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1-22-97

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UL 427

12-30-94

91



Underwriters Laboratories Inc.®

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January 22, 1997

Revision pages for

Refrigerating Units

UL 427, Third Edition

Attached to this distribution notice is a reprinted title page for the Third edition of UL 427.

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

As indicated on the title page (page 1), this UL Standard for Safety has been approved by the Department of Defense.

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	December 30, 1994 (Reprinted January 22, 1997)
2	May 1, 1996
3	July 1, 1996
4 - 38	December 30, 1994
39, 40, 40A, 41	May 1, 1996
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76 - 78, 78A, 78B, 79, 80, 80A	May 1, 1996
81 - 85, A1	December 30, 1994

DECEMBER 30, 1994

(Title Page Reprinted: January 22, 1997)



1

UL 427

Standard for

Refrigerating Units

First Edition – March, 1976

Second Edition – December, 1989

Third Edition

December 30, 1994

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated December 30, 1994. These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

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

Approved as ANSI/UL 427-1989, February 2, 1989

Approved as ANSI/UL 427-1996, March 22, 1996

The Department of Defense (DoD) has adopted UL 427 on April 9, 1992. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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.

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

- a) The spacing between an uninsulated live part and the wall of a metal enclosure, including fittings for the connection of conduit or metal-clad cable, shall be not less than 1/8 inch (3.2 mm).
- b) The spacing between wiring terminals regardless of polarity and between the wiring terminal and a dead metal part, including the enclosure and fittings for the connection of conduit which may be grounded when the device is installed, shall be not less than 1/4 inch (6.4 mm).
- c) The spacing between uninsulated live parts regardless of polarity and between an uninsulated live part and a dead metal part, other than the enclosure which may be grounded when the device is installed, shall be not less than 1/32 inch (0.8 mm) provided that the construction of the parts is such that spacings will be definitely maintained.

21.2.2 revised May 1, 1996

21.2.3 The spacings in low-voltage circuits which do not contain devices such as indicated in the previous paragraphs are not specified.

21.2.3 added May 1, 1996

REFRIGERATION SYSTEM

22 General

22.1 Refrigerant

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

22.1.2 **22.1.2 deleted May 1, 1996**

22.2 Pump-down capacity

22.2.1 The section of a product intended to receive the refrigerant charge during a pump-down shall have the capacity to receive the charge without the liquid occupying more than 90 percent of the volume of the section when the temperature of the refrigerant is 32.2°C (90°F).

22.3 Refrigerant tubing and fittings

22.3.1 Copper or steel tubing used to connect refrigerant containing components shall have a wall thickness not less than specified in Table 22.1.

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

Table 22.1
Minimum wall thickness for copper and steel tubing

Outside diameter, Inches (mm)		Copper				Steel Inches (mm)	
		Protected within product		Unprotected			
Inches	(mm)	Inches	(mm)	Inches	(mm)	Inches	(mm)
1/4	(6.4)	0.0245	(0.622)	0.0265	(0.673)	0.025	(0.64)
5/16	(7.9)	0.0245	(0.622)	0.0285	(0.724)	0.025	(0.64)
3/8	(9.5)	0.0245	(0.622)	0.0285	(0.724)	0.025	(0.64)
1/2	(12.7)	0.0245	(0.800)	0.0285	(0.724)	0.025	(0.64)
5/8	(15.9)	0.0315	(0.800)	0.0315	(0.800)	0.032	(0.81)
3/4	(19.1)	0.0315	(0.799)	0.0385	(0.978)	0.032	(0.81)
7/8	(22.2)	0.0410	(1.041)	0.0410	(1.041)	0.046	(1.17)
1	(25.4)	0.0460	(1.168)	0.0460	(1.168)	—	—
1-1/8	(28.6)	0.0460	(1.168)	0.0460	(1.168)	0.046	(1.17)
1-1/4	(31.8)	0.0505	(1.283)	0.0505	(1.283)	0.046	(1.17)
1-3/8	(34.9)	0.0505	(1.283)	0.0505	(1.283)	—	—
1-1/2	(38.1)	0.0555	(1.410)	0.0555	(1.410)	0.062	(1.57)
1-5/8	(41.3)	0.0555	(1.410)	0.0555	(1.410)	—	—
2-1/8	(54.0)	0.0640	(1.626)	0.0640	(1.626)	—	—
2-5/8	(66.7)	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.

22.3.2 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.

22.3.3 Tubing forming part of a component, such as an evaporator or condenser, where protection is provided by inherent construction is to judged by the Strength Tests, Section 45, requirements.

22.3.3 revised May 1, 1996

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Underwriters Laboratories Inc.®



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
 Refrigerants, UL 2182
 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

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AVA Documents
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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-

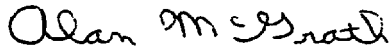
January 9, 1997

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.

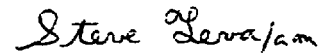
Unless specifically requested to do so, UL will not acknowledge comments indicating concurrence with these proposals.

UNDERWRITERS LABORATORIES INC.



ALAN MCGRATH (Ext. 43038)
Project Engineer
Standards Department

REVIEWED BY:



STEVE LEVA (Ext. 42419)
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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 15-1989.~~

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 15-1989.

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.®

July 1, 1996

Revision pages for

Standard for

Refrigerating Units

UL 427, Third Edition

Attached to this distribution notice is a revision of the Third edition of UL 427.

A CHANGE ON A PAGE DATED JULY 1, 1996 IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THESE NEW AND REVISED REQUIREMENTS IN THIS STANDARD ARE NOW IN EFFECT EXCEPT FOR THOSE PARAGRAPHS, SECTIONS, TABLES, FIGURES, AND OTHER ELEMENTS OF THE STANDARD HAVING FUTURE EFFECTIVE DATES AS INDICATED IN THE NOTE FOLLOWING THE AFFECTED ITEM. TO RETAIN THE REQUIREMENTS IN EFFECT UNTIL THESE FUTURE EFFECTIVE DATES, DO NOT DISCARD THE PAGES REPLACED BY THOSE HAVING FUTURE EFFECTIVE DATES UNTIL THOSE DATES.

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 revised requirements are substantially in accordance with UL's Bulletin on this subject dated February 1, 1996. The bulletin is now obsolete and may be discarded.

As indicated on the title page (page 1), this UL Standard for Safety has been approved by the Department of Defense.

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:

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54, 54A	May 1, 1996

(Continued)

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Standards for Components	A1
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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.

Table 47.1
Accelerated aging test criteria

Measured temperature rise		Test program	
		material	
°C	(°F)	Rubber or neoprene	Thermoplastic
35	(63)	Air oven aging for 70 hours at $100 \pm 2^{\circ}\text{C}$ ($212 \pm 3.6^{\circ}\text{F}$)	7 days in an air circulating oven at 100°C (212°F)
50	(90)	Air oven aging for 168 hours at $100 \pm 2^{\circ}\text{C}$ ($212 \pm 3.6^{\circ}\text{F}$)	10 days in an air circulating oven at 100°C (212°F)
55	(99)	7 days in an air circulating oven at 113°C (235.4°F)	
65	(117)	10 days in an air circulating oven at 121°C (249.8°F)	7 days at 121°C (249.8°F) or 60 days at 97°C (206.6°F) in an air-circulating oven
80	(144)	7 days in an air circulating oven at 136°C (276.8°F)	
100	(180)	60 days in an air circulating oven at 136°C (276.8°F)	
125	(225)	60 days in an air circulating oven at 158°C (316.4°F)	
175	(315)	60 days in an air circulating oven at 210°C (410°F)	

Table 47.1 revised July 1, 1996

48 Reliability Test – Heater Termination

48.1 Electric heaters employing integrally molded leads or molded terminal assemblies shall withstand a test load of 20 pounds (9.1 kg) applied for 1 minute. The load is to be applied in the same direction at which the lead exits the heater case or molded connection and is not to result in displacement of insulation or separation of the connection between the lead and heater.

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

49.1 General

49.1.1 The requirements specified in 49.1.2 – 49.2.1 apply to gaskets and sealing compounds required for electrical enclosures as determined during the Rain Test, Section 35. The requirements specified in 49.3.1 apply to adhesives required to secure such gaskets to enclosures or covers.

49.1.2 Neoprene or rubber compounds, except foamed materials, forming gaskets shall have physical properties before and after exposure in an air oven for 70 hours at $100 \pm 2^{\circ}\text{C}$ ($212 \pm 3.6^{\circ}\text{F}$) as indicated in Table 49.1.

49.1.2 revised July 1, 1996

Table 49.1
Physical properties for gaskets

	Before test	After test
Recovery — Maximum set when 1 inch (25.4 mm) gauge marks are stretched to 2-1/2 inches (63.5 mm) and held for 2 minutes and measured after release	1/4 inch (6.4 mm)	
Elongation — Minimum increase in distance between 1 inch (25.4 mm) gauge marks at break	250 percent (1 to 3-1/2 inches) (25.4 to 88.9 mm)	65 percent of original
Tensile Strength — Minimum force at breaking point	850 psig (5.9 MPa)	75 percent of original

49.1.3 Foamed neoprene or rubber compounds forming gaskets are to be subjected to exposure in an air oven for 70 hours at $100 \pm 2^\circ\text{C}$ ($212 \pm 3.6^\circ\text{F}$). The compounds shall not harden or otherwise deteriorate to a degree which will affect their sealing properties.

49.1.3 revised July 1, 1996

49.1.4 Thermoplastic materials forming gaskets is to be subjected to a test involving exposure in an air oven at 87°C (188.6°F) for a period of 7 days. The material shall not deform, melt, or otherwise deteriorate to a degree which will affect its sealing properties.

49.1.5 With reference to 49.1.4, polyvinyl chloride gasket material shall have an ultimate tensile strength of not less than 1200 psig (8.3 MPa) and an ultimate elongation of not less than 250 percent before the air-oven test. The minimum tensile strength shall be not less than 90 percent and the elongation not less than 75 percent of the original values after the air-oven test.

49.2 Sealing compound

49.2.1 Sealing compounds are to be applied to the surface they are intended to seal. A representative sample of the surface with the sealing compound applied is to be subjected to a test involving exposure in an air oven at 87°C (188.6°F) for a period of 7 days. The sealing compound shall not melt, become brittle, or otherwise deteriorate to a degree that will affect its sealing properties as determined by comparing the aged sample to an unaged sample.

49.3 Adhesives

49.3.1 For gaskets secured by adhesives, samples of the gasket adhesive and mounting surface are to be exposed to 87°C (188.6°F) air oven for 7 days and then immersion in distilled water for 3 days. The force required to peel the gasket from its mounting surface after exposure shall not be less than 50 percent of the value determined on "as-received" samples and in no case less than 2 pounds per inch (350 N/m) of gasket width.



Underwriters Laboratories Inc.®

An independent, not-for-profit organization testing for public safety

May 1, 1996

Revision pages for

Standard for

Refrigerating Units

UL 427, Third Edition

Attached to this transmittal notice is a revision of the Third edition of UL 427.

A CHANGE ON A PAGE DATED MAY 1, 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.

The new and revised requirements are substantially in accordance with UL's bulletin on this subject dated August 15, 1995. The bulletin is now obsolete and may be discarded.

Attention is directed to the note on the title page of this standard identifying that the Department of Defense has adopted the text of UL 427.

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	December 30, 1994 (Reprinted May 1, 1996)
2 - 3	May 1, 1996
4 - 38	December 30, 1994
39, 40, 40A, 41 - 43	May 1, 1996
44 - 53	December 30, 1994
54, 54A	May 1, 1996
55 - 75	December 30, 1994
76 - 78, 78A, 78B, 79, 80, 80A	May 1, 1996
81 - 85, A1	December 30, 1994

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1

UL 427

Standard for

Refrigerating Units

First Edition – March, 1976

Second Edition – December, 1989

Third Edition

December 30, 1994

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

The Department of Defense (DoD) has adopted UL 427 on April 9, 1992. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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.

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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.

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

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

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

19.15 An automatic control that does not have a marked "off" position is not required to comply with 19.14.

20 Transformers

20.1 A transformer that directly supplies a National Electrical Code, ANSI/NFPA 70-1993, Class 2 circuit (see 3.3) shall, in accordance with the Standard for Class 2 and Class 3 Transformers, UL 1585, either limit the output current (inherently limited transformer) or be equipped with an overcurrent device (not inherently limited transformer).

21 Spacings

21.1 High-voltage circuits

21.1.A1 The following electrical spacing requirements apply to a high-voltage circuit defined in 3.3(a).

21.1.A1 added May 1, 1996

21.1.1 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 specified in Table 21.1.

21.1.1 revised May 1, 1996

21.1.2 The through air and over surface spacings given in Tables 21.1 and 21.2 as measured 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, the spacings at a component that controls only the compressor motor are based on the volt-amperes of the compressor motor. The spacings at a component that controls loads in addition to the compressor motor are based on the sum of the volt-amperes of the loads so controlled, except that spacings at a component that independently controls separate loads are based on the volt-amperes of the larger load. The volt-ampere values for the aforementioned loads are to be determined by the marked rating of the load, except that for loads that are not required to have a marked rating, the measured input is to be used in determining the volt-ampere values.

21.1.2 revised May 1, 1996

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

21.1.3 revised May 1, 1996

21.1.4 The spacing requirements specified in 21.1.1 – 21.1.3 do not apply to the inherent spacings of a component part of the product, such as a snap switch, controller, attachment-plug cap, or the like, for which spacing requirements are given in a standard for the component. However, the electrical clearance resulting from the assembly of the components into the complete product, including clearance to dead metal or enclosures, shall be those indicated.

Table 21.1
Electrical spacings in refrigerated and/or air-handling compartments

Ratings		Minimum spacing in inches (mm)		
		Through air ^a	Over surface ^a	To enclosure ^{c, d}
Volt-Amperes	Volts			
2000 or less	300 or less	1/8 ^b (3.2)	1/4 (6.4)	1/4 (6.4)
	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 this table. Wiring terminals are those connected in the field and not factory wired.

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

^d Does not apply to an individual enclosure of a component part within an outer enclosure or cabinet.

Table 21.1 revised May 1, 1996

21.1.5 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 29, exceeds 500 volts, the developed potential is to be used in determining the spacings for the parts affected.

21.1.5 revised May 1, 1996

21.1.6 An insulating lining 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) in thickness and shall be so located or of such material that it will not be adversely affected by arcing.

Exception No 1: Fiber not less than 0.013 inch (0.3 mm) in thickness may be used in conjunction with an air spacing of no less than 50 percent of the spacing required for air alone.

Exception No. 2: Material having a lesser thickness may be used if it has equivalent insulating, mechanical, and flammability properties.

21.1.6 revised May 1, 1996

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

21.1.7 added May 1, 1996

21.1.8 With reference to paragraphs 21.1.2 and 21.1.3, the spacings To Enclosure are not to be applied to an individual enclosure of a component part within an outer enclosure or cabinet.

21.1.8 added May 1, 1996

21.1.9 The spacings indicated in Table 21.2 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 21.1 apply.

21.1.9 added May 1, 1996

Table 21.2
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 paragraph 21.1.9.				
a Includes fittings for conduit or metal-clad cable.				

Table 21.2 added May 1, 1996

21.2 Low-voltage circuits

21.2.A1 The following electrical spacing requirements apply to low-voltage circuits, as defined in 3.3(b).

21.2.A1 added May 1, 1996

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

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

- a) The spacing between an uninsulated live part and the wall of a metal enclosure, including fittings for the connection of conduit or metal-clad cable, shall be not less than 1/8 inch (3.2 mm).
- b) The spacing between wiring terminals regardless of polarity and between the wiring terminal and a dead metal part, including the enclosure and fittings for the connection of conduit which may be grounded when the device is installed, shall be not less than 1/4 inch (6.4 mm).
- c) The spacing between uninsulated live parts regardless of polarity and between an uninsulated live part and a dead metal part, other than the enclosure which may be grounded when the device is installed, shall be not less than 1/32 inch (0.8 mm) provided that the construction of the parts is such that spacings will be definitely maintained.

21.2.2 revised May 1, 1996

21.2.3 The spacings in low-voltage circuits which do not contain devices such as indicated in the previous paragraphs are not specified.

21.2.3 added May 1, 1996

REFRIGERATION SYSTEM

22 General

22.1 Refrigerant

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

22.1.2 **22.1.2 deleted May 1, 1996**

22.2 Pump-down capacity

22.2.1 The section of a product intended to receive the refrigerant charge during a pump-down shall have the capacity to receive the charge without the liquid occupying more than 90 percent of the volume of the section when the temperature of the refrigerant is 32.2°C (90°F).

22.3 Refrigerant tubing and fittings

22.3.1 Copper or steel tubing used to connect refrigerant containing components shall have a wall thickness not less than specified in Table 22.1.

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

Table 22.1
Minimum wall thickness for copper and steel tubing

Outside diameter,		Copper				Steel	
		Protected within product		Unprotected			
Inches	(mm)	Inches	(mm)	Inches	(mm)	Inches	(mm)
1/4	(6.4)	0.0245	(0.622)	0.0265	(0.673)	0.025	(0.64)
5/16	(7.9)	0.0245	(0.622)	0.0285	(0.724)	0.025	(0.64)
3/8	(9.5)	0.0245	(0.622)	0.0285	(0.724)	0.025	(0.64)
1/2	(12.7)	0.0245	(0.800)	0.0285	(0.724)	0.025	(0.64)
5/8	(15.9)	0.0315	(0.800)	0.0315	(0.800)	0.032	(0.81)
3/4	(19.1)	0.0315	(0.799)	0.0385	(0.978)	0.032	(0.81)
7/8	(22.2)	0.0410	(1.041)	0.0410	(1.041)	0.046	(1.17)
1	(25.4)	0.0460	(1.168)	0.0460	(1.168)	—	—
1-1/8	(28.6)	0.0460	(1.168)	0.0460	(1.168)	0.046	(1.17)
1-1/4	(31.8)	0.0505	(1.283)	0.0505	(1.283)	0.046	(1.17)
1-3/8	(34.9)	0.0505	(1.283)	0.0505	(1.283)	—	—
1-1/2	(38.1)	0.0555	(1.410)	0.0555	(1.410)	0.062	(1.57)
1-5/8	(41.3)	0.0555	(1.410)	0.0555	(1.410)	—	—
2-1/8	(54.0)	0.0640	(1.626)	0.0640	(1.626)	—	—
2-5/8	(66.7)	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.

22.3.2 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.

22.3.3 Tubing forming part of a component, such as an evaporator or condenser, where protection is provided by inherent construction is to be judged by the Strength Tests, Section 45, requirements.

22.3.3 revised May 1, 1996

22.3.4 Special alloys or constructions used in refrigerant-containing components, including tubing with a wall thickness less than indicated in 22.3.1, may be acceptable. Among the factors taken into consideration when judging the acceptability are its:

- a) Resistance to mechanical abuse,
- b) Strength against internal pressure,
- c) Resistance to corrosion,
- d) Protection against refrigerant contamination, and
- e) Conformity with requirements of safety codes, such as the Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1992, as compared to tubing of the minimum wall thicknesses indicated in Table 22.1.

22.3.4 revised May 1, 1996

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

23 Refrigerant-Containing Parts

23.1 The parts of a product subjected to refrigerant pressure shall withstand, without failure, the pressure indicated in the Strength Tests, Section 45.

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

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

23.4 Pressure vessels bearing the ASME Code "U" symbol complying with 23.3 are considered acceptable without tests.

23.5 Pressure vessels bearing the ASME Code "UM" symbol are to be tested to determine compliance with Strength Tests, Section 45, requirements. The manufacturer is to submit evidence of compliance of these vessels with the ASME Boiler and Pressure Vessel Code, Section VIII.

24 Pressure-Limiting Device

24.1 A pressure-limiting device intended to automatically stop the operation of the compressor shall be installed on all water-cooled products except systems containing 3 pounds-mass (1.4 kg) or less of refrigerant that comply with the provisions of 45.1(h) and on all air-cooled products with a system containing more than 20 pounds-mass (9.1 kg) of refrigerant.

24.2 The maximum cutout pressure to which a pressure-limiting device may be set by the adjusting means shall not exceed 90 percent of the following, whichever is lowest:

- a) One-fifth of the ultimate strength of high-side refrigerant-containing parts.
- b) The marked design pressure of high-side pressure vessels.
- c) The setting of the pressure-relief device.

24.3 A pressure-limiting device on an air-cooled system that is not required by 24.1 may have a maximum cutout setting not exceeding one-third of the ultimate strength of high-side refrigerant-containing parts, provided the device conforms with 24.2(c).

24.4 There shall be no shutoff valve between the pressure-limiting device and the compressor.

25 Pressure Relief

25.1 General

25.1.1 The refrigeration system shall be constructed so that pressure due to fire will be relieved. Pressure-relief devices, fusible plugs, or soldered or brazed tubing joints may be employed for this purpose.

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

25.1.3 A product with a pressure vessel over 3 inches (76.2 mm) inside diameter, but not exceeding 3 cubic feet (0.08 m³) internal gross volume, shall be protected by a pressure-relief device or fusible plug.

25.1.4 A product with a pressure vessel exceeding 3 cubic feet (0.08 m³), but less than 10 cubic feet (0.3 m³) internal gross volume, shall be protected by a pressure-relief device.

25.1.5 There shall be no shutoff valve between the pressure-relief means and the parts or section of the system.

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

30.3 The defrost test sequence is to be as follows:

- a) The product is to be mounted or positioned in accordance with the manufacturer's installation instructions (see 4.1).
- b) The product is to be operated in a room maintained at 21 – 27°C (70 – 80°F) dry-bulb with approximately 50 percent relative humidity for not less than 6 hours. Automatic controls that initiate the defrost cycle are to be shunted out of the circuit. The evaporator fan motor(s) is to be made inoperative. See 30.4.
- c) Following operation as described in (b), the controls are to be placed back in the circuit. The defrost cycle is to be initiated and allowed to continue until the cycle is terminated by its automatic control. In addition to electrical input, temperatures and pressures are to be recorded as specified in 30.1 and 30.2.

30.4 If agreeable to those concerned, 30.3(b) may be omitted if there are no uninsulated live parts located beneath:

- a) Any portion of the evaporator including tubing, hairpin turns, return bends, fins, end plates, and inlet and outlet tubes,
- b) Refrigerant suction lines, and
- c) An expansion valve.

Exception: If (b) is omitted, temperature rises are to be determined in the following manner for temperature-terminated defrost systems. The cut-in/cut-out temperature differential of the defrost cycle control is to be determined. The control is then to be shunted out of the circuit and a thermocouple placed at the location where the control senses the temperature. The defrost heaters are to be energized and allowed to operate until the temperature rise at the control sensing location is equal to the temperature differential previously determined. The temperatures recorded at the time the differential is reached are to be reduced by 23°C (42°F) and the resulting values are to be used to determine compliance with 30.1.

30.5 Following the defrost cycle 30.3(c), the insulation resistance of the product is to be determined. The insulation resistance shall be at least 50,000 ohms. After measuring insulation resistance the product shall then comply with the requirements of the Dielectric Voltage-Withstand Test, Section 31.

Exception: Determination of insulation resistance following the defrost cycle may be omitted if 30.3(b) is omitted or it is evident from visual examination of the product that moisture or water resulting from the defrost operation cannot contact uninsulated live parts.

30.6 With reference to 30.3(c), if the defrost cycle is time-terminated, the product is to be operated for the maximum adjustable length of time permitted by the integral control arrangement. Temperatures recorded after the elapsed time are to be used in determining compliance with the requirements in 30.1.

31 Dielectric Voltage-Withstand Test

31.1 A complete product shall withstand for a period of 1 minute, without breakdown, the application of a test potential between high-voltage live parts and dead metal parts and between live parts of high- and low-voltage circuits. The test potential is to be 1000 volts plus twice rated voltage at any frequency between 40 and 70 hertz.

Exception No. 1: 1000 volts for motors rated at not more than 1/2 hp (373 W output).

Exception No. 2: If the steady-state voltage developed in a motor circuit through the use of capacitors exceeds 500 volts as measured during the Temperature and Pressure Test, Section 29, the test potential for the parts affected is to be 1000 volts plus twice the developed capacitor voltage.

31.1 revised May 1, 1996

31.2 A product employing a low-voltage circuit shall withstand for 1 minute, without breakdown, a test hertz potential of 500 volts applied between low-voltage live parts and dead metal parts. The test potential shall be at any frequency between 40 and 70 hertz. Where components specified in 21.2.2 are employed in the low-voltage circuit, the dielectric voltage withstand test is also to be conducted between live parts of opposite polarity.

31.2 revised May 1, 1996

31.3 With reference to 31.2, the test between low-voltage parts of opposite polarity is conducted on magnet coil windings of the transformer after breaking the inner coil lead where it enters the layer. This opposite polarity test may be waived on the complete assembly provided the components have been separately subjected to this test condition.

31.3 revised May 1, 1996

31.4 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 used is such that it maintains the specified high potential voltage at the equipment during the duration of the test.

31.4 revised May 1, 1996

31.5 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 capacitor and capacitor-type filters may be tested as described in 31.6.

31.5 added May 1, 1996

31.6 The capacitors and capacitor-type filter mentioned in 31.5 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.

31.6 added May 1, 1996

31.7 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.

31.7 added May 1, 1996

32 Condenser Fan Motor Failure Test

32.1 A product shall not be exposed to pressure or temperature that could result in risk of injury or leak refrigerant if the condenser fan motor locks or fails to start.

32.2 The requirement in 32.1 will be complied with if:

a) The refrigeration system does not rupture or develop leaks during the test. The maximum high- and low-side pressures are to be recorded as reference values for the Strength Tests, Section 45. An assembly employing a pressure-limiting device complying with 24.2 or 24.3, as applicable, is considered to comply with the high-side pressure required.

b) The maximum temperature of the compressor enclosure or fan motor winding (open type) or fan motor enclosure (enclosed type) does not exceed 150°C (302°F). The temperature test on the component may be waived if the component is equipped with a thermal protective device as specified in 18.6 and 18.10.

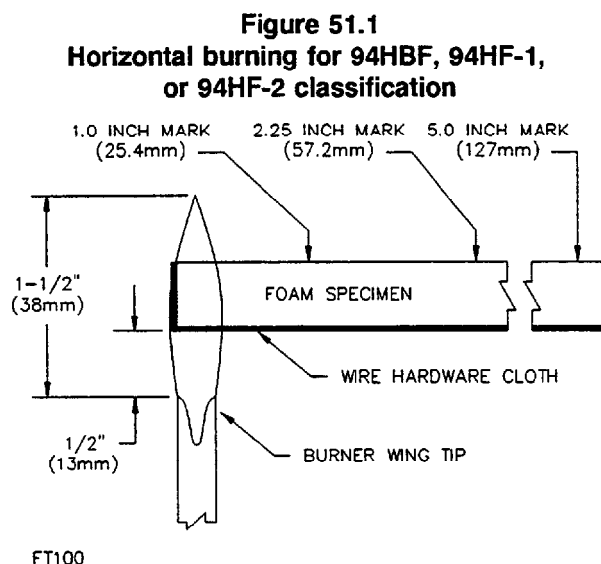
51.3.3 The formed steel wire cloth is to be held by the clamps and ring stands so that the 8 by 3 inch (203 by 76 mm) section is horizontal, 1/2 inch (12.7 mm) above the top of the burner wing tip. A typical method of mounting the wire cloth in place is to secure it to a 4 inch (102 mm) diameter ring support so that the upturned end extends approximately 3 inches (76 mm) past the end of the ring.

51.3.4 Each specimen is to be marked across its width with three lines: 1, 2.25, and 5 inches (25.4, 57, and 127 mm) from one end. The test specimen is to be placed flat on the wire cloth with the 6 by 2 inch (152 by 50.8 mm) surface of the specimen horizontal. The end of the specimen closest to the 1 inch mark is to be placed in contact with the upturned end of the wire cloth. Specimens with a high density exterior on one side are to be tested with the exterior down. Specimens with adhesive on one side are to be tested with the adhesive side facing up.

51.3.5 In tests for classifying 94HF-1 and 94HF-2 materials, a 3 inch (76 mm) square layer of dry absorbent surgical cotton, thinned to a maximum freestanding thickness of 1/4 inch (6.4 mm), is to be placed 12 inches (305 mm) below the test specimen. The cotton layer is to be horizontal and located so that one edge of the square is below the upturned end of the wire cloth.

51.3.6 If new wire cloth is not used for each test, any material remaining on the wire cloth from previous tests is to be burned off, and the wire cloth is to be allowed to cool before conducting the test.

51.3.7 The burner, with wing tip, then is to be placed remote from the specimen, ignited, and adjusted to provide a blue flame with a maximum height of 1-1/2 inches (38 mm) when measured in subdued light. The flame is to be obtained by adjusting the gas supply and the air port of the burner until a 1-1/2 inch yellow-tipped blue flame is produced. The air supply is then to be increased until the yellow tip disappears. The height of the flame is to be measured again and corrected, if necessary. The burner is then to be quickly placed in position beneath the wire cloth, under the upturned end of the specimen support, so that one edge of the flame is in line with the upturned end of the wire cloth and the other edge of the flame extends into the front end of the specimen. See Figure 51.1. The center of the width of the wing tip is to be in line with the longitudinal axis of the specimen.



51.3.8 The flame is to be applied for 60 seconds and then removed from the specimen. If the material continues to burn after removal of the test flame, the time for the flame to travel from the 1 inch (25.4 mm) mark to the 5 inch (127 mm) mark is to be determined. If the specimen ceases to burn before the 5 inch mark is reached, the duration of burning after removal of the test flame and the distance of burning from the end exposed to the test flame are to be recorded.

MANUFACTURING AND PRODUCTION TESTS

52 General

52.1 Each product shall be tested and proved tight at not less than the design pressure(s) marked on the product. See 55.4.

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

52.3 **52.3 deleted May 1, 1996**

52.4 **52.4 deleted May 1, 1996**

52.5 At least once each year, the manufacturer shall conduct a strength test on refrigerant-containing parts of the shell type, including compressor shells that have an inside diameter greater than 3 inches (76.2 mm), except that ASME Code vessels bearing the Code "U" symbol need not be retested. The tests shall be conducted on at least one sample of each size and type. The sample shall not fail when subjected to pressures indicated under Strength Tests, Section 45.

53 Production Line Dielectric Voltage-Withstand Tests

53.1 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 between:

- a) The primary wiring, including connected components, and accessible dead metal parts that are likely to become energized; and
- b) The primary wiring and accessible low-voltage, 42.4 volts peak or less, metal parts, including terminals.

53.1 revised May 1, 1996

53.1.1 The production-line test shall be conducted in the time and at the potential specified in either Condition A or Condition B of Table 53.1.

53.1.1 revised added May 1, 1996

Table 53.1
Production-line test conditions

Product rating	Condition A			Condition B		
	Potential, volts ac ^c volts dc		Time, seconds	Potential, volts ac ^c volts dc		Time, seconds
250 volts or less with no motor rated more than 1/2 horsepower (373 watts output)	1000	1400	60	1200	1700	1
250 volts or less with a motor rated more than 1/2 horsepower (373 watts output)	1000 + 2V ^a	1400 + 2.8V ^a	60	1200 + 2.4V ^a	1700 + 3.4V ^a	1
251 – 600 volts	1000 + 2V ^b	1400 + 2.8V ^b	60	1200 + 2.4V ^b	1700 + 3.4V ^b	1
^a Maximum marked voltage but not less than 120 volts if the maximum marked voltage is within the range 105 – 120 volts, and not less than 240 volts if the maximum marked voltage is within the range 210 – 240 volts. ^b Maximum marked voltage. ^c Where there are capacitors across the insulation under test (e.g radio-frequency filter capacitors), it is recommended that d.c. test voltages are used.						

Table 53.1 added May 1, 1996

53.2 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.

53.2 revised May 1, 1996

53.2.1 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.

53.2.1 added May 1, 1996

53.3 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).

53.3 revised May 1, 1996

53.4 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.

53.4 revised May 1, 1996

53.5 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.

53.5 revised May 1, 1996

53.6 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.

53.6 added May 1, 1996

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

53.7 added May 1, 1996

53.8 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.*

53.8 added May 1, 1996

MARKING

54 General

54.1 Unless otherwise specifically indicated, every marking required in this Standard shall be permanent.

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

54.3 A refrigerating unit 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 Electrical Markings, Section 56.
- d) The kind and amount of refrigerant in pounds (kg x 2.2) and/or ounces-mass (kg x 35.3). See Refrigerant Markings, Section 55.
- e) The high- and low-side design pressures. See 55.4.
- 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. The date code shall not require reference to the manufacturer's records to determine when the product was manufactured.

54.4 The information specified in 54.3, 55.1, and 56.1 – 56.15 shall be on a nameplate or plates located, where after installation of the product, they will be readily visible and legible without requiring the use of keys or tools for removal of panels, or the like. The nameplate shall be constructed and fastened so as to form a permanent part of the assembly.

54.5 If parts or sections of a product are separately shipped from the factory, the primary nameplate for the product shall comply with 54.4, and the section incorporating the primary nameplate shall be permanently marked in a manner which will relate the proper sections to one another when they are installed in the field. The parts or sections shall be permanently marked with the manufacturer's or vendor's name or identifying symbol and a distinctive model or type designation.

54.6 If a section of a refrigerating unit is intended for outdoor use, the product shall be permanently marked to so indicate. The marking shall be located on or adjacent to the product's nameplate, and identify the section intended for outdoor use.

54.7 The following information shall appear on the product or wiring diagram:

- a) If a product is controlled by a specific-use controller that is not installed on the assembly, the marking on the product or wiring diagram shall show the identifying designation of the controller. The rating of the overcurrent (heater) element intended to be used shall be shown when a thermal overload relay is part of the controller.
- b) If a product is provided with magnetic or thermal motor running overload protective devices mounted remote from the protected motor, one of the following markings, visible on removal of parts to enter the device enclosure, shall be employed:
 - 1) The tripping current marked on the overload device. If a replaceable heater element is employed, the marking shall be on the heater element, or
 - 2) A designation on the device and an adjacent tabulation showing the tripping current, identified with the device marking. For a device employing a replaceable heater element, the motor full-load current and percent protection shall also be shown, or
- c) If a product is intended to be connected to a low-voltage supply source, the minimum rating of the supply transformer shall be shown if a transformer rated 5 volt-amperes or more is required.

54.8 A product that incorporates a hermetic motor-compressor with a thermal protector that provides protection in accordance with the requirements in 18.3(b) shall be marked "Motor-Compressor Thermally Protected" or with an equivalent statement to reference the motor-compressor(s) involved, unless the motor-compressor(s) is marked "Thermally Protected."

54.9 A product that incorporates a complete protective system that provides protection in accordance with the requirements specified in 18.3(b) shall be marked "Motor-Compressor Thermally Protected System," or with an equivalent statement to reference the motor-compressor(s) involved.

54.10 If other than three overcurrent units are employed for protection of a 3-phase motor, the product shall be marked to indicate that the motor is protected under primary single-phasing conditions. This marking may be a separate paper sticker or decal or may be on the attached wiring diagram.

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

54.12 A product that is intended for use with a walk-in cooler or refrigerated warehouse, in accordance with the Exception to 8.2.7, shall be marked "UNIT FOR USE WITH WALK-IN COOLER OR REFRIGERATED WAREHOUSE" or with an equivalent statement. The marking shall be permanent, shall be in letters not less than 1/4 inch (6.4 mm) high, and shall be located on or adjacent to the unit nameplate. Also see Exception No. 1 to 8.2.5.

54.13 Additional marking requirements are specified by 7.6, 9.3.5, 25.2.1, 25.3.2, 25.3.3, and 27.4.

55 Refrigerant Markings

55.1 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.

55.1 revised May 1, 1996

55.2 Examples for refrigerant marking are as follows: R 12, 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.

55.2 revised May 1, 1996

55.3 Products equipped with more than one refrigeration system shall be marked to indicate the amount of refrigerant in each system. If different refrigerants are used, the kind of refrigerant and factory test pressures for the high- and low-pressure sides shall be shown for each system.

55.4 The high- and low-side design pressures marked on the refrigerating unit shall not be less than the values recorded during the Temperature and Pressure Test, Section 29, nor less than that specified in Table 55.1.

Table 55.1
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)
^a For other refrigerants, the minimum design pressure shall not be less than the saturation pressure of the refrigerant at the following temperature: 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 55.1 revised May 1, 1996

56 Electrical Markings

56.1 Products shall be marked with the operating voltage, the frequency, the number of phases, and the total or individual loads as indicated in 56.2.