neoprene, or thermoplastic	60 days in an air-circulating oven at 136EC (276.8EF)
125	(225)	Rubber, neoprene, or thermoplastic	60 days in an air-circulating oven at 158EC (316.4EF)
175	(315)	Rubber, neoprene, or thermoplastic	60 days in an air-circulating oven at 210EC (410EF)

Table 49.1 revised May 14, 1996

50 Reliability Test – Heater Terminations

50.1 Electric heaters employing integrally molded leads or molded terminal assemblies shall withstand a test load of 20 pounds-force (89.0 N) applied for 1 minute. The load is to be applied in the same direction at which the lead exits the heater case or molded connection and is not to result in displacement of insulation or separation of the connection between the lead and heater.

51 Accelerated Aging Tests on Gaskets, Sealing Compounds, and Adhesives

51.1 51.2 – 51.6 apply to gaskets and sealing compounds required for electrical enclosures as determined during the Rain Test, Section 38. 51.7 applies to adhesives required to secure such gaskets to enclosures or covers.

51.2 Neoprene or rubber compounds, except foamed materials, shall have physical properties as indicated in Table 51.1 before and after accelerated aging under the conditions indicated in Table 51.2.

Table 51.1
Physical properties for gaskets

	Neoprene or rubber compound		Polyvinyl-chloride materials	
	Before test	**After test**	**Before test**	**After test**
Recovery – maximum set when 1-inch (25.4-mm) gage marks are stretched to 2-1/2 inches (63.5 mm), held for 2 minutes and measured 2 minutes after release	1/4 inch (6.4 mm)	–	Not specified	
Elongation – Minimum increase in distance between 1-inch (25.4 mm) gage marks at break	250 percent (1 to 3-1/2 inches) (25.4 to 88.9 mm)	65 percent of original	250 percent (1 to 3-1/2 inches) (25.4 to 88.9 mm)	75 percent of original
Tensile strength – Minimum force at breaking point	850 psi (5.86 MPa)	75 percent of original	1200 psi (8.27 MPa)	90 percent of original

51.3 Foamed neoprene or rubber compounds are to be subjected to accelerated aging under the conditions indicated in Table 51.2. The compounds shall not harden or otherwise deteriorate to a degree which will affect their sealing properties.

51.4 Thermoplastic materials shall be subjected to accelerated aging under the conditions indicated in Table 51.2. Thermoplastic material shall not deform or melt, or otherwise deteriorate to a degree which will affect its sealing properties. Solid polyvinyl-chloride gasket material shall have physical properties as indicated in Table 51.1 before and after the accelerated aging.

51.5 Gaskets of materials other than those mentioned in 51.2 – 51.4 shall be nonabsorptive and shall provide equivalent resistance to aging and temperatures.

51.6 Sealing compounds shall be applied to the surface they are intended to seal. A representative sample of the surface with the sealing compound applied shall be subjected to accelerated aging under the conditions indicated in Table 51.2 for air-circulated oven exposure. The sealing compound shall not melt, become brittle, or otherwise deteriorate to a degree which will affect its sealing properties as determined by comparing the aged sample to an unaged sample.

51.7 Where gaskets are secured by adhesives, samples of the gasket adhesive and mounting surface shall be subjected to:

a) Accelerated aging under the conditions indicated in Table 51.2 for air-circulated oven exposure and

b) Immersion in distilled water for 3 days.

The force required to peel the gasket from its mounting surface after exposure shall be not less than 50 percent of the value determined on "as-received" samples and in no case less than 2 pounds per inch (0.35 N/mm) of gasket width.

51.8 The temperatures indicated in Table 51.2 correspond to the maximum temperature rise measured on the gasket during the Temperature and Pressure Test, Section 33.

Table 51.2
Accelerated aging conditions

Measured temperature rise		Material	Test program
EC	(EF)		
35	(63)	Rubber or neoprene	70-hour air oven aging test at 100EC ±2EC (212EF ±3.6EF)
35	(63)	Thermoplastic	7 days in an air-circulating oven at 87EC (189EF)
50	(90)	Rubber or neoprene	168-hour air oven aging test at 100EC ±2EC (212EF ±3.6EF)
50	(90)	Thermoplastic	10 days in an air-circulating oven at 100EC (212EF)
55	(99)	Rubber, neoprene, or thermoplastic	7 days in an air-circulating oven at 113EC (235.4EF)
65	(117)	Rubber or neoprene	10 days in an air-circulating oven at 121EC (249.8EF)
65	(117)	Thermoplastic	7 days at 121EC (249.8EF) or 60 days at 97EC (206EF) in an air-circulating oven
80	(144)	Rubber, neoprene, or thermoplastic	7 days in an air-circulating oven at 136EC (276.8EF)

Table 51.2 revised May 14, 1996

52 Metallic Coating Thickness Test

52.1 The solution to be used for the Chromic Acid Dropping Test is to be made from distilled water and is to contain 200 grams per liter of chemically pure chromic acid, CrO_3, and 50 grams per liter of chemically pure concentrated sulfuric acid, H_2SO_4. The latter is equivalent to 27 milliliters per liter of chemically pure concentrated sulfuric acid, specific gravity 1.84, containing 96 percent of H_2SO_4.

52.2 The test solution is to be contained in a glass vessel, such as a separatory funnel, with the outlet equipped with a stopcock and a capillary tube of approximately 0.025 inches (0.64 mm) inside bore and 5.5 inches (140 mm) long. The lower end of the capillary tube is to be tapered to form a tip; the drops from which are to be approximately 0.05 milliliter each. To preserve an effectively constant level, a small glass tube is to be inserted in the top of the funnel through a rubber stopper and its position is to be adjusted so that, when the stopcock is open, the rate of dropping is 100 ±5 drops per minute. If desired, an additional stopcock may be used in place of the glass tube to control the rate of dropping.

52.3 The sample and the test solution should be kept in the test room long enough to acquire the temperature of the room, which should be noted and recorded. The test is to be conducted at a room temperature of 70 to 90EF (21.1 to 32.2EC).

52.4 Each sample is to be thoroughly cleaned before testing. All grease, lacquer, paint, and other nonmetallic coatings are to be removed completely by means of suitable solvents. Samples are then to be thoroughly rinsed in water and dried with clean cheesecloth. Care should be exercised to avoid contact of the cleaned surface with the hands or any foreign material.

52.5 The sample to be tested is to be supported 0.7 – 1 inch (17.8 – 25.4 mm) below the orifice so that the drops of solution strike the point to be tested and run off quickly. The surface to be tested should be inclined approximately 45 degrees from horizontal.

52.6 After cleaning, the sample to be tested is to be placed under the orifice. The stopcock is to be opened and the time in seconds is to be measured with a stopwatch until the dropping solution dissolves off the protective metallic coating exposing the base metal. The end point is the first appearance of the base metal recognizable by the change in color at that point.

52.7 Each sample of a test lot is to be subjected to the test at three or more points, excluding cut, stenciled, and threaded surfaces, on the inside surface, and at an equal number of points on the outside surface, at places where the metallic coating may be expected to be the thinnest. On enclosures made from precoated sheets, the external corners that are subjected to the greatest deformation may have thin coatings.

52.8 To calculate the thickness of the coating being tested, select from Table 52.1 the thickness factor appropriate for the temperature at which the test was conducted and multiply by the time in seconds required to expose base metal as determined in 52.6.

Table 52.1
Coating thickness factors

Temperature in degrees,		Thickness factors, 0.00001 inches (0.0003 mm) per second	
EF	(EC)	Cadmium platings	Zinc platings
70	(21.1)	1.331	0.980
71	(21.7)	1.340	0.990
72	(22.2)	1.352	1.000
73	(22.8)	1.362	1.010
74	(23.3)	1.372	1.015
75	(23.9)	1.383)	1.025
76	(24.4)	1.395	1.033
77	(25.0)	1.405	1.042
78	(25.6)	1.416	1.050
79	(26.1)	1.427	1.060
80	(26.7)	1.438	1.070
81	(27.2)	1.450	1.080
82	(27.8)	1.460	1.085
83	(28.3)	1.470	1.095
84	(28.9)	1.480	1.100
85	(29.4)	1.490	1.110
86	(30.0)	1.501	1.120
87	(30.6)	1.513	1.130
88	(31.1)	1.524	1.141
89	(31.7)	1.534	1.150
90	(32.2)	1.546	1.160

53 Marking Label Adhesion Tests

53.1 General

53.1.1 After being subjected to the conditions described in 53.2.1 – 53.5.1, a pressure-sensitive label or a label secured by cement or adhesive is considered to be of a permanent nature if immediately following removal from each test medium:

a) Each sample demonstrates good adhesion and the edges are not curled,

b) The label resists defacement or removal as demonstrated by scraping across the test panel with a flat metal blade 1/32 inch (0.8 mm) thick, held at right angles to the test panel, and

c) The printing is legible and is not defaced by rubbing with thumb or finger pressure.

53.2 Oven-aging test

53.2.1 Three samples of the label applied to test surfaces as in the intended application are to be placed in an air oven maintained at the temperature indicated in Table 53.1 for 240 hours, and then allowed to cool in a controlled atmosphere maintained at 73.4 ±3.2EF (23 ±2EC) and 50 ±5 percent relative humidity.

Table 53.1
Temperatures, oven-aging test

Maximum temperature of surfaces to which applied[a]	Test temperature
60EC (140EF) or less	87EC (189EF)
80EC (161EF) or less	105EC (221EF)
100EC (212EF) or less	121EC (250EF)
125EC (257EF) or less	150EC (302EF)
150EC (302EF) or less	180EC (356EF)
Over 150EC (302EF)	b

[a] As measured during temperature tests.

[b] A label which is applied to a surface attaining a temperature greater than 150EC (302EF) during the temperature tests is to be oven-aged at a temperature which is representative of the temperature attained by the refrigerator during normal and abnormal operation.

53.3 Immersion test

53.3.1 Three samples of the label applied to test surfaces as in the intended application are to be placed in a controlled atmosphere maintained at 73.4 ±3.2EF (23 ±2EC) and 50 ±5 percent relative humidity for 24 hours. The samples are then immersed in water at a temperature of 69.8 ±3.2EF (21 ±2EC) for a period of 48 hours.

53.4 Standard-atmosphere test

53.4.1 Three samples of the label applied to test surfaces as in the intended application are to be placed in a controlled atmosphere maintained at 73.4 ±3.2EF (23 ±2EC) and 50 ±5 percent relative humidity for 72 hours.

53.5 Unusual-condition exposure test

53.5.1 If the labels are exposed to unusual conditions in service, such as oil, grease, cleaning solutions, or the like, three samples of the label applied to test surfaces as in the intended application are to be placed in a controlled atmosphere maintained at 73.4 ±3.2EF (23 ±2EC) and 50 ±5 percent relative humidity for 24 hours. The samples are then to be immersed for 48 hours in a solution representative of service use maintained at the temperature the solution would attain in service, but in no case less than 73.4 ±3.2EF (23 ±2EC).

MANUFACTURING AND PRODUCTION TESTS

54 Pressure Tests

54.1 Each water cooler shall be tested and proved tight at pressures not less than those specified in Table 54.1 and not less than the design pressure marked on the water cooler.

Exception: A method other than pressure testing at the design pressure may be employed if it can be demonstrated that the alternate test method produces results that are at least equivalent to the pressure test method.

Revised 54.1 effective March 24, 1998

Table 54.1
Minimum design pressure

	Minimum design pressure					
	Low-side		High-side			
			Air-cooled		Water cooled	
Refrigerant	psig	(kPa)	psig	(kPa)	psig	(kPa)
R12	85	(586)	169	(1165)	127	(876)
R22	144	(993)	278	(1917)	211	(1455)
R134a	88	(606)	186	(1282)	135	(930)
R500	102	(703)	203	(1400)	153	(1054)
R502	162	(1117)	302	(2082)	232	(1600)

Table 54.1 revised September 24, 1996

54.2 If the final assembly is completed with flare-type fittings or telescoped tubing joints which are sealed with silver solder, brazing, or the equivalent, the leakage test on the complete system may be at the indicated low-side test pressure provided the high-side parts are individually tested either by the water cooler manufacturer or by the manufacturer of the part at not less than the high-side pressure indicated.

54.3 Condensers constructed of finned copper tubing having a wall thickness less than 0.016 inch (0.41 mm) are to be tested at a pressure not less than 125 percent of the maximum pressure developed in the Temperature and Pressure Test, Section 33.

54.4 At least once each year, the manufacturer shall conduct a strength test on refrigerant-containing parts of the shell type, including compressor shells which have an inside diameter greater than 3 inches (76.2 mm). The tests shall be conducted on at least one sample of each size and type. The sample shall not fail when subjected to pressures indicated under Strength Tests – Pressure Containing Components, Section 48.

Exception: ASME code vessels bearing the Code "U" symbol need not be retested.

55 Production Line Dielectric Voltage-Withstand Tests

55.1 Each product shall withstand without electrical breakdown, as a routine production-line test, the application of a potential at a frequency within the range of 40 – 70 hertz, or a dc potential

a) Between the primary wiring, including connected components, and accessible dead metal parts that are likely to become energized and

b) Between primary wiring and accessible low-voltage, 42.4 volts peak or less, metal parts, including terminals.

55.1 revised May 14, 1996

55.1.1 The production-line test shall be conducted in the time and at the potential specified in either Condition A or Condition B of Table 55.1.

55.1.1 added May 14, 1996

Table 55.1
Production-line test conditions

Product rating	Condition A			Condition B		
	Potential		Time,	Potential		Time,
	volts, ac[c]	volts, dc	seconds	volts, ac[c]	volts, dc	seconds
250 volts or less with no motor rated more than 1/2 horsepower (373 watts output)	1000	1400	60	1200	1700	1
250 volts or less with a motor rated more than 1/2 horsepower (373 watts output)	1000 + 2V[a]	1400 + 2.8V[a]	60	1200 + 2.4V[a]	1700 + 3.4V[a]	1
251 – 600 volts	1000 + 2V[b]	1400 + 2.8V[b]	60	1200 + 2.4V[b]	1700 + 3.4V[b]	1

[a] Maximum marked voltage but not less than 120 volts if the maximum marked voltage is within the range 105 – 120 volts, and not less than 240 volts if the maximum marked voltage is within the range 210 – 240 volts.

[b] Maximum marked voltage.

[c] Where there are capacitors across the insulation under test (e.g. radio-frequency filter capacitors), it is recommended that d.c. test voltages are used.

Table 55.1 added May 14, 1996

55.2 For equipment employing low-voltage circuits, the test is to be conducted with the low-voltage circuit connected to the cabinet, chassis, or other dead metal part so that the potential applied between the high-voltage live parts and dead metal parts will simultaneously be applied between high-voltage live parts and low-voltage circuits.

55.2 revised May 14, 1996

55.2.1 The test shall be conducted when the product is fully assembled. It is not intended that the product be unwired, modified, or disassembled for the test.

Exception No. 1: A part, such as a snap cover or friction-fit knob, that would interfere with performance of the test need not be in place.

Exception No. 2: The test may be performed before final assembly if the test represents that for the completed product. Any component not included shall not affect the results with respect to determination of possible risk of electric shock resulting from miswiring, defective component, insufficient spacings, and the like.

55.2.1 added May 14, 1996

55.3 Solid-state and similar components that might be damaged by a secondary effect (induced voltage surge, excessive heating, and the like), of the test may be short-circuited by means of a temporary electrical jumper or the test may be conducted without the component electrically connected, providing the wiring and terminal spacings are maintained. Additionally, components providing a d.c. path in parallel with the insulation to be tested (primary to dead-metal) may be disconnected during the test. Examples of such components are discharge resistors for filter capacitors and voltage limiting devices such as transient voltage suppressors (other than capacitors.)

55.3 added May 14, 1996

55.4 If the output of the test-equipment transformer is less than 500 volt-amperes, the equipment shall include a voltmeter in the output circuit to directly indicate the test potential.

55.4 revised May 14, 1996

55.5 The test equipment shall have a means of:

a) Indicating the test potential,

b) An audible or visual indicator of electrical breakdown, and

c) Either a manually reset device to restore the equipment after electrical breakdown or an automatic reject feature of any noncomplying unit.

When an ac test potential is applied, the test equipment shall include a transformer having an essentially sinusoidal output.

55.5 revised May 14, 1996

55.6 If the output of the test-equipment transformer is 500 volt-amperes or more, the test potential may be indicated:

a) By a voltmeter in the primary circuit or in a tertiary-winding circuit;

b) By a selector switch marked to indicate the test potential; or

c) For equipment having a single test-potential output, by a marking in a readily visible location to indicate the test potential. If a marking is used without an indicating voltmeter, the equipment shall include a positive means, such as an indicator lamp, to indicate that the manually reset switch has been reset following a dielectric breakdown.

55.6 added May 14, 1996

55.7 Test equipment other than that described in the preceding paragraphs may be used if found to accomplish the intended factory control.

55.7 added May 14, 1996

55.8 During the test,

a) The primary switch is to be in the on position,

b) Both sides of the primary circuit of the product are to be connected together and to one terminal of the test equipment, and

c) The second test-equipment terminal is to be connected to accessible dead metal.

Exception: A product having circuitry that is resistive, high-impedance winding, or the like and is not subject to excessive secondary-voltage build-up in case of electrical breakdown during the test may be tested:

a) With a single-pole primary switch, if used, in the off position, or

b) With only one side of the primary circuit connected to the test equipment when the primary switch is in the on position or when a primary switch is not used.

55.8 added May 14, 1996

56 Production Line Grounding Continuity Tests

56.1 The manufacturer shall test each water cooler which has a power supply cord to assure electrical continuity between the device and the grounding blade of the attachment plug as required by 11.1.

56.2 An indicating device such as an ohmmeter, low-voltage battery- and buzzer-combination, or the like, may be employed in the test mentioned in 56.1.

56.3 Where internal parts are referred to in 11.1 are determined in the investigation of the device to be bonded to the frame and enclosure of the water cooler, a test which determines the electrical continuity between the grounding blade and the frame or enclosure is sufficient for establishing compliance with 56.1.

MARKING

57 General

57.1 Unless otherwise specifically indicated, all markings shall be permanent.

57.2 A marking that is required to be permanent shall be molded, die-stamped, paint-stenciled, stamped, or etched metal that is permanently secured, or indelibly stamped on pressure-sensitive labels secured by adhesive that, upon investigation, see Marking Label Adhesion Tests, Section 53, is found to be adequate for the application. Ordinary usage, handling, and storage of the water cooler is considered in the determination of the permanence of the marking.

57.3 Each water cooler shall be marked with the following:

a) The manufacturer's or private labeler's name or identifying symbol.

b) A distinctive type or model designation.

c) The electrical rating.

d) The kind and amount of refrigerant in pounds-mass (kg x 2.2) and/or ounces (kg x 35.3).

e) The high- and low-side design pressure.

f) The date of manufacture, which may be in code.

Revised 57.3 effective March 24, 1998

57.4 The kind of refrigerant shall be designated by number according to the Standard for Number Designation and Safety Classification of Refrigerants, ANSI/ASHRAE 34-1992. The number shall be prefixed or suffixed with the word "Refrigerant" or it shall be prefixed with the letter "R" or the trade name of the refrigerant. Combinations of these marks are acceptable, except that employing the letter "R" and the word "Refrigerant" in the same marking group is not appropriate.

57.5 Examples for refrigerant marking are as follows: R12, Refrigerant 12, or 12 Refrigerant; (Trade Name) 12, (Trade Name) R 12, or (Trade Name) 12 Refrigerant.

57.5.1 The high- and low-side design pressure marked on the water cooler shall not be less than the values recorded during the Temperature and Pressure Test, Section 33, nor less than the values shown in Table 54.1. For other refrigerants, the minimum design pressure shall be not less than the values recorded during the temperature and pressure test nor less than the saturation pressure of the refrigerant at the following temperatures:

a) 80EF (26.5EC) for low-sides,

b) 105EF (40.5EC) for water-cooled high-sides,

c) 125EF (51.7EC) for air-cooled high-sides.

Added 57.5.1 effective March 24, 1998

57.6 Water coolers shall be marked with the operating voltage, the frequency, and the total or individual loads as indicated in 58.1 and 59.1. Permanently connected water coolers shall also be marked with the number of phases.

57.7 The information specified in 57.3 – 57.6 shall be on a nameplate or plates located, where after installation of the water cooler, they will be readily visible and legible without requiring the use of keys or tools for removal of panels, or the like. The nameplate shall be constructed and fastened so as to form a permanent part of the assembly.

57.7.1 If parts or sections of a water cooler are separately shipped from the factory, the primary nameplate for the water cooler shall comply with the requirements of 57.7, and the section incorporating the primary nameplate shall be permanently marked in a manner that will relate the sections to one another when they are installed in the field. The parts or sections shall be permanently marked with the manufacturer's or private labeler's name or identifying symbol and a distinctive model or type designation.

57.7.1 added September 24, 1996

57.8 A water cooler that incorporates a hermetic motor-compressor with a thermal protector that provides protection in accordance with the requirements in 15.4(b) shall be marked "Motor-Compressor Thermally Protected" or with an equivalent statement to reference the motor-compressor(s) involved, unless the motor-compressor(s) is marked "Thermally Protected."

57.9 A water cooler that incorporates a complete protective system that provides protection in accordance with 15.4(d) shall be marked "Motor-Compressor Thermally Protected System," or with an equivalent statement to reference the motor-compressor(s) involved.

57.10 A cautionary marking shall be prefixed by CAUTION, WARNING, or DANGER, and shall be in letters no less than 1/8 inch (3.2 mm) high.

57.11 If the design of the water cooler requires the use of tools for removal of panels, covers, and the like, for the purpose of user cleaning or similar servicing recommended by the manufacturer, and if such removal involves the exposure of persons to unintentional contact with any normally enclosed or protected uninsulated high-voltage live part, moving part, or hot part of a water heating system, the water cooler shall be marked with the following or equivalent statement: "Disconnect Power Before Servicing." The marking shall be permanent and shall be located so as to be visible before or immediately upon removal of a panel, cover, or the like, that normally encloses or protects the live part, moving part, or hot part. The marking shall not be on the back of a removable panel or cover.

57.12 With respect to 57.9, if the marking is located on a removable panel or cover, the design of the panel or cover or its means of attachment is to be such that replacement will not obscure the warning.

57.13 The working pressure, 127.5 psig (0.88 MPa) maximum, for an unvented hot-water storage tank which has been tested in accordance with 48.18 shall be plainly marked on the exterior of a hot- and cold-type water cooler.

57.14 The working pressure (not greater than one fifth of the hydrostatic test pressure) of an unvented water heating tank, tested in accordance with 48.19, shall be plainly marked on the exterior of a hot- and cold-type water cooler.

57.15 A hot- and cold-type water cooler with an unvented water-heating tank shall be marked to indicate the means provided for the connection of a field-installed pressure-relief valve. The marking shall include the statement "INSTALL PRESSURE-RELIEF MECHANISM AS REQUIRED BY LOCAL CODES." This information may appear on a paper sticker glued and/or shellacked to an accessible cover.

57.16 As a precautionary reminder, a hot- and cold-type water cooler with an unvented water-heating tank shall be provided with installation instructions to indicate that discharge from pressure-relief valves, where required, must be directed away from electrical components and persons using or servicing the equipment.

57.17 A water cooler intended for outdoor use shall be permanently marked to so indicate. The marking shall be located on or adjacent to the water cooler's nameplate.

57.18 If a manufacturer produces water coolers at more than one factory, each such assembly shall have a distinctive marking to identify it as the product of a particular factory.

57.19 Additional marking requirements are specified in 8.2.17, 8.4.4 – 8.4.7, 9.1.2, 15.10, 27.3.1, 27.3.3, and 46.1.7.

58 Permanently Connected Water Coolers

58.1 Except as indicated in 58.3 and 58.4, a permanently connected water cooler shall have the individual loads marked in amperes. The marking shall indicate clearly which loads operate concurrently unless it is obvious that the total load is the sum of the individual loads.

58.2 The individual loads shall be indicated as follows:

a) For a motor other than a hermetic refrigerant motor-compressor:

1) Full-load amperes, and

2) Horsepower, except as noted in 58.3.

b) For a hermetic refrigerant motor-compressor:

1) Rated-load amperes.

2) Locked-rotor amperes, except as noted in 58.5.

3) The branch-circuit-selection current in amperes, if required in accordance with 58.13.

c) For a resistance-type heating element, except as indicated in 58.3, in amperes, watts, or kilowatts.

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58.3 Motors rated less than 1/8 horsepower (93.2 W output) and heater circuits may be marked in watts. A heater load of less than 1 ampere and pilot duty loads need not be marked.

58.4 The nameplate ampere rating for single-phase water coolers intended for permanent connection to a single branch circuit, as described below, may be a single ampere value rather than individual ratings for the individual loads under the following conditions:

a) The water cooler includes a combination of a hermetic refrigerant motor-compressor and other loads (one or more motors, heaters, and the like).

b) The single load rating (amperes), the marked maximum size supply-circuit overcurrent device, and the marked minimum supply circuit ampacity do not exceed the tabulated values as specified in Table 58.1.

c) The single marked ampere rating is not less than the sum of the individual load ratings (at the maximum concurrent load condition) which would be required to be marked on the water cooler if the individual load ratings were shown.

Table 58.1
Single ampere rating limitations

Maximum ampere rating	Maximum voltage rating	Maximum size of branch-circuit overcurrent device, amperes	Minimum circuit ampacity, amperes
12	120	15	15
16	120	20	20
12	208 or 240	15	15

58.5 Except where a single ampere rating is permitted by 58.4, a permanently connected water cooler shall be marked with the locked-rotor current of single-phase compressors having rated load currents of more than 9 amperes at 115 volts and more than 4.5 amperes at 230 volts and with the locked-rotor current of compressors rated above 230 volts or if polyphase.

58.6 The following shall appear on the nameplate of a permanently-connected water cooler: the minimum circuit ampacity and the maximum rating of the branch circuit fuse if the water cooler employs:

a) More than one motor, or

b) A motor and other loads. If a permanently-connected water cooler is intended for use on two or more circuits, the nameplate shall include the above information for each circuit. Also see 58.7 – 58.12.

58.7 The marking required in 58.6 may additionally specify a maximum "HACR Type" circuit breaker size if the required short-circuit tests have been conducted in accordance with the Limited Short-Circuit Test, Section 46, using an "HACR Type" circuit breaker.

58.8 A circuit breaker may be specified for overcurrent protection of the supply circuit provided:

a) The branch circuit is protected at not more than 20 amperes at 125 volts or less, or 15 amperes at 600 volts, and

b) The rating of any motor in the circuit does not exceed 1 horsepower (746 W output) and 6 amperes.

58.9 The marking required in 58.6 may specify a maximum fuse size or a maximum circuit-breaker size or both, or it may refer to the maximum rating of an overcurrent protective device without referring to fuse or circuit breakers if the internal motor circuit involved is protected by:

a) A circuit breaker provided as part of the unit, that has been subjected to short-circuit tests, in combination with the motor-circuit wiring and components, and found to provide short-circuit and ground-fault protection for the motor circuit wiring and components, or

b) A fuse, provided as part of the equipment, of a type and rating found to provide short-circuit and ground-fault protection for the motor circuit wiring and components.

See Limited Short-Circuit Test, Section 46.

58.10 The marking required in 58.6 may specify a maximum fuse or circuit-breaker size or both, or it may refer to the maximum rating of an overcurrent-protective device without referring to fuses or circuit breakers, if the unit complies with (a) - (c), inclusive:

a) Each motor overload-protective device complies with the requirements of the Limited Short-Circuit Test, Section 46. Compliance may be established by one of the following means:

1) The internal motor circuit involved is protected by an overcurrent device, provided as part of the equipment, of a type and rating acceptable for short-circuit and ground-fault protection of the motor circuit involved, or

2) A short-circuit test on the motor overload-protective device is not required (for example, if the motor overload-protective device is located at the center point of a wye-connected, three-phase motor, or is located inside a hermetic motor-compressor enclosure), or

3) The motor overload-protective device has been subjected to the Limited Short Circuit Test, Section 46, using a fuse rated so that the circuit impedance during the test is the same or less than could be anticipated using a circuit breaker rated not more than the marked maximum rating of the overcurrent device; and:

i) The results of the test are such that the motor overload-protective device opens the circuit and

ii) The fuse does not open during the test.

b) The marked maximum rating of the overcurrent-protective device does not exceed 225 percent of the full-load current rating of any motor controller protected against short circuits and ground-faults by the overcurrent device.

c) The marked maximum rating of the overcurrent-protective device does not exceed 180 percent of the ampacity of motor-circuit conductors protected by that overcurrent-protective device, except as specified in 9.2.6 (c). Ampacities of conductors are to be determined from the ampacity tables in the National Electrical Code, ANSI/NFPA 70-1987, for the type of wire or cord employed or the wire or cord equivalent to appliance-wiring material.

58.11 The minimum ampacity required in accordance with 58.6 shall be at least equal to:

a) 125 percent of the rated current of the largest motor plus

b) The rated current ratings of other motors and loads supplied.

The largest motor is determined by its rated current. The ampacity marked on the nameplate shall be the highest of those calculated for each concurrent load condition.

58.12 The maximum rating of a supply-circuit overcurrent-protective device shall not exceed 225 percent of the rated load current of the largest hermetic motor plus an amount equal to the sum of any additional concurrent loads. For a circuit involving other than hermetic motors, the rating of the overcurrent-protective device shall not exceed 400 percent of the full-load current of the largest motor plus an amount equal to the sum of any additional concurrent loads.

58.13 If a thermal protector or protective system for a hermetic motor-compressor permits a continuous current of more than 156 percent of the rated-load current of the motor-compressor as marked on the water cooler nameplate, and the water cooler is intended for use on a circuit which exceeds the limitation mentioned in 15.5, a "branch-circuit-selection current" rating, in amperes, shall also be marked. The marked value of this rating shall be at least 64.1 percent of the maximum continuous current determined in accordance with Protective Devices – Maximum Continuous Current Test, Section 47.

58.14 Unless correct field-wiring connections are obvious, a wiring diagram shall be attached to each permanently connected water cooler to show the intended method of making field-wiring connections. A paper sticker glued, shellacked, or both, to an accessible cover is considered as complying with this requirement.

58.15 A water cooler with field wiring terminals shall be marked:

a) "Use Copper Conductors Only" if the water cooler is not intended for field connection with aluminum wire, or

b) "Use Copper Or Aluminum Conductors," "Use Copper Or Copper-Clad Aluminum Conductors," or "Use Copper, Copper-Clad Aluminum, Or Aluminum Conductors" if the water cooler is intended for field connection with either copper or aluminum wire.

In either case, an equivalent statement that identifies the intended wiring material may be used. The marking shall be independent of any marking on the terminal connector and may appear on an attached wiring diagram. The marking shall be visible during installation of the water cooler and also when the terminals are exposed for inspection after the unit has been installed.

58.16 If other than three overcurrent units are employed for protection of a three-phase motor, a marking shall appear on the water cooler to indicate that the motor is protected under primary single-phasing conditions. This marking may be a separate paper sticker or decal or may be on the attached wiring diagram.

59 Cord Connected Water Coolers

59.1 A cord connected water cooler shall be marked with the total load in amperes. The marked ampere load shall include all individual loads which may operate concurrently.

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SUPPLEMENT SA – SANITATION REQUIREMENTS FOR DRINKING-WATER COOLERS

INTRODUCTION

SA1 Scope

Added Section SA1 effective March 3, 1995

SA1.1 This supplement covers sanitation requirements for drinking-water coolers, remotely installed bubblers, and other dispensing means. These requirements shall be complied with in addition to the applicable requirements in Sections 1 - 59.

CONSTRUCTION

SA2 Bubbler Nozzle and Guard

Added Section SA2 effective March 3, 1995

SA2.1 The bubbler nozzle and guard shall be constructed of a corrosion-resistant, non-toxic, non-absorbent, non-porous,durable material having a smooth easily cleanable surface finish.

a) The bubbler nozzle orifice and other openings in the supply to the nozzle shall be at least 1 inch (25.4 mm) above the flood-level rim of the bowl so that the nozzle or openings will not be flooded in case of stoppage in the waste provisions. The nozzle and openings shall conform, as modified below, to 5.1 of the American National Standard Air Gaps in Plumbing Systems (American National Standards Institute Standard A112.1.2-1991), as follows:

" Minimum Elevations. All drinking fountain nozzles including those which may at times extend through a water surface and with orifice diameter not greater than 7/16 in. (11.2 mm) or 0.150 sq in. (96.8 mm^2) area shall be placed so that the lower edge of the nozzle orifice is at an elevation not less than 3/4 in. (19.1 mm) above the flood-level rim of the receptacle.

The 3/4 in. (19.1 mm) elevation shall also apply to nozzles with more than one orifice providing that the sum of the areas of all orifices shall not exceed the area of a circle 7/16 in. (11.2 mm) in diameter.

Should the cross-sectional area of a single-nozzle orifice or the sum of the cross sections of the orifices, in case there is more than one, be greater than that of a circle 7/16 in. (11.2 mm) in diameter, the elevation shall be not less than H in the following formula:

$H = [d/0.0440] \times 0.75$ in., ($H = [d/11.2] \times 19.1$ mm)

where d is the diameter of a circle equal in cross-sectional area to that of the nozzle orifice or orifices."

b) The nozzle shall be protected by a guard designed in conjunction with the nozzle to prevent persons from directly contacting the nozzle while drinking from the cooler, and to prevent foreign matter from dropping vertically into the nozzle. The guard shall be such width, height, and design that the user's mouth or lips cannot readily touch the nozzle. Spaces between the nozzle and guard shall be proportioned to allow for convenient cleaning of these parts.

1) The bubbler nozzle and guard shall be designed so as to discourage hose connections or other improper uses.

c) The bubbler stream shall issue from a nozzle set at an angle from the vertical so as to prevent the water in the jet from returning to the orifice or orifices from which it issues. The inclined jet of water issuing from the nozzle shall not touch the ground.

SA3 Air Gap

Added Section SA3 effective March 3, 1995

SA3.1 Where a potable water line (such as a water-cooled condenser outlet) is to be connected to a drainage system, this connection shall be made through an air gap. This air gap shall be one which will permit no back flow under conditions of a flooded, obstructed drain with a 0-30 inch Hg (0-101.4 kPa) vacuum in the water line to the air gap. The air gap to the drainage system shall be equal to at least twice the inside diameter of the condenser-water discharge pipe at the entrance to the air gap, but in any case the air gap shall be not less than one inch (25.4 mm).

a) When the air gap is installed external to the drinking-water cooler, separate connections shall be provided on the cooler for the water-cooled condenser discharge or other similar water outlets and the bubbler bowl drain. The drain connection from the bubbler bowl and the other water discharge line shall not be interconnected ahead of the air gap.

b) A card or tag describing an air gap and giving instructions for its installation shall be attached near the water-cooled condenser connection, unless an air gap is installed at the factory.

SA4 Top or Bowl

Added Section SA4 effective March 3, 1995

SA4.1 A water cooler top or bowl shall include a drain basin which shall be constructed of a smooth, durable, corrosion-resistant, and impervious material such as vitreous china, enameled cast iron, stainless steel, or other material which will continue to be impervious and will retain a smooth, easily cleanable surface under normal use conditions. The basin shall be designed and constructed so as to minimize splashing at the place where the jet falls onto the basin.

a) The connection between the top or bowl and the waste line shall be a smooth, watertight, free-flowing joint utilizing a minimum of components and presenting a minimum of cracks and crevices.

b) The waste system leading from the bowl shall be a closed drain with no restrictions that would reduce the free opening to less than 3/4-inch (19.0 mm) diameter and shall provide free flow and complete drainage of waste water. The inlet to the waste system shall be provided with a strainer which may be an integral part of the bowl. The outlet of the line shall be suitable for attachment to a 1-1/4 inch (31.7 mm) trap.

c) If a precooler is used, it shall provide more than a single thickness of metal between the potable water and the waste water in the heat exchanger.

d) If the water cooler is also designed to supply hot water, the water heating system shall operate at atmospheric pressure or be designed to permit field installation of a relief device where required by local codes.

e) The cabinet shall be of non-absorbent material. The top or bowl shall overhang the sides of the cabinet and any openings in the sides of the cabinet shall be so designed and arranged as to shed outward any fluid overflowing the bowl.

PERFORMANCE

SA5 Nozzle Flow Control Test

Added Section SA5 effective March 3, 1995

SA5.1 The valve or valves provided to control water flow through the nozzle shall meet the following requirements:

a) The hand-operated or foot-operated valve shall be self-closing and shall provide tight shutoff when not in use.

b) The hand- or foot-operated valve, or internal pressure regulating valve where provided, shall be adjustable, to accommodate line pressures from 20 to 90 psig (137.8 to 620.1 gage), so that at maximum opening the nozzle stream will strike the basin well within the rim, and shall be directed so as not to impinge on the waste opening strainer plate.

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APPENDIX A

Standards for Components

Standards under which components of the products covered by this standard are evaluated include the following:

Title of Standard – UL Standard Designation

Armored Cable – UL 4
Attachment Plugs and Receptacles, Electrical – UL 498
Cables, Nonmetallic-Sheathed – UL 719
Conduit, Electrical, Flexible Metal – UL 1
Conduit, Electrical, Rigid Metal – UL 6
Controls, Limit – UL 353
Cord Sets and Power-Supply Cords – UL 817
Electric Motors – UL 1004
Flexible Cord and Fixture Wire – UL 62
Fuseholders – UL 512
Hermetic Refrigerant Motor-Compressors – UL 984
Industrial Control Equipment, Electrical – UL 508
Marking and Labeling Systems – UL 969
Motor-Compressors, Hermetic Refrigerant – UL 984
Motor-Operated Appliances, Electric – UL 73
Motors, Electric – UL 1004
Motors, Overheating Protection for – UL 2111
Outlet Boxes, Metallic, Electrical – UL 514A
Plastic Materials for Parts in Devices and Appliances, Tests for Flammability of – UL 94
Polymeric Materials – Short Term Property Evaluations – UL 746A
Polymeric Materials – Use in Electrical Equipment Evaluations – UL 746C
Refrigerant-Containing Components and Accessories, Nonelectrical – UL 207
Switches, Clock-Operated – UL 917
Switches, Snap, General-Use – UL 20
Switches, Special-Use – UL 1054
Temperature-Indicating and -Regulating Equipment, Electrical – UL 873
Terminals, Electrical Quick-Connect – UL 310
Thermal Cutoffs for Use in Electrical Appliances and Components – UL 1020
Transformers, Class 2 and Class 3 – UL 1585
Transformers, Specialty – UL 506
Tubing, Electrical Metallic – UL 797
Valves, Electrically-Operated – UL 429
Wire Connectors and Soldering Lugs for Use With Copper Conductors – UL 486A
Wire Connectors for Use With Aluminum Conductors – UL 486B
Wires and Cables, Rubber-Insulated – UL 44
Wires and Cables, Thermoplastic-Insulated – UL 83

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