

UL563

ADOPTION NOTICE

UL563, "Ice Makers," was adopted on October 3, 1994 for use by the Department of Defense (DoD). Proposed changes by DoD activities must be submitted to the DoD Adopting Activity: Commander, US Army Natick Research, Development and Engineering Center, ATTN: SATNC-AEL, Natick, MA 01760-5000. DoD activities may obtain copies of this standard from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094. The private sector and other Government agencies may purchase copies from the Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062.

Custodians:
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FSC 4110

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Subjects 2182 (207, 250, 303, 399, 412,
 416, 427, 465, 471, 474, 484, 541, 559, 563,
 621, 984, 1963, 1995, 2170, 2171, 2172, 2205)

333 Pfingsten Road
 Northbrook, IL 60062
 January 9, 1997

TO: Casualty Council of Underwriters Laboratories Inc.,
 Consumer Advisory Council of Underwriters Laboratories Inc.,
 Electrical Council of Underwriters Laboratories Inc.,
 Fire Council of Underwriters Laboratories Inc.,
 Subscribers to UL's Standards Service for
 Refrigerant Containing Components and Accessories, Nonelectrical, UL 207,
 Household Refrigerators and Freezers, UL 250,
 Refrigeration and Air-Conditioning Condensing, and Compressor Units, UL 303,
 Drinking Water Coolers, UL 399
 Refrigeration Unit Coolers, UL 412,
 Refrigerated Medical Equipment, UL 416,
 Refrigerating Units, UL 427,
 Central Cooling Air Conditioners, UL 465,
 Commercial Refrigerators and Freezers, UL 471,
 Dehumidifiers, UL 474,
 Room Air Conditioners, UL 484,
 Refrigerated Vending Machines, UL 541,
 Heat Pumps, UL 559
 Ice Makers, UL 563,
 Ice Cream Makers, UL 621,
 Hermetic Refrigerant Motor Compressors, UL 984
 Refrigerant Recovery/Recycling Equipment, UL 1963,
 Heating and Cooling Equipment, UL 1995,
 Field Conversion/Retrofit of Products to Change to an Alternative
 Refrigerant - Construction and Operation, UL 2170,
 Field Conversion/Retrofit of Products to Change to an Alternative
 Refrigerant - Insulating Material and Refrigerant Compatibility, UL 2171,
 Field Conversion/Retrofit of Products to Change to an Alternative
 Refrigerant - Procedures and Methods, UL 2172
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 Field Conversion/Retrofit of Alternative Refrigerants in Household Refrigerators and Freezers,
 UL 2205

SUBJECT: Use of Classified Refrigerants

SUMMARY OF TOPICS

This bulletin proposes the following changes in requirements:

All of the UL refrigerant containing end-use standards would be revised to require the use of refrigerants that comply with the Standard for Refrigerants, UL 2182.

COMMENTS DUE: February 20, 1997

A not-for-profit organization
 dedicated to public safety and
 committed to quality service

Subjects 2182 (207, 250, 303, 399, 412,
416, 427, 465, 471, 474, 484, 541, 559, 563,
621, 998, 1963, 1995, 2170, 2171, 2172, 2205)

-2-

January 9, 1997

UL announces that as of July 1, 1996, refrigerants are now covered as Classified products in accordance with the Standard for Refrigerants, UL 2182. A tabulation of manufacturer's of Classified refrigerants are contained in the 1996 edition of UL's Electrical Appliance and Utilization Equipment Directory under the Category Control Number of SLGV.

Previous to July 1996 refrigerants were covered as Recognized components and a Recognition Report was developed for each Recognized refrigerant. This report contained information regarding the ignition temperature of the refrigerant. However, the new Classification Marking information does not contain the ignition temperature of the refrigerant.

UL uses this ignition temperature rating when evaluating the results of a refrigerant leak. The test requires the surface temperature to be below the ignition temperature of the refrigerant. Therefore, as part of the end-use investigations of refrigeration and air conditioning equipment, it will still be necessary to review the ignition temperature data. This data will be used to determine the results should a leak develop in proximity to a heat producing component. The Auto Ignition Test will continue to be conducted and the results will be contained in the Classification Report.

UL is proposing to revise its end-use standards covering refrigerant containing equipment to require the use of refrigerants investigated in accordance with UL 2182. These proposed revisions are included in Appendix A. In addition, all UL engineering reports for end-use refrigeration and air conditioning equipment will also be revised to reflect the use of Classified refrigerants.

The UL engineering reports will include the refrigerant manufacturer's name and the trade name of the refrigerant(s) used in testing the product. This information is needed since the trade name may differ from the ANSI/ASHRAE 34 designation and the refrigerant may not even have an ANSI/ASHRAE designation.

It is important for the end-use refrigeration and air conditioning equipment manufacturer's to:

- a) Check the specific refrigerant manufacturer's name when identifying Classified refrigerants, and
- b) Make sure the refrigerants are from a manufacturer and a location who has a UL Classification as indicated in the 1996 edition of the Electrical Appliance and Utilization Equipment Directory.

Please note that proposed requirements are of a tentative and early nature and are for review and comment only. Current requirements are to be used to judge a product until these requirements are published in final form.

PROPOSED EFFECTIVE DATE

These proposed requirements will not necessitate a review or additional testing of currently Listed or Recognized products. Therefore, UL proposes that these requirements become effective upon publication.

REQUEST FOR COMMENTS ON PROPOSALS

Please provide the following:

1. Your comments concerning the proposed requirements; and
2. Your comments concerning the proposed effective date, should the proposals be adopted.

Subjects 2182 (207, 250, 303, 399, 412,
416, 427, 465, 471, 474, 484, 541, 559, 563,
621, 998, 1963, 1995, 2170, 2171, 2172, 2205)

-3-

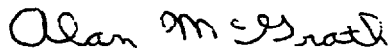
January 9, 1997

Written comments should be sent to the attention of Alan McGrath at UL's Northbrook office, 333 Pfingsten Road, Northbrook, IL 60062-2096. Please reference all correspondence to Subject 2182.

All comments should be sent by February 20, 1997.

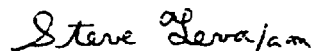
Unless specifically requested to do so, UL will not acknowledge comments indicating concurrence with these proposals.

UNDERWRITERS LABORATORIES INC.



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SR:JTM

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PROPOSED REQUIREMENTS ARE OF A TENTATIVE AND EARLY NATURE AND ARE FOR REVIEW AND COMMENT ONLY. CURRENT REQUIREMENTS ARE TO BE USED TO JUDGE A PRODUCT UNTIL THESE REQUIREMENTS ARE PUBLISHED IN FINAL FORM.

APPENDIX A

PROPOSED REQUIREMENTS AND PROPOSED EFFECTIVE DATES FOR

UL 207, UL 250, UL 303, UL 399, UL 412, UL 416, UL 427, UL 465, UL 471, UL 474, UL 484, UL 541, UL 559, UL 563, UL 621, UL 984, UL 1963, UL 1995, UL 2170, UL 2171, UL 2172, and UL 2205

For your convenience in review, proposed additions to existing requirements are shown underlined and proposed deletions are shown ~~lined-out~~. Proposed new requirements are identified by (NEW). In the case of extensively revised paragraphs, the original text is identified by (CURRENT) and is ~~lined-out~~, followed by the proposed text identified by (PROPOSED).

RATIONALE

UL is proposing to revise the following refrigerant containing end-use standards to require the use of refrigerants investigated in accordance with UL 2182. In addition, the reference to the Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15 is proposed to be deleted from the text of these standards since reference is already made to ASHRAE 15 in the Scope of these standards.

IMPACT

If the following proposals are adopted, they would not require a review, retest, or modifications to presently Listed equipment for the proposals are a clarification of present practice at UL.

PROPOSALS**1. UL 207**

(NEW)

2.5 Refrigerants

2.5.1 The kind of refrigerant employed in the system shall comply with the Standard for Refrigerants, UL 2182.

2.5.1 added (date of publication)

2. UL 250

Since the Standard for Refrigerators, UL 250/CSA No. 63 is a binational standard, this revision will be proposed concurrently with CSA at a later date.

3. UL 303

The Standard for Refrigeration and Air-Conditioning Condensing, and Compressor Units, UL 303, is being replaced by UL 1995 in January 1998. Therefore, please see item 18.

4. UL 399

(CURRENT)

REFRIGERATION SYSTEM**22 Refrigerant**

~~22.1 The refrigerant employed shall possess sufficient chemical stability to prevent disassociation or other changes which are likely to lead to the formation of hazardous substances, see 22.2, when subjected to the maximum range of temperatures and pressures encountered in the refrigerating cycle.~~

~~22.2 The refrigerants used in a water cooler employing the direct method of refrigeration shall be practically nonflammable and shall be of a degree of toxicity that will not produce death or serious injury to guinea pigs during a 2 hour exposure to the refrigerant at a concentration of 2 1/2 percent by volume in air. Refrigerants 12, 22, 500, and 502 are commonly used refrigerants which comply with this requirement.~~

(PROPOSED)

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

22.1 revised (date of publication)

22.2 Clause 22.2 deleted (date of publication)

5. UL 412

REFRIGERATION SYSTEM

23 Refrigerant

23.1 The kind of refrigerant intended for use with the unit cooler shall comply with the Standard for Refrigerants, UL 2182. ~~conform with the Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1978.~~

23.1 revised (date of publication)

6. UL 416

REFRIGERATION SYSTEM

26 Refrigerant

26.1 The kind ~~and quantity~~ of refrigerant employed in the system shall comply with the Standard for Refrigerants, UL 2182. ~~Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1980.~~

26.1 revised (date of publication)

7. UL 427

REFRIGERATION SYSTEM

22 General

22.1 Refrigerant

22.1.1 The kind ~~and quantity~~ of refrigerant employed in the system shall comply with the Standard for Refrigerants, UL 2182. ~~Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1992.~~

22.1 revised (date of publication)

8. UL 465

The Standard for Central Cooling Air Conditioners, UL 465, is being replaced by UL 1995 in January 1998. Therefore, please see item 18.

9. UL 471**REFRIGERATION SYSTEM****29 Refrigerants**

29.1 The kind and quantity of refrigerant employed in the system shall comply with the Standard for Refrigerants, UL 2182, Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1994.

29.1 revised (date of publication)

10. UL 474**REFRIGERATION SYSTEM****18 Refrigerants**

18.1 The kind and quantity of refrigerant employed in the system shall comply with the Standard for Refrigerants, UL 2182, Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1994.

18.1 revised (date of publication)

11. UL 484**REFRIGERATION SYSTEM****26 Refrigerant**

26.1 The kind and quantity of refrigerant employed in the system shall comply with the Standard for Refrigerants, UL 2182, Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1994.

26.1 revised (date of publication)

12. UL 541**REFRIGERATION SYSTEM****29 Refrigerant**

29.1 The kind and quantity of refrigerant employed in the system shall comply with the Standard for Refrigerants, UL 2182, Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1994.

29.1 revised (date of publication)

13. UL 559

The Standard for Heat Pumps, UL 559, is being replaced by UL 1995 in January 1998. Therefore, please see item 18.

14. UL 563**REFRIGERATION SYSTEM****24 Refrigerant**

24.1 The kind and quantity of refrigerant employed in the system shall comply with the Standard for Refrigerants, UL 2182, Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1994.

24.1 revised (date of publication)

15. UL 621**REFRIGERATION SYSTEM****28 Refrigerant**

28.1 The kind and quantity of refrigerant employed in the system shall comply with the Standard for Refrigerants, UL 2182, Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1994.

28.1 revised (date of publication)

16. UL 984

Since the Standard for Hermetic Refrigerant Motor Compressors, UL 984/CSA No. 140.2 is a binational standard, this revision will be proposed concurrently with CSA at a later date.

17. UL 1963**REFRIGERANT SYSTEM****25 Refrigerants**

25.1 The equipment shall operate with refrigerant that complies with the Standard for Refrigerants, UL 2182, Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1990.

25.1 revised (date of publication)

18. UL 1995

Since the Standard for Heating and Cooling Equipment, UL 1995/CSA No. 236 is a binational standard, this revision will be proposed concurrently with CSA at a later date.

19. UL 2170**5.2 Refrigerants**

5.2.1 The kind and quantity of refrigerant used in the system shall comply with the Standard for Refrigerants, UL 2182, Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1992.

5.2.1 revised (date of publication)

~~5.2.2 The alternative refrigerants shall be nonflammable or practically nonflammable as determined by the ASTM E681-85 test method and the auto ignition temperature test method as adjusted to the methods outlined in ASHRAE 34-1992, Designation and Safety Classification of Refrigerants, at room ambient and at 100°C.~~

5.2.2 deleted (date of publication)

(Note: Clause 5.2.3 is shown for reference only. No changes are being proposed to it at this time.)

5.2.3 When a blended refrigerant with a flammable constituent is to be used as an alternative, fractionation that may occur as the result of a system leak shall be considered. This shall include consideration of both the fractionation of the blend remaining in the system and the composition of the blend leaking into the equipment or the equipment space that may involve a risk of fire or injury to persons.

20. UL 2171

Since UL 2170, 2171, and 2172 are a series of standards which are used together, the revision is covered by the revision in UL 2170.

21. UL 2172

Since UL 2170, 2171, and 2172 are a series of standards which are used together, the revision is covered by the revision in UL 2170.

22. UL 2205

Since the following clause is already contained in the proposed first edition of UL 2205, no revision will be proposed:

4.6 The alternative refrigerant shall comply with the Standard for Refrigerants, UL 2182.

**Underwriters Laboratories Inc.®**A not-for-profit organization dedicated to public safety
and committed to quality service**May 16, 1996****Revision pages for****Standard for****Ice Makers****UL 563, Seventh Edition**

Attached to this transmittal notice is a revision of the Seventh edition of UL 563 .

A CHANGE ON A PAGE DATED MAY 16, 1996 IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THESE NEW AND REVISED REQUIREMENTS ARE NOW IN EFFECT EXCEPT FOR PARAGRAPHS 12.16, 12.17, AND 19.16, WHICH BECOME EFFECTIVE MAY 16, 1997 AS INDICATED IN THE SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM. TO RETAIN THE REQUIREMENTS IN EFFECT UNTIL MAY 16, 1997, DO NOT DISCARD THE PREVIOUS PAGES CONTAINING THE REQUIREMENTS SPECIFIED ABOVE UNTIL THIS FUTURE EFFECTIVE DATE.

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

The new and revised requirements are substantially in accordance with UL's bulletins on this subject dated September 8, 1995, September 11, 1995 and January 16, 1996. These bulletins are now obsolete and may be discarded.

Revised and/or additional pages may be issued from time to time.

With the inclusion of the accompanying material, the standard consists of pages dated as shown in the following checklist:

Page	Date
1	July 31, 1995 (Reprinted: May 16, 1996)
2, 3	May 16, 1996
4 – 25	July 31, 1995
26	May 16, 1996
27 – 35	July 31, 1995
36, 36A	May 16, 1996
37 – 43	July 31, 1995
44, 44A	May 16, 1996

(Continued)

May 16, 1996 – UL 563

Page	Date
45 – 47	July 31, 1995
48 – 52, 52A	May 16, 1996
53 – 68	July 31, 1995
69, 70, 70A	May 16, 1996
71 – 77	July 31, 1995
78	May 16, 1996
79 – 87	July 31, 1995
88 – 90, 90A, 90B	May 16, 1996
91 – 98, A1	July 31, 1995

JULY 31, 1995

(Title Page Reprinted: May 16, 1996)

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 31, 1995

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

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 published set of revision pages.

ISBN 1-55989-882-8

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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 differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, 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.

9.3.2 On a permanently-connected ice maker, a terminal solely for connection of an equipment-grounding conductor shall be capable of securing a conductor of the size required by the National Electrical Code, ANSI/NFPA 70-1993.

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

9.3.4 On a permanently-connected ice maker, 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 9.3.5, a pressure wire connector intended for connection of such a conductor shall be plainly identified such as by being marked "G," "GR," "Ground," "Grounding," by the symbol shown in Figure 9.1 or by a marking on a wiring diagram provided on the ice maker. The wire binding screw or pressure wire connector shall be secured to the frame or enclosure of the ice maker and shall be located so that it is unlikely to be removed during service operations such as replacing fuses, resetting manual-reset devices, adjusting controls, or oiling motors.

Figure 9.1
Grounding symbol



9.3.5 If a pressure wire connector intended for grounding is located adjacent to connectors intended for supply conductors involving the neutral conductor of a grounded supply, it shall be identified by a marking EQUIPMENT GROUND, by a green color, or by both.

9.3.6 On a permanently-connected ice maker, 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.

9.3.7 On a cord-connected ice maker, the grounding conductor of the power supply 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 ice maker by a positive means, such as clamping, bolting, or screw connection, that is not likely 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.

10 Internal Wiring

10.1 General

10.1.1 An ice maker shall employ conductors of not less than No. 18 AWG (0.82 mm²) size, except for short integral leads of small electrical components, such as relay coils, clock motors, and indicator lights.

10.1.2 Wiring that is color coded green or green with one or more yellow stripes shall be used only for grounding conductors and not for other purposes.

10.1.3 Wire insulation shall be rated not less than the potential involved and not less than the temperature to which it may be subjected in use. The required temperature rating for wiring is based on the temperatures measured in the Temperature and Pressure Test, Section 36.

10.1.4 Internal wiring shall be of the type indicated in Table 10.1. The insulation of wires or cords connected to fan motors and other auxiliary motors shall be of an oil-resistant type, such as Type SJO, SJT, SPT-3, or appliance wiring materials having oil-resistant insulation.

Table 10.1
Typical wiring materials

Group	Type of wire cord, or cable ^a	Wire size		Insulation Thickness	
		No. AWG	mm ²	Inch	mm
A	Thermoplastic appliance wiring material, with insulation thicknesses shown at the right corresponding to wire sizes indicated, or Type AC, 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	10 and smaller	5.3	2/64	0.8
		8	8.4	3/64	1.2
		6	13.3	4/64	1.6
		4	21.2	4/64	1.6
		3	26.7	4/64	1.6
		2	33.6	4/64	1.6
B	Appliance wiring material ^b having thermoplastic, thermoset, or neoprene insulation, with insulation thicknesses shown at right corresponding to the wire sizes indicated; or Type S, SE, SO, SOO, ST, STO, STOO, SJ, SJE, SJO, SJOO, SJT, SJTO, SJTOO, SP-3, SPE-3, SPT-3	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
		6	13.3	8/64	3.2
		4	21.2	9/64	3.6
		2	33.6	10/64	4.0

^a The designated cord or types of wire other than appliance wiring material may be used without regard to the values specified in this table.

^b Appliance wiring material acceptable for refrigeration use.

Table 10.1 revised May 16, 1996

10.2 Permanently-connected ice makers

10.2.1 Except as indicated in 10.2.2, wiring shall be material indicated by Group A of Table 10.1 and enclosed by means such as conduit, electrical metallic tubing, metal raceways, control boxes, or the like. Fittings shall be designed for use with the type of wiring enclosure employed in the application.

10.2.2 Cords or appliance wiring material of a type indicated in Group A or B of Table 10.1 may be employed if the wiring is enclosed by the cabinet to reduce the risk of:

- Damage of wiring,
- Ignition of flammable material, or
- Emission of flame or molten metal through openings in the cabinet.

12.8 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 – Bonding Conductors and Connections, Section 45; and the Limited Short-Circuit Test, Section 44; 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, that may occur in service. Also, a clamping device is to be considered with particular emphasis on the likelihood of the clamping device being reassembled in its intended fashion.

12.9 Except as permitted by 12.12 and 12.13, a bonding conductor or strap on a cord-connected ice maker shall have a cross-sectional area not less than that of the grounding conductor of the supply cord.

12.10 On a permanently-connected ice maker, 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 unit will be connected. Except as permitted by 12.12 and 12.13, the size of the conductor or strap shall be in accordance with Table 12.1.

Table 12.1
Bonding wire conductor size

Rating or 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	(8.3)
40	10	(5.3)	8	(8.3)
60	10	(5.3)	8	(8.3)
100	8	(8.3)	6	(13.3)
200	6	(13.3)	4	(21.2)

^a Or equivalent cross-sectional area.

12.11 A conductor, such as a clamp or strap, used in place of a separate wire conductor as indicated in 12.10, is acceptable provided that the minimum cross-sectional conducting area is equivalent to the wire sizes indicated in Table 12.1.

12.12 With regard to 12.9 and 12.10, a smaller conductor may be used if the bonding conductor and connection comply with the provisions of the Current Overload Test – Bonding Conductors and Connections, Section 45, and the Limited Short-Circuit Test, Section 44.

12.13 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.

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

12.15 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 unit, a bonding conductor for that motor is to be sized on the basis of the overcurrent device intended for ground-fault protection of the motor.

12.16 A secondary circuit of less than 50 volts that is supplied by a transformer having a primary connected to a source of more than 150 volts to ground shall be bonded for grounding.

Added 12.16 effective May 16, 1997

12.17 With reference to 12.16, the size of the bonding conductor used to bond the secondary circuit conductor that is to be grounded shall be in accordance with 12.13. If one of the secondary circuit conductors is white or natural gray in color and located in a field wiring compartment, the white or natural gray conductor shall be the one that is grounded.

Added 12.17 effective May 16, 1997

ELECTRICAL COMPONENTS

13 Capacitors

13.1 A motor starting or running capacitor shall be housed within an enclosure or container that will protect the plates against mechanical damage and that will prevent the emission of flame or molten material resulting from capacitor failure. 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:

- a) *Sheet metal having a thickness less than that mentioned above, or*
- b) *Material other than metal, if the capacitor is mounted within the enclosure of the unit.*

13.2 If exposed to the effects of weathering, ferrous metal capacitor enclosures shall be protected against corrosion in accordance with 8.2.1. Also see 8.1.5.

13.3 If the container of an electrolytic capacitor is metal, the container shall be considered as 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 0.028 inch (0.71 mm) thick except as indicated in the Exceptions to 21.6.

13.4 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 44.

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 value specified in Table 44.1 but not less than the current established by dividing the circuit voltage by the impedance of the other component(s).

14 Current-Carrying Parts

14.1 All current-carrying parts shall be of silver, copper, a copper alloy, or other material inherently resistant to corrosion and acceptable for use as an electrical conductor.

Exception: Multimetallic thermal elements and heater elements of a thermal protector need not be inherently resistant to corrosion.

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

19.6 On a permanently connected ice maker, 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 ice maker nameplate.

See 18.4.

19.7 The full load current rating of a switch that controls an inductive load (other than a motor) such as a transformer or solenoid, shall be not less than twice the controlled load.

Exception: An ac general-use snap switch may be used to control an inductive load not exceeding the ampere rating of the switch at rated voltage.

19.8 A switch, relay, or similar device that controls a motor of other than the clock-motor type shall have a horsepower or equivalent locked rotor ampere rating not less than that of the motor to be controlled.

Exception: An ac general-use snap switch (not an ac-dc general-use snap switch) may be used to control a motor load not exceeding 80 percent of the ampere rating of the switch at its rated voltage.

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

19.10 With reference to 19.8 and 19.9, the locked-rotor load of a hermetic motor-compressor is to be determined from the locked-rotor current rating of the motor-compressor at the test voltage specified in Table 31.1. If the motor-compressor rated voltage is less than the test voltage, the motor-compressor rated locked-rotor current is to be increased by the ratio of the normal test voltage to the rated voltage in determining compliance with 19.8 and 19.9.

19.11 A single-pole switching device shall not be connected to the grounded conductor.

Exception: An automatic control that does not have a marked OFF position need not comply with this requirement.

19.12 Motor controllers shall be arranged so that they will simultaneously open a sufficient number of ungrounded conductors to interrupt current flow to the motor.

Exception: Crankcase heating arrangements, where the circuit is arranged to permit current flow through a capacitor in series with the start winding of single-phase motor-compressors with the motor not operating, need not comply with this requirement.

19.13 A switch provided as an interlock (see 6.2.1 and 6.3.1) shall be endurance-tested for 100,000 cycles of operation at not less than the load it controls.

19.14 Switching devices shall be housed within an enclosure that will protect coils and contacts against mechanical damage, dirt, and moisture. Protection of the switching device may be provided by its method of mounting within the ice maker enclosure, by inherent construction of the component, or by means of a separate enclosure.

19.15 Where circuit breaker or switch handles are operated vertically, the "UP" position shall be the "ON" position.

19.16 A circuit breaker shall be connected to open all ungrounded conductors of the circuit. Multipole circuit breakers shall be the common trip type.

Exception: Single-pole circuit breakers with handle ties, the combination of which complies with the applicable requirements in the Standard for Molded-Case Circuit Breakers and Circuit-Breaker Enclosures, UL 489, may be used as the protection for each ungrounded conductor supplying line-to-line connected loads of a product rated for connection to a circuit of a grounded system.

Added 19.16 effective May 16, 1997

20 Transformer Protection

20.1 High-voltage transformers

20.1.1 General

20.1.1.1 A transformer (including an autotransformer), other than one as described in 20.1.3.4 and 20.1.3.5 is considered to be a high-voltage transformer and shall:

- a) Be provided with thermal overload protection in accordance with the requirements in 20.1.2.1,
- b) Be protected by an overcurrent device in accordance with the requirements in 20.1.3.1, or
- c) Comply with the Burnout Test – High-Voltage Transformers, Section 52.

Exception: A transformer rated less than 50 volt-amperes that supplies only a motor control circuit and is located in the same enclosure as the motor controller need not comply with this requirement.

20.1.2 Thermal protection

20.1.2.1 If a high-voltage transformer is provided with a thermal overload protective device, the device shall be arranged to interrupt primary current and shall limit temperatures of the transformer windings, under overload conditions, to that permitted for the class of insulation employed in the windings. See Overload Test – High-Voltage Transformers, Section 53.

Exception: If the thermal overload protective device provided is a nonrenewable thermal cutoff, a burnout test is to be conducted in place of the overload test. See Burnout Test – High-Voltage Transformers, Section 52.

20.1.2.2 A thermal cutoff shall comply with the Standard for Thermal Cutoffs for Use in Electrical Appliances and Components, UL 1020. A manual or automatic resetting thermal protector shall have an endurance rating of not less than 6000 cycles and shall comply with the Standard for Temperature-Indicating and -Regulating Equipment, UL 873, pertaining to the calibration of temperature limiting controls.

20.1.3 Overcurrent protection

20.1.3.1 If a high-voltage transformer is protected by an overcurrent device, such protection shall comply with the requirements specified in 20.1.3.2, 20.1.3.3, and 20.1.4.1 – 20.1.4.3.

20.1.3.2 Except as noted in 20.1.3.3, a high-voltage transformer shall be protected by an overcurrent device(s) located in the primary circuit and rated or set as indicated in Table 20.1. See 20.1.4.1.

Exception: If the rated primary current of the transformer is 9 amperes or more and 125 percent of this current does not correspond to a standard rating of fuse or circuit breaker, the next higher standard rating of protective device may be used. Standard ratings of protective devices are specified in Section 240-6 of the National Electrical Code, ANSI/NFPA 70-1993.

Exception No. 3: A lead 12 inches (305 mm) or less in length need not be provided with overcurrent protection.

Exception No. 4: A control-circuit conductor, supplied from the secondary of a single-phase transformer that is connected so that only a 2-wire (single voltage) secondary is used, may be protected by an overcurrent device(s) located on the primary side of the transformer provided:

- a) This protection is in accordance with requirements specified in Transformer Protection, Section 20, and
- b) The rating of the device does not exceed the applicable value specified in Table 21.1 multiplied by the ratio of secondary-to-primary rated transformer voltage.

Exception No. 5: A control circuit conductor that is tapped from the main power circuit at a point outside of the control equipment enclosure shall be protected as specified in Column A of Table 430-72(b) of the National Electrical Code, ANSI/NFPA 70-1993.

Table 21.1
Overcurrent protective device rating for control circuit conductors

Tapped control-circuit conductor size, AWG	Maximum rating of overcurrent protective device, amperes			
	Conductors contained in control equipment enclosure		Conductors extending beyond control equipment enclosure	
	Copper	Aluminum ^a	Copper	Aluminum ^a
18	25	—	7	—
16	40	—	10	—
14	100	—	45	—
12	120	100	60	45
10	160	140	90	75
Larger than 10	b	b	c	c

^a Includes copper-clad aluminum.

^b 400 percent of value specified for 60°C conductors in Table 310-17 of National Electrical code, ANSI/NFPA 70-1993.

^c 300 percent of value specified for 60°C conductors in Table 310-16 of National electrical Code, ANSI/NFPA 70-1993.

21.4 Overcurrent protective devices

21.4.1 Overcurrent protection for a tapped high-voltage control circuit conductor, as required by 21.3.2, shall be provided as part of the ice maker.

Exception: The overcurrent device(s) need not be provided as part of the ice maker if, based on the marked rating(s) of the ice maker, the rating of the branch circuit overcurrent protective device(s) does not exceed the values specified in Table 21.1.

21.4.2 A control circuit overcurrent protective device(s) shall:

- a) Be provided for all ungrounded conductors,
- b) Be sized in accordance with requirements in 21.3.2, and
- c) Have a voltage rating not less than the circuit in which it is used.

The device(s) shall be a circuit breaker acceptable for branch circuit protection, or a fuse acceptable for branch circuit protection, such as a Class CC, G, H, J, K, L, R, or T cartridge fuse or Type S plug fuse. See 57.17.

Exception: If the control circuit is tapped from a circuit supplying other loads in the ice maker, a device used for overcurrent protection may be of the supplementary type provided it has a short-circuit rating acceptable for the circuit in which it is used. See Table 44.1. If the supplementary type device used is a fuse, the ice maker shall be marked in accordance with the exception to 57.17.

ELECTRICAL SPACINGS

22 High-Voltage Circuits

22.1 The following electrical spacing requirements apply to high-voltage circuits, as defined in paragraph 3.4.

22.1 revised May 16, 1996

22.2 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 22.1.

22.2 revised May 16, 1996

22.3 The "Through Air" and "Over Surface" spacings given in Tables 22.1 and 22.2 at an individual component part are to be based on the total volt-ampere consumption of the load or loads that the component controls. For example, spacings at a component that controls only the compressor motor are to be based on the volt-amperes of the compressor motor. Spacings at a component that simultaneously controls several concurrent loads are to be based on the sum of the volt-amperes of the loads so controlled. Spacings at a component that controls several nonconcurrent loads are to be based on the volt-amperes of the largest 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.

22.3 revised May 16, 1996

22.3.1 With reference to paragraph 22.2 and 22.3, the spacings To Enclosure are not to be applied to an individual enclosure of a component part within an outer enclosure or cabinet.

22.3.1 added May 16, 1996

22.3.2 The spacings indicated in Table 22.2 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 22.1 apply.

22.3.2 added May 16, 1996

Table 22.1
Electrical spacings in refrigerated and/or air-handling compartments

Ratings		Minimum spacings in inch (mm)					
Volt-amperes	Volts	Through air ^a		Over surface ^a		To enclosure ^c	
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 22.1 revised May 16, 1996

Table 22.2
Spacings in non-refrigerated and/or non-air handling compartments

Ratings		Minimum spacing in inches (mm)			
Volt-amperes	Volts	Through air	Over surface	To Enclosure ^a	
0 – 2000	0 – 125	1/16 (1.6 mm)	1/16 (1.6 mm)	1/4	(6.4 mm)
	125 – 250	3/32 (2.4 mm)	3/32 (2.4 mm)	1/4	(6.4 mm)

NOTE – See 22.3.2.

^a Includes fittings for conduit or metal-clad cable.

Table 22.2 added May 16, 1996

22.4 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 in the paragraphs above and shall be based on the highest voltage involved.

22.4 revised May 16, 1996

22.4.1 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 machine, including clearance to dead metal or enclosure, shall be as indicated herein.

22.4.1 added May 16, 1996

22.5 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 as determined in the Temperature and Pressure Test, Section 36, exceeds 500 volts, the developed potential is to be used in determining spacings for the parts affected.

22.6 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 0.028 inch (0.7 mm) thick and shall be so located or of such material that it will not be deteriorated by arcing.

Exception No. 1: Fiber no less than 0.013 inch (0.3 mm) thick 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 specified thicknesses specified above.

22.6 revised May 16, 1996

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

22.7 added May 16, 1996

23 Low-Voltage Circuits

23.1 The following electrical-spacing requirements apply to low-voltage circuits, as defined in 3.4.

23.1 revised May 16, 1996

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

23.2 revised May 16, 1996

23.3 The spacings for low-voltage electrical components that are installed in a circuit that includes a pressure-limiting device, motor overload protective device, or other protective device, where a short or grounded circuit may result in a risk of fire, electric shock, or injury to persons, shall comply with items A – C:

- a) The spacing between an uninsulated live part and the wall of an outer 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, that 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, that 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.

23.3 revised May 16, 1996

23.4 The spacings in low-voltage circuits that do not contain devices such as indicated in paragraph 23.3 are not specified.

23.4 revised May 16, 1996

REFRIGERATION SYSTEM

24 Refrigerant

24.1 The kind and quantity of refrigerant employed in the system shall comply with the Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1994.

24.1 revised May 16, 1996

25 Pump-Down Capacity

25.1 The section of an ice maker designed to receive the refrigerant charge during a pumpdown shall have the capacity to receive the charge without the liquid occupying more than 90 percent of the volume of the section when the temperatures of the refrigerant is 90°F (32.2°C).

26 Refrigerant Tubing and Fittings

26.1 Copper, steel, or aluminum tubing used to connect refrigerant-containing components shall have a wall thickness not less than indicated in Table 26.1.

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

26.1 revised May 16, 1996

Table 26.1
Minimum wall thickness for copper and steel tubing

Outside diameter, Inches (mm)		Copper				Steel		Aluminum	
		Protected within appliance		Unprotected ^b					
		Inch	(mm)	Inch	(mm)	Inch	(mm)	Inch	(mm)
3/16	(4.76)	0.0245	(0.623)	0.0265	(0.673)	0.025	(0.635)	0.0350	0.89
1/4	(6.35)	0.0245	(0.623)	0.0265	(0.673)	0.025	(0.635)	0.0350	0.89
5/16	(7.94)	0.0245	(0.623)	0.0265	(0.673)	0.025	(0.635)	0.0350	0.89
3/8	(9.53)	0.0245	(0.623)	0.0265	(0.673)	0.025	(0.635)	0.0350	0.89
1/2	(12.70)	0.0245	(0.623)	0.0285	(0.724)	0.025	(0.635)	0.0350	0.89
5/8	(15.88)	0.0315	(0.799)	0.0315	(0.799)	0.032	(0.813)	0.0488	1.24
3/4	(19.05)	0.0315	(0.799)	0.0385	(0.978)	0.032	(0.813)	0.0488	1.24
7/8	(22.23)	0.0410	(1.041)	0.0410	(1.041)	0.046	(1.168)	0.0650	1.65
1	(25.40)	0.0460	(1.168)	0.0460	(1.168)	—	—	0.0720	1.83
1-1/8	(28.58)	0.0460	(1.168)	0.0460	(1.168)	0.046	(1.168)	—	—
1-1/4	(31.75)	0.0505	(1.283)	0.0505	(1.283)	0.046	(1.168)	—	—
1-3/8	(34.93)	0.0505	(1.283)	0.0505	(1.283)	—	—	—	—
1-1/2	(38.10)	0.0555	(1.410)	0.0555	(1.410)	0.062	(1.575)	—	—
1-5/8	(41.28)	0.0555	(1.410)	0.0555	(1.410)	—	—	—	—
2-1/8	(53.98)	0.0640	(1.626)	0.0640	(1.626)	—	—	—	—
2-5/8	(66.68)	0.0740	(1.880)	0.0740	(1.880)	—	—	—	—

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

^b Tubing which is not protected by an enclosure or by location so that it is exposed to crushing, abrasion, puncture or similar mechanical damage under installed conditions.

Table 26.1 revised May 16, 1996

26.2 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.

26.3 Tubing forming part of components, such as evaporators or condensers, where protection is afforded by inherent construction, shall be judged by the strength test requirements specified in Strength Tests — Pressure Containing Components, Section 50.

26.4 Special alloys or constructions used in refrigerant-containing components, including tubing with a wall thickness less than indicated in 26.1 may be acceptable. Among the factors taken into consideration when judging the acceptability are:

- Resistance to mechanical abuse,
- Strength against internal pressure,
- Resistance to corrosion,
- Protection against refrigerant contamination, and
- Compliance with requirements of safety codes, such as the Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1994, as compared to tubing of the minimum wall thicknesses indicated in Table 26.1.

26.5 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 comply with the Standard for Refrigeration Flare-Type Fittings, ANSI/SAE J513d-1990.

27 Refrigerant-Containing Parts

27.1 Parts subjected to refrigerant pressure shall withstand the pressure indicated in the Strength Tests – Pressure Containing Components, Section 50.

27.2 Parts subjected to refrigerant pressure shall be:

- a) Constructed of corrosion-resistant material, such as copper or stainless steel, or
- b) Protected against external corrosion by means such as plating or painting.

27.3 Pressure vessels over 6 inches (152 mm) inside diameter shall be designed, tested, and stamped in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, for a working pressure not less than the design pressure marked on the ice maker. See 57.2(e).

27.4 Pressure vessels bearing the ASME Code "U" symbol complying with 27.3 are considered acceptable without test.

27.5 Pressure vessels bearing the ASME Code "U" symbol shall be tested to determine compliance with the strength Tests – Pressure Containing Components, Section 50. The manufacturer shall submit evidence of compliance of these vessels with the ASME Boiler and Pressure Vessel Code, Section VIII.

28 Pressure-Limiting Device

28.1 A pressure-limiting device designed to automatically stop the operation of the compressor shall be installed:

- a) On all air-cooled units with a system containing more than 20 pounds-mass (9.1 kg) of refrigerant,
- b) On all water-cooled units, and
- c) On all remote units intended to be connected to a field-installed condenser.

Exception: A pressure-limiting device is not required on a unitary water-cooled unit employing 3 pounds (1.4 kg) or less of refrigerant, provided that the unit complies with 50.1(h).

36.7 The ice maker shall comply with the requirements of the Dielectric Voltage-Withstand Test, Section 38, following the above tests.

37 Starting Test

37.1 An ice maker shall start and operate through all modes without opening the branch circuit fuses for which it is designed to be used, marked to be used, or both. Normally, this test is conducted in conjunction with the Temperature and Pressure Test, Section 36.

Exception: For a permanently-connected unit protected by a fuse sized in accordance with 44.1.4, no starting test is required.

37.2 For a cord-connected unit, the fuse rating is to be determined by the rating of the attachment plug. For a permanently-connected unit protected by a fuse sized in accordance with Exception No. 1 of 44.1.4, the fuse rating is to be as marked on the nameplate.

37.3 The unit and four fuses are to be connected in series. The unit is to be operated under the conditions specified in Table 34.1, and the test voltage is to be maintained as indicated in Table 31.1.

37.4 If no fuse opens, the fuse used is acceptable for starting the unit. If one fuse opens, the test is to be repeated using the three remaining fuses. If none of the three opens, the results are acceptable. If one of the three opens, the results are not acceptable and the test is to be repeated using four time-delay fuses of the same rating as the original fuse.

37.5 If it is determined that time-delay fuses are required for starting, the unit shall be marked in accordance with 57.13.

37.6 If an automatic reset thermal protective device interrupts the current flow one or more times during the test described in 37.3, the unit shall restart and run after each interruption and shall comply with the fusing requirements of 37.4 and 37.5.

38 Dielectric Voltage-Withstand Test

38.1 An ice maker shall withstand, without breakdown, a test potential applied for 1 minute between high-voltage live parts and dead metal parts and between live parts of high- and low-voltage circuits. The test potential shall be 1000 volts plus twice rated voltage at any frequency between 40 and 70 hertz.

Exception No. 1: The test potential for motors rated at not more than 1/2 horsepower (373 W output) 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.

38.1 revised May 16, 1996

38.2 *38.2 revised and combined with 38.1 May 16, 1996*

38.3 An ice maker employing a low-voltage circuit shall withstand, without breakdown, a test potential of 500 volts applied for 1 minute between low voltage live parts and dead metal parts. The test potential shall be at any frequency between 40 and 70 hertz. If protective devices such as specified in paragraph 23.3 are employed in the low-voltage circuit, the dielectric voltage withstand test shall also be conducted between live parts of opposite polarity.

38.3 revised May 16, 1996

38.4 With reference to paragraph 38.3, 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 that the components have been separately subjected to this.

38.4 revised May 16, 1996

38.5 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 the previous paragraphs. 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 maintains the specified high potential voltage at the equipment during the test.

38.5 revised May 16, 1996

38.6 If the charging current through a 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.

38.6 added May 16, 1996

38.7 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.

38.7 added May 16, 1996

38.8 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.

38.8 added May 16, 1996

39 Condenser Fan Motor Failure Test

39.1 An air-cooled ice maker shall not leak refrigerant nor develop pressures or temperatures in excess of those indicated in (a) and (b), if the condenser fan motor locks or fails to start.

a) The maximum high- and low-side pressures shall not exceed one-third of the ultimate strength of high- and low-side parts, respectively, as determined by Strength Tests – Pressure Containing Components, Section 50. A unit employing a pressure-limiting device complying with 28.2 or 28.3, as applicable, is considered to comply with the high-side pressure requirement.

b) The temperature of the compressor motor enclosure, of the fan motor winding (open type) or of the fan motor enclosure (enclosed type) shall not exceed 302°F (150°C). Compressors and condenser fan motors equipped with a thermal protective device(s) as specified in Motors and Motor Overload Protection, Section 18, are considered to comply with this requirement.

39.2 The unit, fitted with pressure gauges on the high- and low-pressure sides of the refrigeration system and provided with thermocouples on the compressor motor enclosure and condenser fan motor winding (open type) or condenser fan motor enclosure (enclosed type), is to be operated with the condenser fan motor locked. If two or more condenser fan motors are employed, the test is to be conducted with one motor locked. Operation is to continue until maximum stabilized temperatures and pressures are reached or until representative maximum temperatures and pressures are attained under cycling load. The low-side pressure is to be recorded while the compressor is operating and after shutdown. If the unit is provided with means to relieve discharge pressure into the low-side of the system, the low-side pressure is to be recorded:

- a) While 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 compressor motor overload device, the fan motor overload device, or both, may operate during this test. The ambient air temperature is to be approximately 77°F (25°C). The test voltage is to be maintained as indicated in Table 31.1.

Table 45.1
Duration of current flow
bonding-conductor test

Rating of overcurrent device, amperes	Minimum duration of current flow, minutes
30 or less	2
31 – 60	4
61 – 100	6
101 – 200	8

46 Overvoltage and Undervoltage Tests

46.1 An electromagnet, such as employed on a relay or solenoid, in a low-voltage circuit shall withstand 10 percent above rated voltage without damage and shall operate at that voltage and also at 15 percent below rated voltage. If the component is supplied by a low-voltage transformer provided as part of the unit, the voltage adjustments are to be based on and made in the primary of the transformer.

46.2 If a relay or other control is used in combination with a motor controller to prevent automatic recycling of the motor due to the operation of a protective device, the components involved shall comply with the requirements in 46.1 under any condition that might result from operation of the protective device and de-energization of the circuit.

46.3 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 then is to be reduced to rated voltage and each relay and solenoid is to operate at this voltage. The potential is to be maintained at this voltage until the coils reach constant temperatures. The potential then is to be reduced to the undervoltage condition, and each relay and solenoid shall operate at this voltage. A relay or solenoid that will not be subject to continuous operation is to be energized at the overvoltage condition and at rated voltage for the maximum time permitted by its duty cycle or until constant temperature is reached, whichever occurs first.

47 Insulation Resistance Test

47.1 An ice maker employing thermal or acoustical insulating material likely to be affected adversely by moisture under conditions of use shall have an insulation resistance of not less than 50,000 ohms between live parts and interconnected dead metal parts after exposure for 24 hours to air having a relative humidity of 85 ± 5 percent at a temperature of $90 \pm 4^\circ\text{F}$ ($32.0 \pm 2^\circ\text{C}$).

48 Accelerated Aging Tests on Gaskets, Sealing Compounds and Adhesives

48.1 48.2 – 48.6 apply to gaskets and sealing compounds required for electrical enclosures as determined during the Rain Test, Section 33. 48.8 applies to adhesives required to secure such gaskets to enclosures or covers.

48.2 Neoprene or rubber compounds, except foamed materials, shall have physical properties as indicated in Table 48.1 before and after accelerated aging under the conditions indicated in Table 48.2. The temperature indicated in Table 48.2 corresponds to the maximum temperature rise measured on the gasket during the Temperature and Pressure Test, Section 36.

48.3 Foamed neoprene or rubber compounds are to be subjected to accelerated aging under the conditions indicated in Table 48.2. The compounds shall not harden or otherwise deteriorate to the degree that their sealing properties are affected.

Table 48.1
Physical properties for gaskets

Physical property	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

Table 48.2
Accelerated aging test criteria

Measured temperature rise degrees		Material	Test program
C	F		
35	(63)	Rubber or neoprene	Air oven aging for 70 hours at 100 ±2°C (212 ±3.6°F)
35	(63)	Thermoplastic	7 days in an air circulating oven at 100°C (212°F)
50	(90)	Rubber or neoprene	Air oven aging for 168 hours at 100 ±2°C (212 ±3.6°F)
50	(90)	Thermoplastic	10 days in an air circulating oven at 100°C (212°F)
55	(99)	Rubber, neoprene or thermoplastic	7 days in an air circulating oven at 113°C (235.4°F)
65	(117)	Rubber or neoprene	10 days in an air circulating oven at 121°C (249.8°F)
65	(117)	Thermoplastic	7 days at 121°C (249.8°F) or 60 days at 97°C (206.6°F) in an air-circulating oven
80	(144)	Rubber, neoprene or thermoplastic	7 days in an air circulating oven at 136°C (276.8°F)

Table 48.2 revised May 16, 1996

52 Burnout Test — High-Voltage Transformers

52.1 There shall be no emission of flame or molten metal from the ice maker enclosure when a high-voltage transformer is operated under the conditions described in 52.2 and 52.3.

Exception: This test does not apply to a high-voltage transformer that is provided with thermal overload protection of other than the nonrenewable thermal cutoff type (see 20.1.2.1) or that is protected by an overcurrent device(s) in accordance with the requirements in 20.1.3.1.

52.2 Three samples of the transformer are to be operated continuously at the normal test voltage indicated in Table 31.1 and rated frequency with the enclosure grounded. The test ambient temperature is to be approximately 77°F (25°C) and operation is to be continued until constant temperature is indicated by a thermocouple on the enclosure or until burnout occurs. The circuit on which the transformer is tested is to be protected by fuses rated not less than that required for the ice maker.

52.3 The load connected to the output terminals is to be the highest of the values specified in (a) – (c) and is to be readjusted to the specified value after 2 minutes of operation, if necessary, with no further readjustment during the test.

- a) A resistance load to provide a current equal to three times the full rated transformer secondary current, or
- b) If the transformer supplies a motor with or without additional loads, a resistance load to provide a current equal to the motor locked-rotor current plus any additional loads, or
- c) If the transformer supplies an inductive load (other than a motor), such as the coils of relays, solenoids, and the like, a resistance load to provide a current equal to the sum of such loads with the armature of the largest blocked open.

Exception: The test may be conducted with the output terminals short-circuited if this results in less than three times rated secondary current.

53 Overload Test — High-Voltage Transformers

53.1 This test applies to a high-voltage transformer provided with thermal protection of other than the nonrenewable thermal cutoff type. See 20.1.2.1.

53.2 Temperatures of a thermally protected high-voltage transformer, measured on the surface of the windings, shall not exceed the insulation temperature rating when the transformer is tested as indicated in 53.3 and 53.4. Insulation temperature rating is defined as the rating for the class of insulation; such as, 105°C for Class 105 insulation, 130°C for Class 130 insulation, and the like.

53.3 A variable resistance load is to be connected to the output terminals and the transformer operated continuously at the normal test voltage indicated in Table 31.1. If the protective device controls a switching device that, in turn, interrupts primary current to the transformer, the switching device is to be in the circuit. The test ambient temperature is to be approximately 25°C (77°F). The resistance load is to be adjusted so that the transformer winding is brought to a stabilized temperature of approximately 10°C (18°F) below its insulation rating. The load is then to be gradually increased until operation of the protector occurs.

53.4 Three samples of the transformer-protector combination are to be tested. Average temperatures of the three samples shall not exceed the winding insulation rating and the temperature of any one sample shall not exceed the insulation rating by more than 5°C (9°F).

53.5 The transformer shall comply with the Dielectric Voltage-Withstand Test, Section 38, following the test specified in 53.3 and 53.4.

MANUFACTURING AND PRODUCTION TESTS

54 Pressure Tests

54.1 Each ice maker shall be tested and proved tight at not less than the design pressure(s) marked on the appliance. See 57.7.

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.

54.2 If the final assembly is completed with flare-type fittings or telescoped tubing joints that are sealed with brazing or the equivalent, the pressure test of the complete system may be at the low-side design pressure, provided that the high-side parts are individually tested either by the ice maker manufacturer or by the manufacturer of the part at not less than the high-side design pressure.

54.3 At least once each year, a strength test shall be conducted on refrigerant-containing components of the shell type that have an inside diameter greater than 3 inches (76.2 mm) including motor-compressor enclosures. The test is to be conducted on at least one sample of each size and type. The part shall comply with requirements of Strength Tests – Pressure Containing Components, Section 50. Such tests may be conducted either by the ice maker manufacturer or by the manufacturer of the component.

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

55 Production-Line Dielectric Voltage-Withstand Test

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 16, 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 16, 1996

Table 55.1
Production-line test conditions

Product rating	Condition A		Time, seconds	Condition B		Time, seconds
	Potential, VAC ^c	VDC		Potential, VAC ^c	VDC	
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 16, 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 16, 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 the 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 16, 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 revised May 16, 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 16, 1996

55.5 The test equipment shall have a means of indicating the test potential, an audible or visual indicator of electrical breakdown, and either a manually reset device to restore the equipment after electrical breakdown or an automatic reject feature of any unacceptable unit. When an ac test potential is applied, the test equipment shall include a transformer having an essentially sinusoidal output.

55.5 revised May 16, 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 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 16, 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 16, 1996

55.8 During the test, the primary switch is to be in the on position, both sides of the primary circuit of the product are to be connected together and to one terminal of the test equipment, and the second test-equipment terminal is to be connected to the accessible dead metal.

Exception: A product having circuitry – resistive, high-impedance winding, or the like – 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 16, 1996

56 Production-Line Grounding Continuity Test

56.1 The manufacturer shall test each ice maker that has a power supply cord to determine that there is electrical continuity between the grounding blade of the attachment plug and the frame or enclosure of the appliance.

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.

MARKING

57 General

57.1 A marking that is required to be permanent shall be molded, die-stamped, paint-stenciled, stamped, or etched in metal that is permanently secured, or indelibly stamped on pressure-sensitive labels secured by adhesive. Pressure-sensitive labels shall comply with the Standard for Marking and Labeling Systems, UL 969.

57.2 Each ice maker shall be permanently 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. See 57.4, 58.1 – 58.4, and 59.1.
- d) The kind and amount of refrigerant in pounds and/or ounces. See 57.3, 57.5, and 57.6.

Exception No. 1: The amount of refrigerant need not be marked on the nameplate of a remote ice maker intended to be connected to a field-installed condensing unit.

Exception No. 2: The amount of refrigerant need not be marked on the nameplate of a remote ice maker intended for connection to a field installed condenser if it is intended to be field charged and has a space and instructions for stamping the amount of refrigerant when charged.

- e) The high- and low-side design pressures. See 57.3 and 57.7.

Exception: The high-side design pressure need not be marked on a remote ice maker that does not incorporate any high-side components.

- f) The date of manufacture that will enable the product to be identified as being manufactured within a consecutive 3-month period. This information may be in code and shall be located on or near the nameplate. A date code marking shall be such that it does not repeat in less than 20 years.

57.3 With reference to 57.2(d), ice makers may be marked with equivalent SI units in addition to the USA customary units of measure.

57.4 Ice makers shall be marked with the operating voltage, the frequency, and the total or individual loads as indicated in 58.2 and 59.1. Permanently-connected units shall also be marked with the number of phases.

57.5 The kind of refrigerant shall be designated by number. 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 revised May 16, 1996

57.6 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 as shown in the Number Designation and Safety Classification of Refrigerants, ANSI/ASHRAE 34-1992.

57.6 revised May 16, 1996

57.7 The high- and low-side design pressures marked on the ice-maker shall not be less than the values recorded during the Temperature and Pressure Test, Section 36, nor less than the values in Table 57.1.

57.7 revised May 16, 1996

Table 57.1
Minimum design pressure

Refrigerant	Minimum design pressure, psig (kPa)					
	Low-side		High-side			
			Air-cooled		Water cooled	
12	85	(586)	169	(1165)	127	(876)
22	144	(993)	278	(1917)	211	(1455)
134a	88	(606)	186	(1282)	135	(930)
401A	85	(586)	182	(1255)	133	(917)
401B	93	(641)	195	(1344)	143	(986)
402A	183	(1262)	347	(2394)	265	(1828)
402B	170	(1172)	324	(2234)	247	(1703)
404A	174	(1200)	331	(2281)	253	(1745)
502	162	(1117)	300	(2067)	232	(1599)
507	180	(1242)	344	(2374)	262	(1808)

Note – For other refrigerants, the minimum design pressure shall be not less than the values recorded during the Input Test (cooling mode), Section 36, nor less than the saturation pressure of the refrigerant at the following temperatures:

80°F (26.5°C) for low-sides
105°F (40.5°C) for water-cooled high-sides
125°F (51.7°C) for air cooled-high-sides

Table 57.1 added May 16, 1996

57.8 The information specified in 57.2 shall be on a nameplate(s) which, after installation of the ice maker, can be read without requiring the use of tools for removal of panels and the like.

57.9 An ice maker that incorporates a hermetic refrigerant motor-compressor having a thermal protector that provides protection in accordance with 18.3(b) shall be permanently marked "Motor-Compressor Thermally Protected" or with an equivalent statement unless the motor-compressor(s) is so marked.

UL 563

ISBN 1-55989-882-8

Ice Makers



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