UL 563

STANDARD FOR SAFETY

Ice Makers

UL Standard for Safety for Ice Makers, UL 563

Eighth Edition, Dated July 31, 2009

Summary of Topics

This revision of UL 563 dated May 26, 2021 includes the addition of Supplement SB – Germicidal UV Irradiator Systems Within Ice Makers

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The new requirements are substantially in accordance with Proposal(s) on this subject dated January 8, 2021.

No Text on This Page

JULY 31, 2009
(Title Page Reprinted: May 26, 2021)

1

UL 563

Standard for Ice Makers

First Edition – October, 1958
Second Edition – May, 1973
Third Edition – February, 1974
Fourth Edition – December, 1975
Fifth Edition – May, 1984
Sixth Edition – January, 1992
Seventh Edition – July, 1995

Eighth Edition

July 31, 2009

This UL Standard for Safety consists of the Eighth Edition including revisions through May 26, 2021.

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

No Text on This Page

CONTENTS

INTRODUCTION

CONSTRUCTION

ELECTRICAL COMPONENTS

ELECTRICAL SPACINGS

REFRIGERATION SYSTEM

PERFORMANCE

APPENDIX A

INTRODUCTION

1 Scope

1.1 These requirements cover automatic ice makers designed for connection to alternating-current circuits rated not more than 600 volts.

1.2 These requirements apply to unitary and remote ice makers. For the purpose of this standard, an ice maker includes a means for automatically manufacturing and harvesting ice in cube, flake, or other readily usable form, with or without provision for storage or means of dispensing ice.

1.3 Self-contained ice makers covered by these requirements employ hermetic refrigerant motor-compressors and air- or water-cooled condensers.

1.4 These requirements do not apply to ice makers of the tray type, ice vending machines, or to ice makers and ice maker kits used in household refrigerators and freezers.

1.5 Requirements for the installation of ice makers are included in the National Electrical Code, NFPA 70, and the Safety Code for Mechanical Refrigeration, ASHRAE 15.

2 General

2.1 Components

2.1.1 *Deleted*

2.1.2 *Deleted*

2.1.3 *Deleted*

2.1.4 *Deleted*

2.2 Units of measurement

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

2.3 Terminology

2.3.1 The terms “appliance,” “ice maker,” and “unit” are used interchangeably and refer to all ice makers or any part thereof covered by this standard 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 ACCESSORY – An optional electrical device or other component intended for installation in or connection to an ice maker, for the purpose of modifying or supplementing the functions of the ice maker. It may be factory-installed or intended for installation by the user or service personnel.

3.3 BARRIER – A partition for the:

a) Insulation or isolation of electrical circuits,

b) Isolation of electrical arcs, or

c) Isolation of moving parts or hot surfaces.

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

3.4 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 (Class 1) – A circuit involving a potential of not more than 30 volts ac (42.4 volts peak) and an output of not more than 1000 volt-amperes.

c) Low-Voltage (Class 2) – A circuit involving a potential of not more than 30 volts ac (42.4 volts peak) or 30 volts dc, and supplied by:

1) A primary battery,

2) A National Electrical Code, ANSI/NFPA 70, standard Class 2 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.

3.4.1 COMPONENT – A device or fabricated part of the appliance covered by the scope of a safety standard dedicated to the purpose. When incorporated in an appliance, equipment otherwise typically field installed (e. g. luminaire) is considered to be a component. Unless otherwise specified, materials that compose a device or fabricated part, such as thermoplastic or copper, are not considered components.

3.5 DESIGN PRESSURE – The maximum allowable working pressure for which the ice maker is designed.

3.6 ELECTRIC GRID – A hot wire assembly designed to cut slab ice into cubes.

3.7 ENCLOSURE – That part of an ice maker that by itself or in conjunction with barriers:

a) Renders inaccessible all or any part of the unit that may otherwise present risk of electric shock,

b) Reduces the risk of contact with parts that may cause injury to persons, and/or,

c) Prevents propagation of flame initiated by electrical disturbances occurring within the unit.

A unit cabinet that serves as sole enclosure for ignition sources is considered to be a group 1 enclosure. Separate enclosures located within or mounted on the outer surface of the unit cabinet are considered group 1 enclosures if they serve as a sole enclosure for ignition sources. Enclosures not serving as an ultimate enclosure for ignition sources are considered to be group 2.

3.8 FUNCTIONAL/STRUCTURAL PART – A part used to maintain the intended relative physical position of fixed or moving parts, or maintain the integrity of the structure. A cabinet liner that supports an electrical component is considered to be a functional part.

3.9 HARVEST CYCLE – The function of removing or separating the manufactured ice from the evaporator.

3.10 ICE MAKER (CYCLIC) – An automatic ice maker that has separate and sequential water fill, freezing, and harvesting phases of ice-making operation.

3.11 NONFUNCTIONAL PART – A part, such as thermal insulation or decorative material, that does not serve as electrical insulation or to support or enclose electrical components, maintain electric spacings, or protect against injury to persons.

3.12 ICE MAKER (NONCYCLIC) – An automatic ice maker that has simultaneous water supply, freezing, and harvesting phases in the ice-making operation.

3.12.1 OPERATING CONTROL – A control intended to start, regulate, or operate the appliance during normal operation. An example would be a thermostat or temperature controller.

3.13 PRESSURE VESSEL – Any refrigerant-containing receptacle of a refrigerating system other than evaporators [each separate section of which does not exceed 1/2 cubic feet (0.014 m^3) of refrigerant containing volume], evaporator coils, compressors, condenser coils, controls, headers, pumps, and piping.

3.13.1 PROTECTIVE (SAFETY) CONTROL – A control intended to prevent the risk of electric shock, fire, or injury to persons, typically during abnormal operation of the appliance. An example would be a pressure limiting control.

3.14 REMOTE ICE MAKER – An ice maker intended to be connected to a field-installed condensing unit or a field-installed condenser located remote from the ice maker. Such ice makers are intended to be connected to the condensing unit or condenser in accordance with the Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15.

3.15 SELF-CONTAINED ICE MAKER – Unitary equipment consisting of a complete factory assembled and factory tested refrigerating system in which all the refrigerant-containing parts are permanently connected at the factory.

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

3.17 UNITARY ICE MAKER – Equipment consisting of a complete factory assembled and factory tested refrigeration system comprising one or more assemblies that may be shipped separately but are intended to be used together.

CONSTRUCTION

4 General

4.1 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 No. 1: This requirement does not apply to parts, such as washers, screws, bolts, or the like, where corrosion of such unprotected parts would not affect compliance with the requirements of this standard.

Exception No. 2: This requirement does not apply to surfaces of sheet steel and cast iron if oxidation of steel or iron due to exposure of the metal to air and moisture is not likely to be appreciable, considering the metal thickness and temperature.

4.2 Exposed unimpregnated asbestos material shall not be used in an air handling compartment, nor in compartments where it may contact potable water or ice. The unprotected edge of a gasket sandwiched between two parts is considered to be exposed.

4.3 A component shall:

a) Comply with the safety standard covering that component;

b) Be used in accordance with its rating(s) established for the intended conditions of use;

c) Be used within its established use limitations or conditions of acceptability;

d) Comply with the applicable requirements of this end product standard; and

e) Not contain mercury.

Exception: A component of a product covered by this standard is not required to comply with a specific component requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product, or

b) Is superseded by a requirement in this standard, or

c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

4.4 A component that is also required to perform other necessary functions, such as overcurrent protection, ground-fault circuit interruption, surge suppression, any other similar functions, or any combination thereof, shall comply additionally with the requirements of the applicable standard(s) covering products that provide those functions.

Exception: Where these other functions are not required for the application and not identified as part of markings, instructions, or packaging for the appliance, the additional component standard(s) need not be applied.

5 Assembly

5.1 General

5.1.1 If a unitary ice maker is provided in more than one section, the separate sections shall be designed to be used together, and these requirements are based on the use of matched sections. Interconnection of the sections shall result in a completely factory-charged refrigeration system.

5.1.2 An ice maker incorporating a condensing unit of the slide-out type shall be constructed so that the condensing unit can be pulled out and reinserted without kinking or otherwise damaging the refrigerant tubing, and without pinching, abrading, or stressing wires or cords.

5.2 Mechanical Protection

5.2.1 With the appliance installed in its intended manner (see Installation and Operating Instructions, Section 64), openings in the enclosure shall be designed or located to reduce the risk of unintentional contact with:

a) Moving parts such as augers, fan blades, blower wheels, gears, and belts, and

b) Surfaces that exceed the temperatures permitted by items E(3) and E(4) of Table 37.1.

The minor dimension of such openings shall not exceed 76.2 mm (3 inches) (see also 5.2.2 – 5.2.4). In evaluating openings, parts of the enclosure, such as cover, panels, and grilles are to be removed unless tools are required for their removal or when exposed, a moving part is made inoperative through the use of interlocking devices.

Exception No. 1: Openings may be larger than 76.2 mm if the part is unlikely to be contacted because of the location of fixed components, including baffles, water and refrigerant tubing, drain tubes, and the like.

Exception No. 2: The requirement of 5.2.1(b) does not apply to compressors, condensers, or refrigerant tubing located inside the ice maker enclosure (regardless of whether these components are accessible without requiring tools for removal of covers, panels, grilles, and the like) or to fittings for refrigerant tubing located outside of the ice maker enclosure, such as those used for the interconnection of a condensing unit and ice-making section.

5.2.2 The minor dimension of an opening is to be determined by the largest hemispherically-tipped rod that can be inserted through the opening with a force of 22.3 N (5 pounds).

5.2.3 Openings having a minor dimension of less than 25.4 mm (1 inch) are acceptable if the probe illustrated in Figure 5.1 cannot make contact with moving parts and hot surfaces. The probe shall be applied:

a) With a force of 11.1 N (2.5 pounds), and

b) In any possible configuration and to any depth that the size of an opening will permit.

The probe shall be rotated or angled to any possible position before, during, or after insertion through the opening; and, if necessary, the configuration shall be changed after the probe has been inserted through the opening.

5.2.4 Openings having a minor dimension of 25.4 mm (1 inch) or more are acceptable if the distance from the opening to a moving part or hot surface is in accordance with Table 5.1.

Table 5.1
Clearance from openings

Minor dimension of opening[a]		Minimum distance from opening to moving part of hot surface	
mm	inches	mm	inches
25.4	1	154	6-1/16
38.1	1-1/2	267	10-1/2
50.8	2	368	14-1/2

Table 5.1 Continued on Next Page

Table 5.1 Continued

Minor dimension of opening[a]		Minimum distance from opening to moving part of hot surface	
mm	inches	mm	inches
57.2[b]	2-1/4	419	16-1/2
63.5[b]	2-1/2	470	18-1/2
69.9[b]	2-3/4	521	20-1/2
76.2[b]	3	572	22-1/2
Over 50.8	Over 2	762	30

[a] For an opening having a minor dimension between two of the values in the table, the distance from the opening to the guarded part shall not be less than found by interpolation between values in the right hand column of the table.

[b] These values apply only to openings at the base of the ice maker where the upper edge of the opening is less than 203 mm (8 inches) above the floor.

5.3 Electrical Protection

5.3.1 With the appliance installed in its intended manner (see Installation and Operating Instructions, Section 64), openings in the enclosure shall be designed or located to reduce the risk of unintentional contact with uninsulated live parts in high-voltage and low-voltage (Class 1) circuits. The minor dimension of such openings shall not permit passage of a 25.4 mm (1 inch) diameter hemispherically-tipped rod, applied with a force of 5 pounds (22.3 N). In evaluating openings, parts of the enclosure, such as covers, panels, and grilles, are to be removed unless:

a) Tools are required for their removal, or

b) When exposed, the uninsulated electrical part is de-energized through the use of interlocking devices.

Exception: An ice cutting grid supplied by a circuit as described in 17.1 need not comply with this requirement.

5.3.2 An opening is acceptable if the probe illustrated in Figure 5.1 cannot contact uninsulated live parts in high-voltage and low-voltage (Class 1) circuits. The probe shall be applied:

a) With a force of 11.1 N (2.5 pounds), and

b) In any possible configuration and to any depth that the size of an opening will permit.

The probe shall be rotated or angled to any possible position before, during, or after insertion through the opening; and, if necessary, the configuration may be changed after the probe has been inserted through the opening.

Exception No. 1: For film-coated wire, an opening of 19.1 mm (3/4 inch) or less is acceptable if the probe illustrated in Figure 5.2 cannot contact the wire.

Exception No. 2: An ice cutting grid supplied by a circuit as described in 17.1 need not comply with this requirement.

Figure 5.1

Accessibility probe

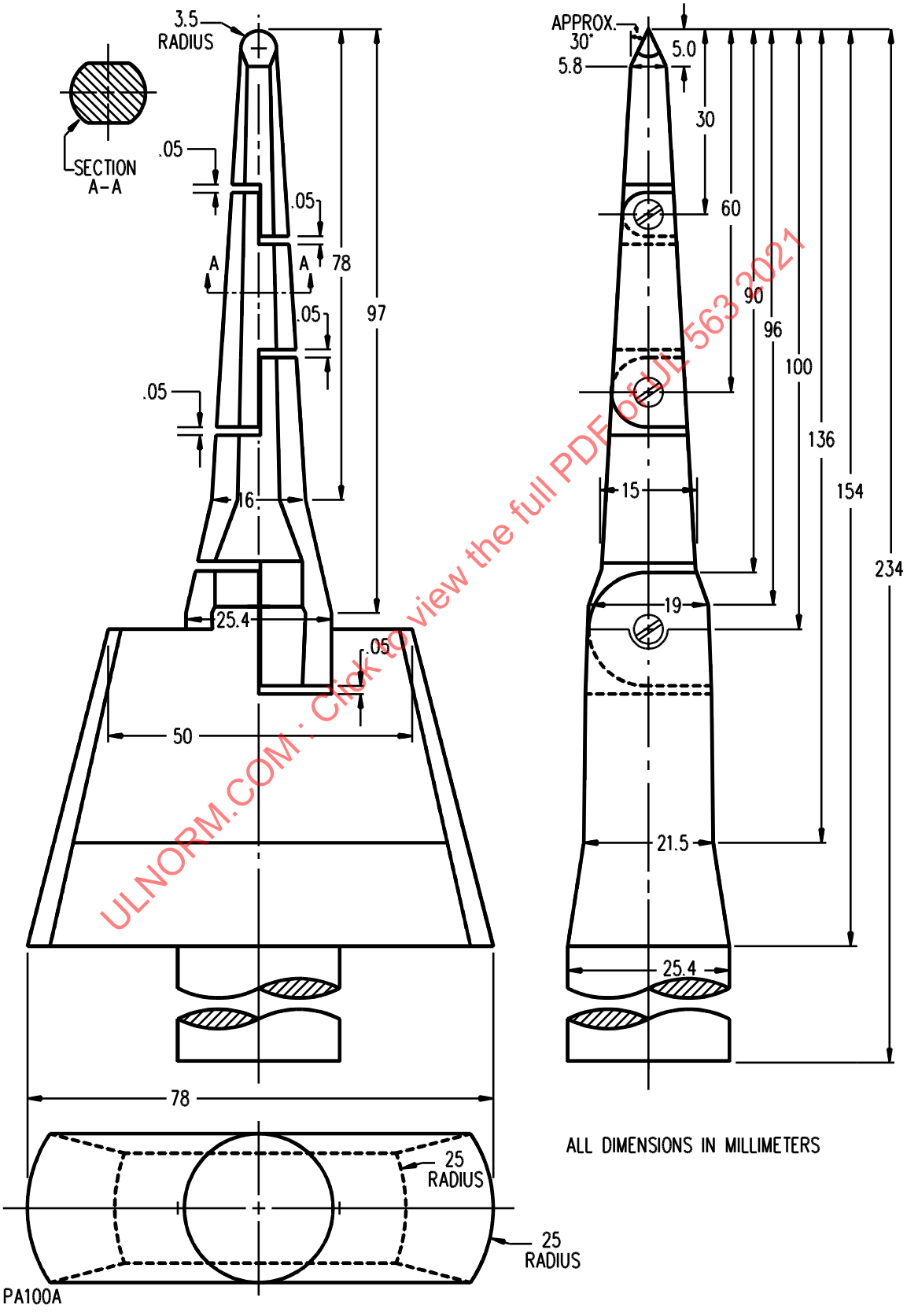
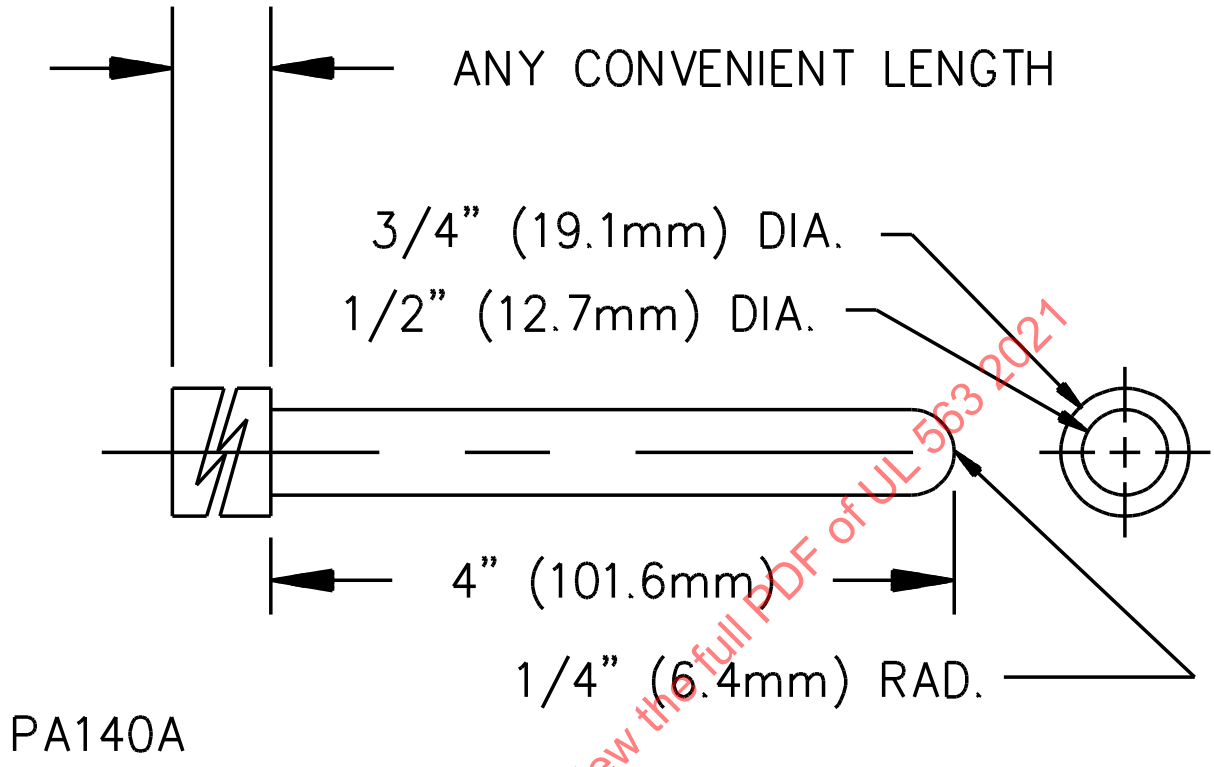


Figure 5.2

Probe



5.3.3 In addition to the requirements of 5.3.1 and 5.3.2, uninsulated live parts in high-voltage and low-voltage (Class 1) circuits inside the enclosure that are likely to be contacted by persons performing operations such as replacing fuses, resetting manual-reset devices, oiling motors, or other such intended service operations, shall be located, guarded, or enclosed to reduce the risk of unintentional contact, unless tools are required to expose the live part. See 61.14.

Exception: An ice cutting grid supplied by a circuit as described in 17.1 need not comply with this requirement.

5.3.4 Except as permitted in the Rain Test, Section 34, electrical components shall be located or enclosed so that accumulation or overflow of water will not wet uninsulated live parts. See Overflow Test, Section 42.

5.3.5 If leakage from a water line or fitting provided as part of an ice maker would result in a risk of electric shock, these components shall be fabricated of materials that are resistant to corrosion by water.

5.3.6 A switch, an attachment-plug receptacle, or similar component shall be secured in position and shall be prevented from turning.

Exception No. 1: The requirement that a switch be prevented from turning will be waived if all of the following conditions are complied with:

a) The switch is of 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) Electrical spacings are not reduced below the minimum required values if the switch rotates.

d) Operation of the switch is by mechanical means rather than direct contact by persons.

Exception No. 2: A lampholder of a type in which the lamp cannot be replaced, such as a neon pilot or indicator light in which the lamp is sealed in a nonremovable jewel, need not be prevented from turning if rotation cannot reduce electrical spacings below the minimum acceptable values. See Electrical Spacings, Sections 23 and 24.

5.3.7 The means for preventing rotation mentioned in 5.3.6 shall consist of more than friction between surfaces. A toothed lock washer that provides both spring takeup 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.

5.3.8 An uninsulated current-carrying part and a part that supports a live part shall be secured 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 Electrical Spacings, Sections 23 and 24. 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 5.3.7 is acceptable.

5.3.9 Flammable or electrically conductive thermal or acoustical insulation shall not contact uninsulated live parts.

6 Accessories

6.1 An ice maker having provisions for the use of accessories to be attached in the field shall comply with the requirements of this section, and shall comply with the requirements of this standard with or without the accessory installed.

6.2 Installation of electrical accessories by the user shall be restricted to an arrangement that can be accomplished by means of receptacles and plug-in connectors.

Exception: Low-voltage (Class 2) accessories may be connected to existing wiring terminals if the accessory leads terminate with connectors that will maintain electrical spacings.

6.3 Installation of electrical accessories by service personnel shall be by means of receptacles, plug-in connectors, insulated wire connectors, or by connection to existing wiring terminals.

6.4 Installation of an accessory that requires the cutting of wiring or the soldering of connections by the installer is not acceptable. Installation of accessories by the user shall not require cutting, drilling, or welding. Installation of accessories by service personnel that requires cutting, drilling, or welding is not acceptable in electrical enclosures and in other areas where such operation may damage electrical or refrigeration components and wiring within the enclosure. Installation of accessories shall not require relocation of factory-installed components.

6.5 Accessories intended for connection to a source of electrical power independent of that of the ice maker shall comply with the requirements specified in 9.1.3 – 9.1.21 for permanently-connected units. Such accessories shall not be used with cord-connected units.

6.6 Strain-relief means shall be provided for the wiring in the accessory if there is a possibility of transmitting stress to the terminal connections during installation. See Strain Relief Test, Section 52

6.7 All terminals and wiring intended to be field connected shall be identified on the accessory, on the ice maker if connections are made between the accessory and the ice maker, and on the wiring diagrams(s).

6.8 The mounting location of the accessory shall be indicated on the ice maker.

Exception: If the mounting location is fixed due to the function of the accessory and arrangement of the ice maker, and instructions are provided covering the installation and location for the accessory, the mounting location of the accessory need not be indicated on the ice maker.

6.9 As part of the investigation, accessories are to be trial-installed to determine that their installation is feasible and that the instructions are detailed and correct.

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 total or partial collapse resulting in a risk of electric shock, injury to persons, or damage to components in the refrigeration and electrical systems. Enclosures for individual electrical components, outer enclosures, and combinations of the two are to be considered in determining compliance with this requirement.

7.1.2 Among the factors that are to be taken into consideration when evaluating an enclosure are

a) Mechanical strength,

b) Impact resistance,

c) Moisture-absorptive properties,

d) Flammability,

e) Distortion resistance at temperatures to which the material may be subjected under conditions of use, and

f) Corrosion resistance.

For a nonmetallic enclosure or part of an enclosure, all of these factors, including the effect of exposure to weathering if for outdoor use, are considered with respect to aging.

7.1.3 The enclosure(s) of an ice maker shall reduce the risk of mechanical damage to wiring, electrical components, and refrigerant tubing.

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

7.1.5 A sheet metal enclosure is to be evaluated with respect to its size, shape, metal thickness, and use in a particular application. Sheet steel used as an electrical enclosure of uninsulated live parts shall be not less than 0.66 mm (0.026 inch) if uncoated or 0.74 mm (0.029 inch) if galvanized, or 0.91 mm (0.036 inch) nonferrous sheet metal, except for relatively small areas or for surfaces that are curved or corrugated or otherwise reinforced such as by angles, channels, flanges, or ribs.

7.1.6 Steel enclosures shall be protected against corrosion by metallic or nonmetallic coatings, such as plating or painting. See 7.2.1 – 7.2.8 for outdoor-use enclosures.

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

7.1.8 If threads for the connection of conduit are tapped 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 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 rounded inlet hole for the conductors that shall:

a) Afford protection to the conductor equivalent to that provided by a standard conduit bushing, and

b) Have an internal diameter approximately the same as that of the corresponding trade size of rigid conduit.

7.1.9 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 or reduction in electrical spacings.

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

7.1.11 A knockout shall be:

a) Provided with a flat surrounding surface for seating of a conduit bushing, and

b) Located so that installation of a bushing at any knockout likely to be used during installation will not result in electrical spacings between uninsulated live parts and the bushing of less than those required by this standard.

7.1.12 In measuring a spacing between an uninsulated live part and a bushing installed at a knockout, it is to be assumed that rigid metal conduit is brought into the enclosure and held in position by a bushing located inside the enclosure and a locknut located outside the enclosure. The dimensions of the bushing are indicated in Table 7.1.

Table 7.1
Knockout or hole sizes and dimensions of bushings

Trade size of conduit		Nominal knockout or hold diameter[a]		Bushing dimensions			
				Overall diameter		Height	
mm O.D.	(inches)	mm	(inches)	mm	(inches)	mm	(inches)
21.3	(1/2)	22.3	(7/8)	25.4	(1)	9.6	(3/8)
26.7	(3/4)	27.8	(1-3/32)	31.4	(1-15/64)	10.7	(27/64)
33.4	(1)	34.6	(1-23/64)	40.5	(1-19/32)	13.1	(33/64)
42.3	(1-1/4)	45.7	(1-23/32)	49.2	(1-15/16)	14.3	(9/16)
48.3	(1-1/2)	50.1	(1-31/32)	56	(2-13/64)	15.1	(19/32)
60.3	(2)	62.8	(2-15/32)	68.7	(2-45/64)	17.9	(5/8)
73	(2-1/2)	76.2	(3)	81.8	(3-7/32)	19.1	(3/4)

[a] A tolerance of ±0.8 mm (1/32 inch) permitted.

7.1.13 A hinged panel or cover shall be positioned or arranged so that, when it is in an open position to facilitate service operations, it is not subject to falling or swinging due to gravity or vibration that can cause risk of injury to persons from the panel or cover, from moving parts, or risk of electric shock from uninsulated live parts.

7.1.14 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

a) Without removing parts other than a service cover(s) or panel(s), and

b) By opening the cover or door enclosing the device.

7.1.15 A required protective device shall not be accessible from outside the enclosure except by 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.

7.1.16 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.

7.1.17 Covers for enclosures of fuses in high-voltage circuits shall be hinged. Covers for enclosures of manual-reset overload protective devices 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 that 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 auxiliary resistance heaters, such as crankcase heaters with a maximum rating of 100 watts; or

c) An extractor-type fuse with its own enclosure; or

d) Fuses in low-voltage (Class 2) circuits.

7.1.18 Hinged covers, where required by 7.1.17, shall not depend solely upon screws or other similar means to hold them closed, but shall be provided with a latch or the equivalent.

7.1.19 A spring latch, a magnetic latch, a dimple, or any other mechanical arrangement that will hold the cover closed and will require some effort on the user's part to open, is acceptable for securing the cover as required in 7.1.18. When provided as the sole means for securing the cover, an interlocking mechanism is considered to comply with 7.1.18.

7.1.20 A door or cover giving direct access to fuses in other than low-voltage (Class 2) circuits shall shut closely against a 6.4 mm (1/4 inch) 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 and shall overlap the edges of the box not less than 12.7 mm (1/2 inch). A special construction, such as a fuse enclosure, located within an outer enclosure, enclosure or a flange and rabbet combination that affords the equivalent protection is acceptable.

7.1.21 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 38.1 mm (1-1/2 inches) from each end of each strip and at points between these end fastenings, not more than 152 mm (6 inches) apart.

7.2 Enclosures exposed to weather

7.2.1 Sheet steel cabinets and electrical enclosures exposed to the effects of weathering shall be protected against corrosion by the following means or by other metallic or nonmetallic coatings that provide equivalent protection as follows:

Type of cabinet and enclosure	1.35 mm (0.053 inch) and Heavier as specified by:	Lighter than 1.35 mm (0.053 inch) as specified by
Outer cabinets which protect motors, wiring or enclosed current-carrying parts	7.2.2	7.2.3
Inside enclosures which protect current-carrying parts other than motors	7.2.2	7.2.3
Outer cabinets which are the sole enclosure of current-carrying parts	7.2.3	7.2.3

7.2.2 To comply with 7.2.1, as referenced to 7.2.2, one of the following coatings shall be used:

a) Hot-dipped mill galvanized sheet steel complying with the Coating Designation G60 or A60 in Table 1 of the Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, ASTM A653/A653M, with not less than 40 percent of the zinc on any side, based on the minimum single spot test requirement in the ASTM specification. The weight of zinc coating may be determined by any recognized laboratory method. However, in case of question, the weight of coating shall be established in accordance with the Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings, ASTM A90/A90M. An A60 (alloyed) coating shall also comply with 7.2.4.

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 0.0104 mm (0.00041 inch) on each surface with a minimum thickness of 0.0086 mm (0.00034 inch). The thickness of the coating shall be established by the Metallic Coating Thickness Test, Section 50. An annealed coating shall also comply with 7.2.4.

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

7.2.3 To comply with 7.2.1, as referenced to 7.2.3, one of the following coatings shall be used:

a) Hot-dipped mill galvanized sheet steel complying with the Coating Designation G90 and Table 1 of the Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, ASTM A653/A653M with not less than 40 percent of the zinc on any side, based on the minimum single spot test requirements in the ASTM specification. The weight of zinc coating may be determined by any recognized laboratory method. However, in case of question, the weight of coating shall be established in accordance with the Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings, ASTM A90/A90M.

b) A zinc coating, other than that provide on hot-dipped mill-galvanized sheet steel, uniformly applied to an average thickness of not less than 0.0155 mm (0.00061 inch) on each surface with a minimum thickness of 0.0137 mm (0.00054 inch). The thickness of the coating shall be established

by the Metallic Coating Thickness Test, Section 50. An annealed coating shall also comply with 7.2.4.

c) A cadmium coating of not less than 0.025 mm (0.001 inch) in thickness on both surfaces. The thickness of coating shall be established by the Metallic Coating Thickness Test, Section 50.

d) A zinc coating complying with 7.2.2 (a) or (b) with one coat of outdoor paint as specified in 7.2.2(c).

e) A cadmium coating of

1) Not less than 0.0191 mm (0.00075 inch) in thickness on both surfaces with one coat of outdoor paint on both surfaces, or

2) Not less than 0.013 mm (0.0005 inch) 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 50, and the paint shall be as specified in 7.2.2(c).

7.2.4 An annealed-zinc coating that 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 comply with this requirement.

7.2.5 With reference to 7.2.1, 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 complying with 7.2.1 (a), 7.2.2 or 7.2.3, as applicable, indicate they provide equivalent protection. Among the factors to be taken into consideration when judging such coating systems are exposure to salt spray, moist carbon dioxide-sulphur dioxide-air mixtures, moist hydrogen sulphide-air mixtures, ultraviolet light, and water.

7.2.6 Nonferrous enclosures may be employed without special corrosion protection.

7.2.7 If 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 7.2.8, and shall comply with the requirements of 49.1 – 49.6. Sealing compounds required to seal electrical enclosures shall comply with the requirements of 49.7. Adhesives required to secure gaskets shall comply with the requirements of 49.8. Gaskets shall be neoprene, rubber, or thermoplastic. Other materials may be used if they have equivalent properties.

7.2.8 Gaskets held captive, either by their location or placement of other components in the enclosure, when the cover is removed and that would be reengaged in the intended manner when the cover is replaced are not required to be held by mechanical fasteners or adhesives. Consideration is to be given to the intended mounting of the gasket in the application.

8 Nonmetallic Materials

8.1 General

8.1.1 The requirements in 8.1.2 – 8.3.7 cover polymeric and wood materials used to form outer enclosures, nonfunctional or functional parts, and miscellaneous parts for indoor use only. Nonmetallic materials for outdoor use shall comply with the requirements in the Standard for Polymeric Materials - Use