

UL 250

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Household Refrigerators and Freezers

Underwriters Laboratories Inc. (UL)
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UL Standard for Safety for Household Refrigerators and Freezers, UL 250

Tenth Edition, Dated November 1, 1993

Revisions: This Standard contains revisions through and including August 25, 2000.

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The new and revised requirements are substantially in accordance with UL's Bulletin(s) on this subject dated December 19, 1997 and April 16, 1999. The bulletin(s) is now obsolete and may be discarded.

The revisions dated August 25, 2000 include a reprinted title page (page1) for this Standard.

The revisions dated August 25, 2000 include updates to outside references and other editorial revisions.

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

As indicated on the title page (page1), this UL Standard for Safety has been adopted by the Department of Defense.

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that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if

the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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Page	Date
1-8	August 25, 2000
9-13	November 1, 1993
14	August 25, 2000
15	November 1, 1993
16-16B	August 25, 2000
17-18	November 1, 1993
19-24	August 25, 2000
25-33	November 1, 1993
34-34A	August 25, 2000
34B	April 29, 1998
35-40	November 1, 1993
41-44	August 25, 2000
44A-44B	April 29, 1998
45	November 1, 1993
46-48B	June 23, 1997
49-52	November 1, 1993
53	August 25, 2000
54	November 1, 1993
55	August 25, 2000
56	April 29, 1998
57-60	November 1, 1993
61-62B	June 23, 1997
63	November 1, 1993
64	June 23, 1997
65	November 1, 1993
66-66B	August 25, 2000
67-69	November 1, 1993
70	June 23, 1997
71-73	November 1, 1993
74-74B	April 29, 1998
75-76B	August 25, 2000
77	November 1, 1993
78-80B	August 25, 2000
81-82	November 1, 1993
83-84B	June 23, 1997
85	November 1, 1993
86-86B	April 29, 1998
87-88	August 25, 2000
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Household Refrigerators and Freezers

November 1993

(Title Page Reprinted: August 25, 2000)



Commitment for Amendments

This Standard is issued jointly by Canadian Standards Association and Underwriters Laboratories Incorporated. Amendments to this Standard will be made only after processing according to the Standards writing procedures by both Canadian Standards Association and Underwriters Laboratories Incorporated.

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated November 1, 1993. These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

Approved as ANSI/UL 250-1997, July 30, 1997

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CONTENTS

Preface	6
Foreword (CSA)	7
FOREWORD	8
1 Scope	9
2 Definitions	9
3 General	11
3.1 Components	11
3.2 Units of measurement	12
3.3 Undated references	12
4 Construction	12
4.1 General	12
4.2 Enclosures	13
4.3 Mechanical protection	13
4.4 Electrical protection	15
4.5 Assembly	16A
4.6 Accessories	18
4.7 Latch-release mechanism	19
4.8 Polymeric materials – application	20
4.9 Field supply connections	22
4.10 Wiring and wiring methods	31
4.11 Secondary circuits	36
4.12 Separation of circuits	37
5 Electrical Components	38
5.1 Capacitor	38
5.2 Current-carrying parts	39
5.3 Defrost heaters	39
5.4 Guarding of lamps	40
5.5 Incandescent lighting systems	41
5.6 Insulating material	41
5.7 Motors and motor overload protection	42
5.8 Switches and controllers	44A
5.9 Transformers, power converters, and power inverters	46
6 Electrical Spacings	46
6.1 Line-voltage circuits	46
6.2 Extra-low voltage (Class 2) circuits	48
7 Refrigeration System	48A
7.1 Refrigerant	48A
7.2 Refrigerant tubing and fittings	48A
7.3 Refrigerant-containing parts	50
7.4 Pressure relief	50
8 Performance	50
8.1 Instrumentation	50
8.1.2 Pressure measurements	51
8.2 Test voltage and frequency	51
8.3 Leakage current test – cord-connected refrigerators	52
8.4 Component washing test	54
8.5 Input test	56

8.6	Temperature and pressure test	56
8.7	Starting test	61
8.8	Dielectric voltage-withstand test	61
8.9	Defrost test	62
8.10	Defrost heater burnout test	63
8.11	Condenser fan motor failure test	63
8.12	Overflow test	64
8.13	Spill test	64
8.14	Stability test	64
8.15	Static load test – cabinets	65
8.16	Strain relief test	66
8.17	Overvoltage and undervoltage tests	67
8.18	Limited short circuit test	67
8.19	Current overload test – bonding conductors and connections	68
8.20	Defrost heater control tests	68
8.21	Insulation resistance test	69
8.22	Accelerated aging test – electric heaters	69
8.23	Reliability test – heater terminations	70
8.24	Strength tests – pressure containing components	70
8.25	Shelf strength test	72
8.26	Component restraint test	73
8.27	Glass strength test	73
8.28	Door latch release test	73
8.29	Door hinge strength test	74
8.30	Impact test	74A
9	Polymeric Materials – Performance	75
9.1	Electrical enclosure flammability	75
9.2	Vertical burning test – 5VA, 5VB, materials	76
9.3	Vertical burning test – V-0, V-1, or V-2 solid materials	76
9.4	Horizontal burning test – HB materials	76
9.5	Horizontal burning test – HBF, HF-1, or HF-2 foamed materials	76A
9.6	Mold stress-relief test	77
9.7	Fastener strength test	77
9.8	Adhesive test	78
9.9	Flame spread test	78
9.10	Volume resistivity test	79
9.11	High-current arc ignition test	79
9.12	Hot wire ignition test	79
9.13	Burnout test – impedance protected motors	80
9.14	Electrical disturbance test	80
9.15	Grounding continuity test	80
9.16	Distortion test	81
9.17	Heating test – condensate wiring	81
10	Manufacturing and Production Tests	82
10.1	Pressure tests	82
10.2	Production line dielectric voltage-withstand tests	83
10.3	Production line grounding continuity test	84A
11	Marking	84A
11.1	General	84A
11.2	Installation and operating instructions	87

**SUPPLEMENT SA - REQUIREMENTS FOR REFRIGERATORS AND FREEZERS EMPLOYING A
FLAMMABLE REFRIGERANT IN THE REFRIGERATING SYSTEM**

SA1 Scope	SA1
SA2 Definitions	SA1
SA3 General	SA2
SA4 CONSTRUCTION	SA3
SA4.1 General	SA3
SA4.2 Valves/Fittings	SA3
SA4.3 Resistance to Corrosion	SA4
SA5 PERFORMANCE	SA4
SA5.1 Leakage Test	SA4
SA5.2 Ignition test	SA6
SA5.3 Temperature test	SA7
SA5.4 Scratch test	SA7
SA6 MARKING AND INSTALLATION AND OPERATING INSTRUCTIONS	SA9
SA6.1 Marking	SA9
SA6.2 Installation and operating instructions	SA10

Appendix A**Standards for Components**

A1 Component Standards	A1
A2 Other Standards	A6

Appendix B**Marking Translations**

Preface

This is the common UL and CSA Standard for Household Refrigerators and Freezers. It is the Fourth edition of CAN/CSA-C22.2 No. 63 Household Refrigerators and Freezers and the tenth edition of UL 250, Household Refrigerators and Freezers.

This common Standard was prepared by Canadian Standards Association and Underwriters Laboratories Inc., and the appliance manufacturing industry. The efforts and support of the Canadian Appliance Manufacturers Association (CAMA) and the Association of Home Appliance Manufacturers (AHAM) are gratefully acknowledged.

This Standard was reviewed by the CSA Subcommittee of the Technical Committee on Consumer and Commercial Products under the jurisdiction of the CSA Steering Committee on the Canadian Electrical Code, Part II, and was approved by these committees.

This Standard will be submitted to the Standards Council of Canada for approval as a National Standard of Canada.

This Standard has been approved by the American National Standards Institute (ANSI) as an American National Standard.

Note: *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*

UL Effective Date

As of August 25, 2000 all products Listed or Recognized by UL must comply with the requirements in this Standard except for the Clauses in the following list which are effective August 27, 2001.

Clause 11.1.26. Table 11.1.

Between August 25, 2000 and August 27, 2001, new product submittals to UL may be evaluated under all requirements in this Standard or, if requested in writing evaluated, under presently effective requirements only. The presently effective requirements are contained in the tenth edition of UL 250.

CSA Effective Date

The effective date for CSA will be announced through *CSA Informs* or *CSA Certification Notice*.

Foreword (CSA)

The Canadian Standards Association, which operates under the name CSA International (CSA), provides certification services for manufacturers who, under license from CSA, wish to use the appropriate registered CSA Marks on certain products of their manufacture to indicate conformity with CSA Standards.

CSA Certification for a number of products is provided in the interest of maintaining agreed-upon standards of quality, performance, interchangeability and/or safety, as appropriate. Where applicable, certification may form the basis for acceptance by inspection authorities responsible for enforcement of regulations. Where feasible, programs will be developed for additional products for which certification is desired by producers, consumers or other interests.

In performing its functions in accordance with its objectives, CSA does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of the Association represent its professional judgement given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed.

Products in substantial accord with this Standard but which exhibit a minor difference or a new feature may be deemed to meet the Standard providing the feature or difference is found acceptable utilizing appropriate CSA Certification and Testing Division Operating Procedures. Products which comply with this Standard shall not be certified if they are found to have additional features which are inconsistent with the intent of this Standard. Products shall not be certifiable if they are discovered to contravene applicable laws or regulations.

Testing techniques, test procedures and instrumentation frequently must be prescribed by the CSA Certification and Testing Division in addition to the technical requirements contained in Standards of CSA. In addition to markings specified in the Standard, the CSA Certification and Testing Division may require special cautions, markings and instructions that are not specified by the Standard.

Some tests required by CSA Standards may be inherently hazardous. The Association neither assumes nor accepts any responsibility for any injury or damage that may occur during or as the result of tests, wherever performed, whether performed in whole or in part by the manufacturer or the Association, and whether or not any equipment, facility or personnel for or in connection with the test is furnished by the manufacturer or the Association.

Manufacturers should note that, in the event of the failure of the CSA Certification and Testing Division to resolve an issue arising from the interpretation of requirements, there is an appeal procedure: the complainant should submit the matter, in writing, to the Secretary of the Canadian Standards Association.

If this Standard is to be used in obtaining CSA Certification please remember, when making application for certification, to request all current Amendments, Bulletins, Notices and Technical Information Letters that may be applicable and for which there may be a nominal charge. For such information or for further information concerning CSA Certification please address your inquiry to Applications and Customer Service, CSA International, 178 Rexdale Boulevard, Toronto, Ontario M9W 1R3.

FOREWORD

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

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

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

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

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

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

Household Refrigerators and Freezers

1 Scope

1.1 This Standard applies to self-contained household refrigerators and freezers designed to be installed and used in residential occupancies in accordance with the Canadian Electrical Code, Part I, CSA Standard C22.2, and the National Electrical Code, ANSI/NFPA 70.

1.2 These requirements apply to household refrigerators and freezers intended for connection to 15 or 20 A, 100 to 140 V or 15 A, 200 to 250 V, single phase, alternating-current (ac) circuits; and combination ac/dc circuits or direct-current (dc) circuits where the dc voltage does not exceed 30 V.

1.3 The terms "appliance", "refrigerator", "product", "equipment", and "unit" are used interchangeably and refer to all household refrigerators, combination refrigerator-freezers, freezers, and refrigerated kitchen units or any part thereof covered by this Standard unless specifically noted otherwise.

1.4 The equipment is air-cooled employing hermetic refrigerant motor-compressors or is of the absorption type employing electricity as a heat source. These requirements apply to (a) freestanding, wall-hung, recessed, and built-in refrigerators and freezers; (b) refrigerators and freezers for use in recreational vehicles; (c) refrigerated kitchen units; and (d) accessories.

1.5 A product that contains features, characteristics, components, materials, or systems new or different from those in use when the Standard was developed, and that involves a risk of fire, electric shock, or injury to persons, shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the level of safety for the user of the product as originally anticipated by the intent of this Standard.

2 Definitions

2.1 For the purpose of this Standard, the following definitions apply.

2.2 **ABSORPTION TYPE REFRIGERATOR** – A refrigerator in which electricity is used as a heat source.

2.3 **ACCESSORY** – An optional electrical device, such as an ice maker, intended for installation in or connection to a refrigerator for the purpose of modifying or supplementing the functions of the refrigerator. It may be factory installed or intended for installation by the user or service personnel.

2.4 **BARRIER** – A partition for the insulation or isolation of electric circuits, for the isolation of electric arcs, or for isolation of moving parts or hot surfaces. In this respect, a barrier may serve as a portion of an enclosure or as a functional part.

2.5 **BOND STRENGTH** – The load applied in tension, compression, flexure, peel, impact, cleavage, or shear, required to break an adhesive assembly with failure occurring in or near the plane of the bond.

2.6 **BUILT-IN REFRIGERATOR (OR FREEZER)** – A recessed type refrigerator (or freezer) intended for slide-in installation, into a confined space and trimmed to blend with room decor.

2.7 CIRCUIT, EXTRA-LOW VOLTAGE – A circuit that has an ac potential of not more than 42.4 V peak (30 V), and power of 100 VA or less; or 30 V dc supplied by a primary battery; or supplied by a Class 2 transformer; or supplied by a combination of a transformer and fixed impedance that, as a unit, complies with all the performance requirements for a Class 2 transformer. A circuit that is derived from a circuit that exceeds 30 V by connecting resistance or impedance, or both, in series with the supply circuit to limit the voltage and current, is not considered to be an extra-low voltage circuit.

2.8 CIRCUIT, LINE VOLTAGE – A circuit having characteristics in excess of those of an extra-low voltage circuit.

2.9 CONTROL, DEFROST CYCLE – A control that is intended to regulate a normal defrost cycle.

2.10 CONTROL, TEMPERATURE-LIMITING – A control that serves to prevent excessive temperature.

2.11 DESIGN PRESSURE – The maximum allowable working pressure for which the appliance is designed.

2.12 ENCLOSURE – A part that by itself or in conjunction with barriers (1) renders inaccessible all or any parts that may otherwise present a risk of electric shock, (2) reduces the risk of contact with parts that may cause injury to persons, or (3) prevents propagation of flame due to electrical disturbances occurring within. A cabinet that serves to enclose electrical components or wiring is considered to be an enclosure.

2.13 FREESTANDING REFRIGERATOR (OR FREEZER) – A unit designed for installation in other than a confined space.

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

2.15 FUSIBLE PLUG – A device having a predetermined-temperature fusible member for the relief of pressure.

2.16 HIGH SIDE – The part of a refrigerating system under condenser pressure.

2.17 HOUSEHOLD REFRIGERATOR – A cabinet or any part of a cabinet that is designed for the refrigerated storage of food at temperatures above 0°C (32°F) that has a source of refrigeration and that is intended for residential use. It may include a compartment for the freezing and storage of ice, for storage of food, or both at temperatures below 0°C (32°F).

2.18 HOUSEHOLD FREEZER – A cabinet that is designed for the extended storage of frozen food at a temperature of -17.8°C (0°F) or below and with inherent capability for freezing of food, that (1) has a source of refrigeration and (2) is intended for residential use.

2.19 JUNCTION BLOCK – A device in which connections between wires are enclosed.

2.20 LOW SIDE – The part of a refrigerating system under evaporator pressure.

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

2.22 POWER CONVERTER – A device that changes alternating-current power to direct-current power, or vice versa.

2.23 POWER INVERTER – A device that changes direct-current power to alternating-current power.

2.24 PRESSURE-LIMITING DEVICE – A pressure-responsive mechanism deigned to automatically stop the operation of the pressure-imposing element at a predetermined pressure.

2.25 RECESSED REFRIGERATOR (OR FREEZER) – A unit designed for installation in a confined space.

2.26 REFRIGERATED KITCHEN UNIT – A unit consisting of a refrigerator in combination with a range, a sink, or both.

2.27 SAFETY CIRCUIT (OR CONTROL DEVICE) – For the purposes of this Standard, a safety circuit (or control device) is a circuit (or control device) which is relied upon to reduce a risk of fire, electric shock, or injury to persons.

2.28 SECONDARY CIRCUITS – Those circuits supplied from transformer output windings which are electrically separated from the input windings.

2.29 SELF-CONTAINED REFRIGERATOR – A completely factory-made and factory-tested assembly to which no refrigerant-containing parts are connected in the field.

2.30 TEMPERATURE-LIMITING THERMOSTAT – A thermostat that functions only under conditions that produce abnormal temperatures. The failure of such a thermostat might result in a hazard.

2.31 WALL-HUNG REFRIGERATOR (OR FREEZER) – A unit intended to be suspended from the outside of a wall using the hardware specified by the manufacturer.

3 General

3.1 Components

3.1.1 Except as indicated in Clause 3.1.2, a component of a product covered by this standard shall comply with the applicable requirements for that component. See Appendix A for a list of Standards covering components generally used in the products covered by this Standard. A component shall comply with both the Underwriters Laboratories Inc. and the Canadian Standards Association Standards for the component.

3.1.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or
- b) Is superseded by a requirement in this standard.

3.1.3 A component shall be used in accordance with its ratings for the intended conditions of use.

3.1.4 Specific components are recognized (accepted) as being incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions for which they have been investigated.

3.2 Units of measurement

3.2.1 If a value for measurement as given in this Standard is followed by an equivalent value in other units, the second value may only be approximate. The first stated value is the requirement. The values given in SI (metric) units are the standard. The values given in parentheses are for information only.

3.3 Undated references

3.3.1 Any undated reference to a code or Standard appearing in this Standard shall be interpreted as referring to the latest edition of that code or Standard.

4 Construction

4.1 General

4.1.1 Refrigerators shall be so designed and constructed as to provide protection against:

- a) the hazards of electric shock;
- b) mechanical hazards; and
- c) other hazards as included in this Standard.

4.1.2 If corrosion of a ferrous metal part will contribute to or cause a hazard as stated in Clause 4.1.1, the part shall be protected against corrosion by metallic or nonmetallic coatings, such as plating or painting. This requirement shall not apply to parts such as washers, screws, bolts, and the like, where corrosion of such unprotected parts would not affect compliance with the requirements of this Standard. This requirement shall also not apply to surfaces of sheet steel and cast iron if oxidation of steel or iron due to exposure of the metal to air and moisture is not likely to be appreciable, considering the metal thickness and temperature.

4.1.3 Fiberglass thermal insulation shall not be used in areas where forced air movement could cause particles to be blown into food storage compartments.

4.1.4 Exposed unimpregnated asbestos material shall not be used in air handling or food storage compartments. The unprotected edge of a gasket sandwiched between two parts is considered to be exposed.

4.1.5 The electric range portion of a refrigerated kitchen unit shall comply with the applicable requirements in the Standard for Household Electric Ranges, UL 858, and Household Electric Ranges, CSA Standard C22.2 No. 61.

4.1.6 The gas range portion of a refrigerated kitchen unit shall comply with the applicable requirements in the Standard for Household Cooking Gas Appliances, ANSI Z21.1-1990 and the Standard for Recreational Vehicle Cooking Gas Appliances, ANSI Z21.57-1990.

4.2 Enclosures

4.2.1 Enclosures shall be formed and assembled so that they will have the strength and rigidity necessary to resist total or partial collapse which may result in a risk of electric shock, injury to persons, or damage to components in the refrigeration and electrical systems. See static load test – cabinets, Clause 8.15; and impact test, Clause 8.30. For polymeric enclosures, see polymeric materials – application, Clause 4.8.

Exception: This requirement does not apply to refrigerant tubing if the wall thickness of the tubing is acceptable for use in unprotected locations. See Clause 7.2.1.

4.3 Mechanical protection

4.3.1 When installed in its intended manner (see installation and operating instructions, Clause 11.2), openings in the appliance shall be designed or located to reduce the risk of injury to persons due to unintentional contact with (1) moving parts, such as fan blade blower wheels, gears, and belts and (2) surfaces that exceed the temperatures permitted by Items D2 and D3 of Table 8.2. In evaluating openings, parts such as covers, panels, and grilles are to be removed unless (a) tools are required for their removal or (b) when exposed, a moving part is made inoperative through the use of interlocking devices.

4.3.2 The minor dimension of such openings shall not exceed 76.2 mm (3 inches).

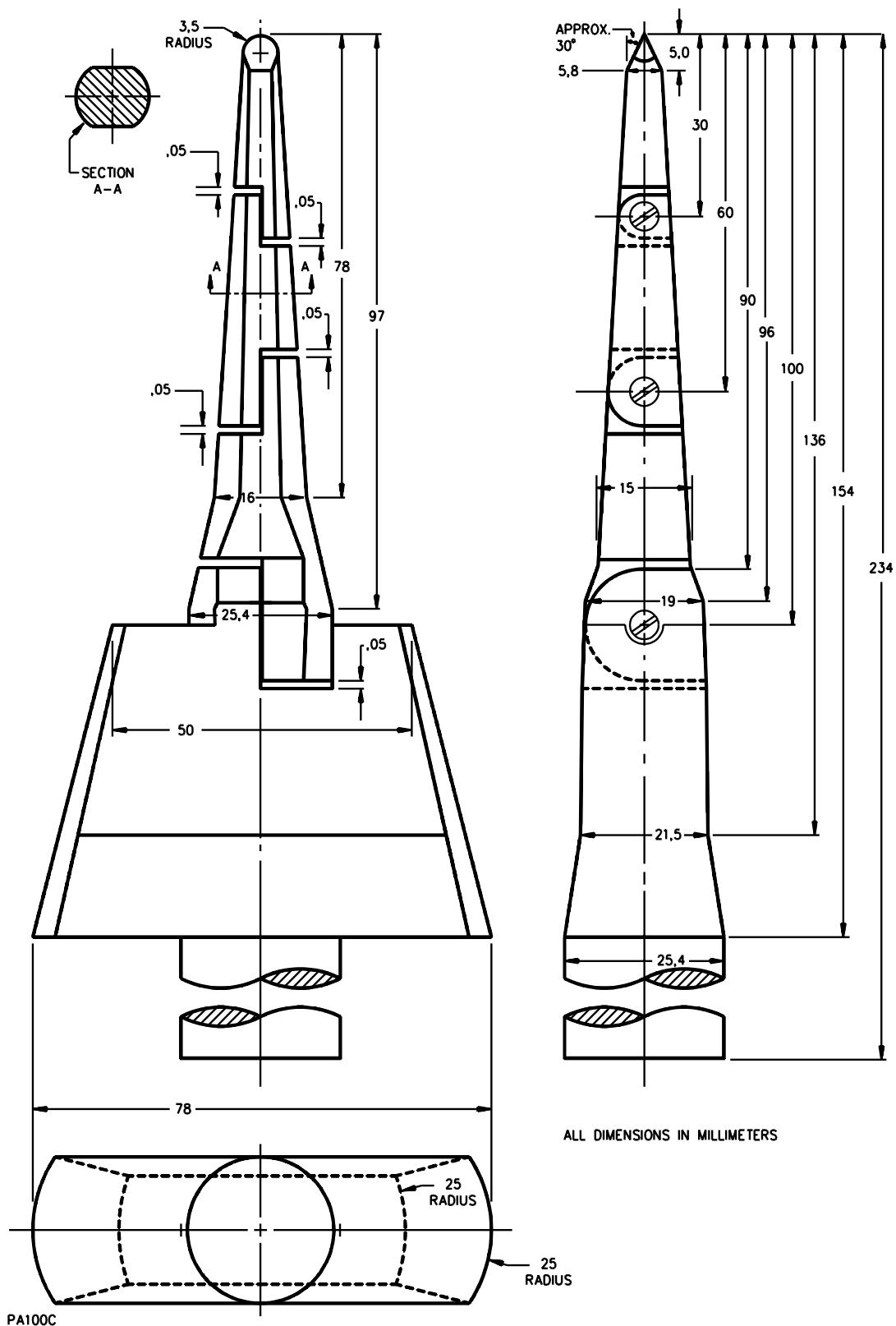
Exception No. 1: Openings may be larger than 76.2 mm (3 inches) if the part is unlikely to be contacted because of the location of fixed components, including baffles, water and refrigerant tubing, drain tubes, and the like.

Exception No. 2: Openings in the bottom of a freestanding, recessed, or built-in unit and in the rear panel of a built-in, recessed, or wall-hung unit may be larger than 76.2 mm (3 inches).

4.3.3 For the purpose of these requirements, the minor dimension of an opening is determined by the largest hemispherically-tipped rod that can be inserted through the opening with a force of 22.3 N (5 pounds).

4.3.4 Openings having a minor dimension of less than 25.4 mm (1 inch) are acceptable if the probe illustrated in Figure 4.1 cannot contact moving parts, hot surfaces, or both. The probe shall be applied (1) with a force of 11.1 N (2.5 pounds), and (2) in any possible configuration and to any depth that the size of an opening will permit. The probe shall be rotated or angled to any possible position before, during, or after insertion through the opening; and, if necessary, the configuration shall be changed after the probe has been inserted through the opening.

Figure 4.1 – Articulate probe



4.3.5 Openings having a minor dimension of 25.4 mm (1 inch) or more are acceptable if the distance from the opening to a moving part or a hot surface is in accordance with Table 4.1.

Table 4.1 – Dimensions of openings

Minor dimension of opening ^a		Minimum distance from opening to moving part or hot surface	
mm	Inches	mm	Inches
25.4	1	154	6-1/16
38.1	1-1/2	267.0	10-1/2
50.8	2	368.0	14-1/2
57.2 ^b	2-1/4 ^b	419.0	16-1/2
63.5 ^b	2-1/2 ^b	470.0	18-1/2
69.9 ^b	2-3/4	521.0	20-1/2
76.2 ^b	3 ^b	572.0	22-1/2
Over 50.8	Over 2	762.0	30

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

^b These values apply only to openings at the base of the refrigerator where the upper edge of the opening is less than 203.2 mm (8 inches) above the floor.

4.3.6 When tested according to the temperature and pressure test, Clause 8.6, and the defrost test, Clause 8.9, surfaces that exceed the temperature of Items D2 and D3 of Table 8.2 shall be guarded in accordance with Clauses 4.3.1 – 4.3.5.

Exception: Surfaces that are recessed or located away from the front of the appliance are not considered subject to casual contact (see Item D3 of Table 8.2). Examples of such surfaces include condensers and compressors located at the rear or in the machine compartment of the unit.

4.3.7 If the temperature on the sheath of a heater element, as installed in the refrigerator, exceeds the limits permitted by Item D2 or Item D3 of Table 8.2, whichever is appropriate, it shall be guarded in accordance with Clauses 4.3.1 – 4.3.5.

4.4 Electrical protection

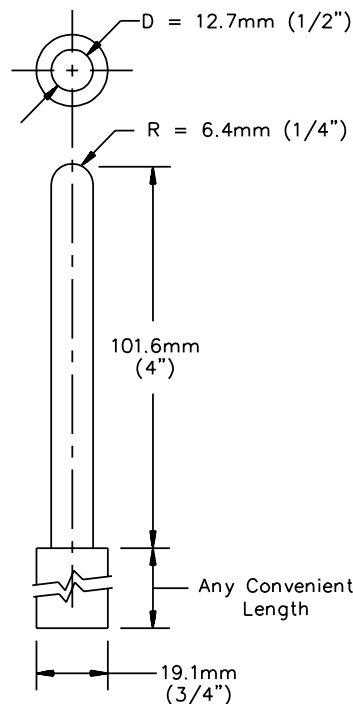
4.4.1 With the appliance installed in its intended manner (see installation and operating instructions, Clause 11.2), openings in the enclosure shall be designed or located to reduce the risk of unintentional contact with uninsulated parts in line-voltage circuits. The minor dimension of such openings shall not permit passage of a 25.4 mm (1 inch) diameter hemispherically-tipped rod, applied with a force of 22.3 N (5 pounds). In evaluating openings, parts of the enclosure, such as covers, panels, and grilles are to be removed unless (1) tools are required for their removal or (2) when exposed, the uninsulated live part is de-energized through the use of non-defeatable interlocking devices.

4.4.2 The requirements in Clause 4.4.1 also apply to openings in enclosures located within a fresh food compartment or freezer compartment.

4.4.3 An opening is acceptable if the probe illustrated in Figure 4.1 cannot contact uninsulated live parts in line-voltage circuits. The probe shall be applied (1) with a force of 11.1N (2.5 pounds) and (2) in any possible configuration and to any depth that the size of an opening will permit. The probe shall be rotated or angled to any possible position before, during, or after insertion through the opening; and, if necessary, the configuration shall be changed after the probe has been inserted through the opening.

Exception: For film-coated wire in motors, an opening of 19.1 mm (3/4 inch) or less is acceptable if the probe illustrated in Figure 4.2 cannot contact the wire.

Figure 4.2 — Probe



PA170D

4.4.4 In addition to the requirements of Clauses 4.4.1 and 4.4.3 uninsulated live parts and film-coated wire in line-voltage circuits located inside the enclosure and that are likely to be contacted by persons performing operations such as adjusting controls or oiling motors shall be located, guarded, or enclosed to reduce the risk of unintentional contact unless tools are required to expose the live part. See 11.1.26.

4.5 Assembly

4.5.1 A refrigerator incorporating a condensing unit of the pull-out type shall be constructed so that the condensing unit can be pulled out and reinserted without kinking or otherwise damaging the refrigerant tubing, and without pinching, abrading, or stressing electrical wiring.

4.5.2 Horizontally-hinged doors that provide access to the food storage compartment(s) of chest-type units shall be (1) counterweighted, (2) spring loaded, or (3) provided with an automatic latch to retain them in the open position. Action members, such as springs and latches shall be enclosed or guarded.

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4.5.3 Slideout food storage components, such as a drawer or shelf, shall be restrained to prevent being unintentionally pulled free of their supporting means as determined by the component restraint test, Clause 8.26.

Exception: The types of components specified in Items (a) – (e) need not be restrained:

- a) a pan, tray, or similar container that rests freely on a shelf or on the storage compartment bottom;*
- b) a component that when loaded as specified in Clause 8.25.3 has a mass not exceeding 4.5 kg (10 pounds);*
- c) a shelf or container located so that the bottom of the shelf or container is not more than 508 mm (20 inches) above the floor, with levelers, if provided, adjusted to raise the refrigerator to its maximum elevation above the floor but not more than 25.4 mm (1 inch);*
- d) a condensate tray not exceeding a 76.2 mm (3 inches) depth or not intended for food storage;*
- e) food storage components in refrigerators having a storage capacity of 0.06 m³ (2 cubic feet) or less.*

4.5.4 Electrical components shall be located or enclosed so that uninsulated live parts or film-coated wire in line-voltage circuits will not be wetted by liquids due to defrosting or cleaning. See component washing, Clause 8.4, and defrost test, Clause 8.9.

4.5.5 Condensate disposal means, such as a pan, trough, or the like, shall be constructed and located so that overflow will not wet uninsulated live parts or film-coated wire in line-voltage circuits.

4.5.6 An automatic ice maker and the make-up water line shall be constructed and located so that overflow due to a blocked drain, a water inlet valve blocked in the open position, or leakage from a water line connection will not wet uninsulated live parts or film-coated wire in line-voltage circuits.

4.5.7 With reference to Clauses 4.5.5 and 4.5.6, an overflow spout, drain hole, cutout, or the like, in the condensate pan or ice maker may be acceptable for preventing dripping of water on uninsulated live parts or film-coated wire in line-voltage circuits. An overflow test, Clause 8.12, is to be conducted if it is not evident that the refrigerator complies with the requirements of Clauses 4.5.5 and 4.5.6.

4.5.8 Lines for dispensing liquids, ice, and the like shall be located so that leakage at a connection will not result in wetting of uninsulated live parts or film-coated wire in line-voltage circuits.

4.5.9 A refrigerator shall be constructed so that a liquid spill on the top surface of the cabinet will not wet uninsulated live parts or film-coated wire in line-voltage circuits. A spill test, Clause 8.13, is to be conducted if it is not evident that the refrigerator complies with this requirement.

4.5.10 A switch, lampholder, receptacle, motor-attachment plug, or similar component shall be secured in position and shall be prevented from turning. The means for preventing rotation is to consist of more than friction between surfaces. For example, a lock washer is acceptable as means for preventing a small stem-mounted switch or other device having a single-hole mounting means from rotating.

4.5.11 The requirement that a switch be prevented from turning will be waived if all of the following conditions are complied with as specified in Items (a) – (d):

- a) the switch shall be of a plunger or other type that does not tend to rotate when operated. A toggle switch is considered to be subject to forces that tend to rotate the switch during the operation of the switch;
- b) means of mounting the switch make it unlikely that operation of the switch will loosen it;
- c) electrical spacings shall not be reduced below the minimum required values if the switch rotates; and
- d) operation of the switch is by mechanical means rather than direct contact by persons.

4.5.12 A lampholder of a type in which the lamp cannot be replaced, such as a neon pilot or indicator light in which the lamp is sealed in a nonremovable jewel, need not be prevented from turning if rotation cannot reduce electrical spacings below the minimum acceptable values.

4.5.13 An uninsulated current-carrying part and a part that supports a live part shall be secured to its mounting surface so that it will be prevented from turning or shifting in position if such motion may result in a reduction of electrical spacings below the minimum acceptable values. Friction between surfaces is not acceptable as a means to prevent shifting or turning of a live part, but a lock washer as described in Clause 4.5.10 is acceptable.

4.5.14 Flammable or electrically conductive thermal or acoustical insulation shall not contact uninsulated live parts or film-coated wire in line-voltage circuits.

4.5.15 For switches located in areas where disconnection of the leads would result in exposure of an uninsulated live part or reduction of electrical spacings, a means for simultaneous disconnection of the leads shall be provided.

4.6 Accessories

4.6.1 A refrigerator having provisions for the attachment of accessories in the field shall comply with the requirements of this Standard with or without the accessory installed.

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

4.6.3 The installation of accessories by service personnel shall be by means of receptacles, plug-in connectors, insulated wire connectors, or by connection to existing wiring terminals.

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

4.6.5 Strain-relief means shall be provided for the wiring in the accessory if there is a possibility of transmitting stress to the terminal connections during or after installation. See strain relief test, Clause 8.16.

4.6.6 The mounting location of the accessory shall be indicated on the refrigerator.

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

4.6.7 As part of the investigation, accessories are to be trial-installed as necessary to determine that their installation is acceptable and that the instructions are detailed and correct.

4.7 Latch-release mechanism

4.7.1 Except as indicated in Clause 4.7.7, a door or lid permitting entry into a refrigerated storage space that has a minor dimension of 203.2 mm (8 inches) or more and a volume of 0.06 m³ (2 cubic feet) or more, with any arrangement or removal of shelving, shall be constructed so that it will open easily from the inside by a force applied outwardly to the door or to a release actuator. See door latch release test, Clause 8.28.

4.7.2 With reference to Clause 4.7.1, shelving is defined as any shelf, basket, drawer, or baffle that can be removed from the refrigerator without the use of tools.

4.7.3 Interior latch-release actuators shall function with the refrigerator in its intended operating position and shall be operable from all spaces that are directly accessible when the door(s) is opened.

4.7.4 A magnetic door gasket is considered a door-latching device.

4.7.5 A latch-release device shall not depend on an electrical source for operation.

4.7.6 A latch-release device shall be constructed so that cleaning or defrosting in accordance with the manufacturer's recommendations, or normal condensation will not affect compliance with the door latch release test, Clause 8.28.

4.7.7 A key-lock that cannot be released from the inside is acceptable if the construction complies with all the conditions specified in Items (a) – (d):

- a) the refrigerator complies with the requirements of Clauses 4.7.1, 4.7.3, 4.7.5, and 4.7.6 in the unlocked position;
- b) the lock is of the nonself-engaging type;
- c) the key slot is spring loaded or equivalent so that the key must be manually held in the lock in any position of the lock; and
- d) the key is permanently marked as indicated in Clause 11.1.15.

4.8 Polymeric materials – application

4.8.1 General

4.8.1.1 The requirements in Clauses 4.8.1.2 – 4.8.1.7, apply to polymeric materials for use in household refrigerators and freezers. These requirements do not apply to control knobs, buttons, insulating bushings, resilient mounts, clamps, wiring straps, seals including door gaskets, door handles, coated metal, food storage components such as shelves, pans, and trays or other small nonfunctional parts. As a guide, small nonfunctional parts may be considered those having an area of less than 0.093 m² (1 square foot) and that do not provide direct or indirect support of live parts.

4.8.1.2 Among the factors that are taken into consideration when judging the acceptability of a polymeric material are (1) flame resistance, (2) mechanical strength, (3) resistance to impact, (4) moisture absorptive properties, and (5) resistance to distortion at temperatures to which the material may be subjected under conditions of normal or abnormal usage. All of these factors are considered with respect to aging.

4.8.1.3 Polymeric materials used in areas where the effects of an adjacent lamp may result in distortion shall comply with the requirements in the distortion test, Clause 9.16.

4.8.1.4 Polymeric materials shall be isolated from ignition sources. Ignition sources within the unit are considered to be line-voltage wiring and any electrical components, such as coil windings, splices, open type switches, or arcing parts not enclosed in metal or a polymeric material that has been evaluated as an enclosure. Metal not less than 0.13 mm (0.005 inch) thick, fiberglass not less than 12.7 mm (0.5 inch) thick, or a polymeric material classed as 5V or as an electrical enclosure, are acceptable barriers for isolation of ignition sources.

Exception No. 1: Impedance protected motors employing open-coil construction need not be isolated as indicated above if they comply with the burnout test – impedance protected motors, Clause 9.13.

Exception No. 2: Wiring need not be isolated as indicated above if it is separated from HBF, or HB materials by positive clamping and routing at a minimum of 6.4 mm (1/4 inch). Wiring need not be isolated from 5V, V-0, V-1, V-2, HF-1, or HF-2 materials.

Exception No. 3: Wiring need not be isolated if it complies with the VW-1 flame test described in the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581, or FT1 flame test described in Test Methods for Electrical Wires and Cables, CSA Standard C22.2 No. 0.3.

Exception No. 4: Wiring need not be isolated from HB, or HBF materials if the part is additionally evaluated under conditions of the electrical disturbance test, Clause 9.14, or hot wire ignition test, Clause 9.12.

4.8.1.5 Thermal insulation located between an outer metal cabinet or metal door and inner liner and a refrigerator need not be tested for flammability if (1) all entrance and exit holes for wiring, foaming, and the like located within this volume are sealed with caps, permagum, foil tape or the like, and (2) either the securement of the outer cabinet surfaces is inherent in the construction or the maximum spacing between screws, spot welds, or other securement means on the outer metal cabinet does not exceed 152.4 mm (6 in.).

Exception: Holes in the outer metal cabinet need not be sealed if (1) there are not more than two, (2) wiring is not routed through the hole, and (3) the total area is no more than 1 inch². For unsealed holes larger than 1 inch² the construction must be evaluated for flammability using the test method outlined in Sec. 9.5 for HF-1 material.

4.8.1.5A Thermal insulation located between a non-metallic outer cabinet or door and an inner liner of a refrigerator need not be tested for flammability if (1) all entrance and exit holes (for wiring, foaming, and the like) located within this volume are sealed, (2) either the securement of the outer cabinet surfaces is inherent in the construction, or the maximum spacing between screws or other securement means on the outer cabinet does not exceed 152.4 mm (6 inches), (3) ignition sources (including line voltage wiring) are isolated as described in Clauses 4.8.1.4, 4.8.1.6 and 4.8.1.7, and (4) the radiant panel or Flame Spread Test, Clause 9.9, is conducted on the cabinet and/or door materials.

Exception: Holes in the outer metal cabinet need not be sealed if (1) there are not more than two, (2) wiring is not routed through the hole, and (3) the total area is not more than 1 inch². For unsealed holes larger than 1 inch² the construction may be evaluated for flammability using the test method outlined in Sec. 9.5 for HF-1 material.

4.8.1.6 The tests that may be conducted are identified in Table 4.2. Table 4.3 specifies the tests applicable to the polymeric part being evaluated.

4.8.1.7 A lampholder or switch that controls only a light, or fan motor, ice maker, dispenser auger motor, anti-condensate heater, or similar load located within the confines of a food storage compartment, may be mounted on a polymeric part provided that:

- a) wiring is separated or isolated from the polymeric material (see Clause 4.8.1.4);
- b) leads are integral to the component or are provided with insulated terminations; and
- c) the switch or lampholder has no uninsulated live parts after insulated terminals are connected as judged by the requirements of assembly, Clause 4.5.

Table 4.2 – Test summary

1	Electrical Enclosure Flammability, Clause 9.1
2	Vertical Burning Test - 5VA, and 5VB Materials, Clause 9.2
3	Vertical Burning Test - V-0, V-1, or V-2 Materials, Clause 9.3
4	Horizontal Burning Test - HB Materials, Clause 9.4
5	Horizontal Burning Test - HBF, HF-1, or HF-2 Foamed Materials, Clause 9.5
6	Mold Stress-Relief Test, Clause 9.6
7	Fastener Strength Test, Clause 9.7
8	Adhesive Test, Clause 9.8
9	Flame Spread Test ^a , Clause 9.9
10	Volume Resistivity Test, Clause 9.10
11	High Current Arc Ignition Test, Clause 9.11
12	Hot Wire Ignition Test, Clause 9.12
13	Electrical Disturbance Test, Clause 9.14
14	Impact Test, Clause 8.30
^a As an alternate, the radiant panel method in the Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source, ASTM E162-1998 can be employed.	

Table 4.3 – Tests on a polymeric part

Test Group	Applicable Test Number
<u>Group 1</u> A part serving as an enclosure of uninsulated live parts	1 ^{a, m} , 2 ^a , 6 ^k , 7 ^{e, j} , 8 ^e , 9 ^f , 10 ^g , 11 ⁱ , 12 ^j , 14
<u>Group 2</u> A part serving as an enclosure of insulated live parts	1 ^{b, c} , 2 ^{b, c} , 3 ^{b, c} , 4 ^{b, c} or 5 ^{b, c} , 6 ^k , 7 ^{d, j} , 8 ^e , 9 ^f , 10 ^g , 11 ^h , 12 ⁱ , 14
<u>Group 3</u> A functional part	3 ^{b, c} , 4 ^{b, c} or 5 ^{b, c} , 6 ^k , 7 ^{d, j} , 8 ^e , 10 ^g , 11 ^h , 12 ⁱ , 14
<u>Group 4</u> A nonfunctional part	3 ^b , 4 or 5, 9 ^f , 13 ^{a, b}

^a This test does not apply to a polymeric material having a 5V rating.
^b This test does not apply to a polymeric material having a V-0, V-1, V-2, or 5V rating.
^c If ignition sources are separated or isolated in accordance with Clause 4.8.1.4, materials having a HB, or HBF rating may be used.
^d Applies only to ultrasonic welds, or heat welds; polymeric screws or nuts; metal screws threaded into a polymeric part; or other means where degradation of a polymeric material may affect securement.
^e Applies only if the adhesive is relied on to maintain the integrity of an enclosure or functional part.
^f Applies only to polymeric parts forming portions of the external enclosure, or of a decorative part if the total area of the polymeric enclosure exceeds 0.93 m² (10 square feet).
^g Applies only if electrical spacings between uninsulated live parts and the material are less than specified in line-voltage circuits, Clause 6.1, and extra-low voltage (Class 2) circuits, Clause 6.2, or if the part is used as indirect support of an uninsulated live part.
^h Applies only if the material is used to enclose uninsulated live parts or to provide indirect support of uninsulated live parts. This test need not be conducted if the uninsulated live parts are located at least 12.7 mm (1/2 inch) from the enclosure or functional part.
ⁱ Applies only if the material is within 12.7 mm (1/2 inch) of electrically-heated wires, resistors, or the like.
^j Does not apply to an enclosure that serves only to reduce the risk of injury to persons.
^k In the case of a cabinet liner that provides indirect support of an electrical component, the test may be waived if a metal plate having an area at least equal to the projected area of the supported component, including its mounting means, is secured to the component and to the liner. The thickness of the metal plate shall be sufficient to withstand the impact specified in Clause 8.30.3.
^m An enclosure provided with a barrier interposed between the material and an ignition source will be tested with the barrier in place.

4.9 Field supply connections

4.9.1 Cord-connected refrigerators

4.9.1.1 A refrigerator intended for cord connection to an ac power supply shall be equipped with a flexible cord having an equipment grounding conductor terminating in a grounding-type attachment plug that complies with the American National Standards designated in Table 4.4.

Exception: A refrigerator intended for connection to a circuit rated (1) other than 60 Hz, (2) other than the ac voltages specified in the first column of Table 4.4, or (3) both, may employ a grounding-type attachment plug acceptable for the circuit involved.

4.9.1.2 The rating of the attachment plug shall be not less than 125 percent of the marked rating of the refrigerator and not less than the total input measured during the temperature and pressure test, Clause 8.6; and defrost test, Clause 8.9, whichever produces the higher input. The total input shall include all concurrent loads, including the loads drawn by accessories intended for use with the refrigerator.

Table 4.4 – Attachment-plug rating

Attachment plug rating amperes, volts		ANSI Designation ^a
15	125	5 – 15P
20	125	5 – 20P
15	250	6 – 15P

^a Standard for Wiring Devices – Dimensional Requirements, ANSI/NEMA WD6-1988.

4.9.1.3 A cord-connected refrigerator shall employ Type S, SE^a, SO, SOO^a, ST, STO^a, STOO^a, SJ, SJE^a, SJO, SJOO^a, SJT, SJTO^a, SJTOO^a, SP-3^a, SPE-3^a, or SPT-3 power supply cord having a voltage rating not less than that of the refrigerator. The ampacity of the cord as given in Table 12 in the Canadian Electrical Code, Part I, CSA Standard C22.2-1990 and Table 400-5 in the National Electrical Code, ANSI/NFPA 70 shall not be less than that required by the ampere input measured in the temperature and pressure test, Clause 8.6, and the defrost test, Clause 8.9. The ampere input value shall include all concurrent loads including the current drawn by accessories intended for use with the refrigerator.

^aCord type included only in the National Electrical Code, ANSI/NFPA 70.

4.9.1.4 A refrigerator with swivel-type rollers or swivel-type casters may employ Type SP-3, SPE-3, or SPT-3 flexible cord only if the design prevents damage to the cord when the refrigerator is moved. Only casters provided on or with the refrigerator at the factory, or as factory-provided accessories, are considered in judging compliance with this requirement.

4.9.1.5 The length of a power supply cord shall be not less than 1.5 m (5 feet) nor more than 3.0 m (10 feet). The length shall be measured between the attachment plug and (1) any point at which the cord exits the refrigerator cabinet or (2) the last strain relief, whichever is shorter.

Exception No. 1: The power-supply cord for a wall-hung refrigerator shall not exceed 0.6 m (2 feet) in length.

Exception No. 2: For built-in refrigerators the power-supply cord may be less than 1.5 m (5 feet) long provided:

a) the bottom of the machine compartment or condensing unit is at least 1.7 m (5.58 feet) above the floor;

b) the installation instructions indicate the location of the electrical outlet in the alcove for the refrigerator so as to accommodate the shorter length of power supply cord;

c) the unit is marked in accordance with Clause 11.1.18; and

d) the power supply cord can be connected and disconnected from the front without the need to move the refrigerator.

4.9.1.6 The power supply cord shall be provided with strain relief means so that a stress on the cord will not be transmitted to terminals, splices, or internal wiring. See Clause 8.16. If the strain relief is metallic, it shall not contact uninsulated live parts or reduce electrical spacings within the enclosure if the cord is moved inward.

4.9.1.7 The edges of the entry hole for the power supply cord, including the cord entry hole in a bushing, shall be rounded and without burrs, fins, or sharp edges that might damage the cord insulation. Within the unit, the power supply cord shall be routed to reduce the risk of damage to the cord insulation.

4.9.1.8 Clamps or clips used to secure thermoplastic-insulated wires shall be nonmetallic material. Metal clamps having well rounded edges may be acceptable subject to investigation.

4.9.2 DC and AC/DC units

4.9.2.1 The requirements of Clauses 4.9.2.2 – 4.9.2.4 apply to DC and AC/DC refrigerators and are in addition to the provisions of Clauses 4.9.1.1 – 4.9.1.7 and Clauses 4.9.3.1 – 4.9.3.24. AC/DC refrigerators are to be provided with two separate means for connection to the power supplies.

4.9.2.2 A refrigerator intended for cord connection to a dc power supply shall be provided with a cord and dc rated attachment plug that (1) complies with the Standard for Vehicle Battery Adapters, UL 2089, and General Use Receptacles, Attachment Plugs and Similar Wiring Devices, CSA Standard C22.2 No. 42, and (2) incorporates a fuse or other overcurrent protective device rated not in excess of the ampacity of copper conductors, as follows:

Wire size		Ampacity
mm ²	AWG	
0.82	18	6
1.3	16	8
2.1	14	15

Exception: The overcurrent protective device may be provided in the supply cord not more than 127 mm (5 inches) from the attachment plug.

4.9.2.3 With reference to Clause 4.9.2.2, if a fuse is employed, the fuse type and rating shall be permanently marked on or adjacent to the fuseholder.

Exception: A marking need not be included if the fuse is inaccessible to the user and if there is no reference to a fuse on the appliance or in the literature provided with the appliance.

4.9.2.4 If an ac/dc unit can be simultaneously connected to the ac and dc power sources, the construction shall be such that disconnection from one power supply will automatically cause de-energization of all circuits within the unit.

Exception: Automatic de-energization may be omitted if the unit is marked in accordance with Clause 11.1.19.

4.9.3 Permanently-connected refrigerators

4.9.3.1 A refrigerator intended for permanent connection to the power supply shall have provision for connection of one of the wiring systems that, in accordance with the Canadian Electrical Code, Part I, CSA Standard C22.2-1990 and the National Electrical Code, ANSI/NFPA 70-1993, would be acceptable for the appliance.

4.9.3.2 Refrigerated kitchen units shall have provision for permanent connection to the power supply.

4.9.3.3 A refrigerator intended for permanent connection to the power supply shall have as a provision for grounding an equipment grounding terminal or lead.

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

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

4.9.3.6 A knockout for connection of a field-wiring system to a field-wiring compartment shall accommodate not less than 12.7 mm (0.5 inch) trade size conduit.

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

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

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

4.9.3.10 In measuring the spacing between an uninsulated live part and a bushing installed in a knockout, it is to be assumed that a bushing having the dimensions indicated in Table 4.5 is in place, in conjunction with a single locknut installed on the outside of the enclosure.

Table 4.5 – Knockout or hole sizes and dimensions of bushings

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

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

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

4.9.3.13 The space provided at terminals or leads intended for the connection of supply conductors, or other conductors to be connected at the time of installation, shall be sufficient for acceptable installation including the accommodation of the necessary splices. An acceptable installation shall (1) be possible using ordinary tools suitable for the installation, and (2) not require installed conductors to be forced into contact with uninsulated live parts, or with noncurrent-carrying parts likely to be grounded. A trial installation may be performed to determine compliance with these requirements.

4.9.3.14 As used in Clauses 4.9.3.15 – 4.9.3.24, field-wiring terminals or leads are considered to be the terminals or leads to which power supply, control, or equipment grounding connections will be made in the field when the refrigerator is installed.

4.9.3.15 A wiring terminal shall accommodate connection of a supply conductor having an ampacity of at least 125% of the current the product will draw in accordance with the National Electrical Code, ANSI/NFPA 70-1993, and the Canadian Electrical Code, Part I, CSA Standard C22.2-1990.

4.9.3.16 A field-wiring terminal shall be secured in position by means other than friction between surfaces if turning or shifting of the terminal may result in reduction of electrical spacings below those required by line-voltage circuits, Clause 6.1, and extra-low voltage (Class 2) circuits, Clause 6.2. This may be accomplished by means such as two screws or rivets; by square shoulders or mortises; by a dowel pin, lug, or offset; or by a connecting strap or clip fitted into an adjacent part.

4.9.3.17 A wire binding screw at a field-wiring terminal shall be not smaller than 4.2 mm diameter (No. 8) except that a 3.5 mm diameter (No. 6) screw may be used for the connection of one 2.1 mm² (No. 14 AWG) or smaller conductor.

4.9.3.18 A terminal plate for a wire binding screw shall be of metal not less than 0.76 mm (0.030 inch) thick for a 2.1 mm² (No. 14 AWG) or smaller wire, and not less than 1.27 mm (0.050 inch) thick for a wire larger than 2.1 mm² (No. 14 AWG), and in either case there shall be not less than two full threads in the metal.

4.9.3.19 A terminal plate formed from stock having the minimum required thickness may have the metal extruded at the tapped hole for the binding screw to provide two full threads.

Exception: Two full threads are not required if a lesser number of threads results in a connection in which the threads will not strip with normal tightening torque in accordance with the values indicated in the Standard for Wire Connectors and Soldering Lugs for Use With Copper Conductors, UL 486A, Wire Connectors, CSA Standard C22.2 No. 65, and Construction and Test of Soldering Lugs, CSA Standard C22.2 No. 19.

4.9.3.20 Upturned lugs or a cupped washer shall retain a conductor of the size mentioned in Clause 4.9.3.15 under the head of the screw or the washer.

4.9.3.21 A wire binding screw shall thread into metal.

4.9.3.22 A field-wiring terminal intended for the connection of a grounded (identified) conductor shall be of a metal, or plated with a metal, that is substantially white in color and shall be readily distinguishable from other terminals, or identification of that terminal shall be shown in some other manner, such as on an attached wiring diagram. A lead intended for the connection of a grounded (identified) conductor shall be finished to show a white or natural grey color, shall be readily distinguishable from other leads, and no other lead shall be so identified.

4.9.3.23 The length of a lead inside an outlet box or wiring compartment shall be 152.4 mm (6 inches) or more if the lead is intended for field connection to an external circuit.

4.9.3.24 Leads intended for connection to the field supply conductors, including grounding conductors, shall be provided with strain relief if stress on the lead may be transmitted to terminals, splices, or internal wiring. See strain relief test, Clause 8.16.

4.9.4 Grounding

4.9.4.1 A refrigerator shall have provision for grounding.

4.9.4.2 On a permanently-connected refrigerator, a terminal solely for connection of an equipment-grounding conductor shall be capable of securing a conductor of the size required in accordance with the Canadian Electrical Code, Part I, CSA Standard C22.2-1990 and the National Electrical Code, ANSI/NFPA 70-1993.

4.9.4.3 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.

4.9.4.4 On a permanently-connected refrigerator, 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, with or without a secondary means of rotation. Except as indicated in Clause 4.9.4.5, a pressure wire connector intended for connection of a grounding conductor shall be plainly identified, such as by being marked "G", "GR", "Ground", or "Grounding", by the International Electrotechnical Committee (IEC) 417, Symbol 5019 or the equivalent, or by a marking on a wiring diagram provided on the refrigerator. The wire binding screw or pressure wire connector shall be secured to the frame or enclosure of the refrigerator and shall be located so that it is not required to be removed during service operations, such as adjusting controls or oiling motors. Upturned lugs or the equivalent shall be provided at a wire binding screw to retain the conductor.

4.9.4.5 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.

4.9.4.6 On a permanently-connected refrigerator, 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.

4.9.4.7 On a cord-connected refrigerator, the grounding conductor of the power supply cord shall be finished with a continuous green color or with 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 refrigerator by a positive means, such as clamping, bolting or screwed connection, that is not required 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.

4.9.5 Bonding for grounding

4.9.5.1 A refrigerator shall have provision for the grounding of all exposed or accessible noncurrent-carrying metal parts that are likely to become energized and that may be contacted by the user or by service personnel during service operations that are likely to be performed while the refrigerator is energized.

Exception: Exposed or accessible metal parts need not comply with Clause 4.9.5.1 provided such parts are double insulated in accordance with the requirements specified in the Standard for Double Insulation Systems for Use in Electrical Equipment, UL 1097, and General Requirements for Double Insulated Equipment, CSA Standard C22.2 No. 0.1.

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

Exception: The metal parts specified in Items (a) – (d) need not be grounded:

a) adhesive-attached metal-foil markings, screws, handles, or the like, that are located on the outside of enclosures or cabinets and isolated from electrical components or wiring by grounded metal parts so that they are not likely to become energized;

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

c) cabinets, panels, and covers that do not enclose uninsulated live parts, if wiring is positively separated from the cabinet, panel, or cover so that it is not likely to become energized; and

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

4.9.5.3 If a component, such as a compartment temperature control or defrost timer, is likely to become separated from its grounding means for purpose of testing or adjustment while the equipment is energized, it shall be provided with a grounding conductor not requiring removal for such service.

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

4.9.5.5 A separate component bonding conductor shall be of copper, a copper alloy, or other material acceptable for use as an electrical conductor. Ferrous metal parts in the grounding path shall be protected against corrosion by metallic or nonmetallic coatings, such as enameling, galvanizing, or plating. A separate bonding conductor or strap shall (1) be protected from mechanical damage or be located within the confines of the outer cabinet or frame, and (2) not be secured by a removable fastener used for any purpose other than bonding for grounding unless the bonding conductor is unlikely to be omitted after removal and replacement of the fastener.

4.9.5.6 The bonding shall be by a positive means such as clamping, riveting, bolted or screwed connection, brazing, or welding. The bonding connection shall penetrate nonconductive coatings such as paint or vitreous enamel. Bonding around a resilient mount shall not depend on the clamping action of rubber or other nonmetallic material except as indicated in Clause 4.9.5.8.

4.9.5.7 With reference to Clause 4.9.5.6, a bolted or screwed connection that incorporates a star washer under the screwhead or a serrated screwhead is acceptable for penetrating nonconductive coatings. If the bonding means depends upon screw threads, two or more screws or two full threads of a single screw shall engage the metal.

4.9.5.8 If a grounding connection relies on the integrity of a polymeric part, the connection shall comply with provisions of the grounding continuity test, Clause 9.15.

4.9.5.9 An internal connection for bonding internal parts to the enclosure for grounding, but not for a field-installed grounding conductor or for the grounding wire in a supply cord, may employ a quick-connect terminal of the dimensions specified in Table 4.6, provided that the connector is not likely to be displaced.

Table 4.6 – Quick-connect terminals

Terminal dimensions	
mm	(Inches)
0.51 by 4.75 by 6.4	(0.020 by 0.187 by 0.250)
0.81 by 4.75 by 6.4	(0.032 by 0.187 by 0.250)
0.51 by 5.2 by 6.4	(0.020 by 0.205 by 0.250)
0.81 by 5.2 by 6.4	(0.032 by 0.205 by 0.250)
0.81 by 6.4 by 7.8	(0.032 by 0.250 by 0.307)

4.9.5.10 Except as permitted by Clauses 4.9.5.13 and 4.9.5.14, a bonding conductor or strap on a cord-connected refrigerator shall have a cross-sectional area not less than that of the grounding conductor of the supply cord.

4.9.5.11 On a permanently-connected refrigerator, the size of a conductor employed to bond an electrical enclosure or motor frame shall be based on the rating of the branch circuit overcurrent device to which the equipment will be connected. Except as permitted by Clauses 4.9.5.13 and 4.9.5.14, the size of the conductor or strap shall be in accordance with Table 4.7.

Table 4.7 – Bonding wire conductor size

Rating of overcurrent device amperes	Size of bonding conductor ^a			
	Copper		Aluminum	
	mm ²	AWG	mm ²	AWG
15	2.1	14	3.3	12
20	3.3	12	5.3	10

^a Or equivalent cross-sectional area.

4.9.5.12 A conductor, such as a clamp or strap, used in place of a separate wire conductor as indicated in Clause 4.9.5.11, is acceptable provided that the minimum cross-sectional conducting area is equivalent to the wire sizes indicated in Table 4.7.

4.9.5.13 With regard to Clauses 4.9.5.10 and 4.9.5.11, 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, Clause 8.19, and the limited short circuit test, Clause 8.18.

4.9.5.14 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.

4.9.5.15 Splices shall not be employed in wire conductors used to bond electrical enclosures, motor frames, or other electrical components. Separable multi-pin connectors that provide for simultaneous disconnection of the current-carrying conductors and the grounding conductor may be employed.

4.10 Wiring and wiring methods

4.10.1 General

4.10.1.1 This Clause shall apply to both line-voltage circuits and extra-low voltage safety circuits, unless stated otherwise. Extra-low voltage nonsafety circuit wiring requirements are not specified.

4.10.1.2 Wiring shall have insulation rated for the potential involved and the temperatures to which it may be subjected. Compliance is to be judged on the basis of the temperatures measured during the applicable temperature tests specified in Clauses 8.6 and 8.8.

Exception: If it can be determined that the wiring shall not be exposed to heat from radiating sources or heated components, and if the ampacity of the conductors is in accordance with Table 4.8, the temperature tests on the wiring may be waived.

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

Table 4.8 – Wiring materials ampacities

Wire size		Ampacity
mm ²	AWG	
0.41	22	4
0.66	20	7
0.82	18	10
1.3	16	13
2.1	14	18
3.3	12	25
5.3	10	30
8.4	8	40
13.3	6	55
21.2	4	70
33.6	2	95
42.4	1	110

^a The ampacities shown apply to appliance wiring materials. For types of wires other than appliance wiring materials, the ampacity shall be determined from Tables 310-16 and 310-17 in the National Electrical Code, ANSI/NFPA No. 70-1993 and Tables 1 through 4 in the Canadian Electrical Code, Part I, CSA Standard C22.1-1990, for the type of wire employed. The correction factors of the referenced tables need not be applied.

4.10.1.4 If the input to a resistance type heater wire exceeds 8 W/m (2.5 W/ft), the wire is rated less than 80°C (176°F), the wires are less than 19.1 mm (3/4 inch) apart, or the wires are not in positive contact with a radiating surface, the heater shall be subjected to the heating test - condensate wiring, Clause 9.17.

4.10.1.5 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.

4.10.1.6 If cords or appliance wiring material are employed in the user accessible refrigerated compartment, such wiring shall be of a type indicated by Table 4.9, Group B, and shall be located or protected so as not to be subjected to contact by product containers, removable shelves, or the like.

Table 4.9 – Typical wiring

Group	Type of wire, cord, or cable ^a	Wire size		Nominal insulation thickness	
		mm ²	No. AWG	mm	Inch
A	Appliance wiring material having thermoplastic insulation, with nominal insulation thicknesses shown at the right corresponding to wire sizes indicated; or Type TW; or Type ^c AC, ACL, ACT, FFH-2, TF, TFF, TFN, TFFN, SF-2, SFF-2, RH, RHH, RHW, THW, XHHW, MTW, THW-MTW, THWN, PF, PGF, PFF, PGFF; or Type ^b TEW, TR-32, R90, RW90, T90, TW75, SEW-1, SEW-2, GTF.	3.3 – 0.82	10 and smaller	0.8	2/64
B	Appliance wiring material having thermoplastic or thermoset insulation, with nominal insulation thicknesses shown at right corresponding to the wire size indicated; or cord Type S, SO, SOO, ST, STO, STOO, SJO, SJOO, SJT, SJTO, SJTOO, SPT-3; or Type ^c SE, SJ, SJE, SP-3, SPE-3; or Type ^b NMD90, NMWU.	0.82	18	1.6 ^d	4/64 ^d
		1.3	16	1.6 ^d	4/64 ^d
		2.1	14	2.0 ^e	5/64 ^e
		3.3	12	2.0 ^e	5/64 ^e
C	Appliance wiring material ^b having rubber insulation, with insulation thicknesses shown at the right corresponding to wire sizes indicated; or cord Type S, SJ, or SP-3.	Same as for Group B			

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

^b Wire Types included only in the Canadian Electrical Code, Part I, CSA Standard C22.1-1990.

^c Wire Types included only in the National Electrical Code, ANSI/NFPA No. 70-1993.

^d Total wire insulation thickness can be achieved by use of 0.8 mm (2/64 inch) insulation integral to the wire plus 0.8 mm (1/32 inch) thick supplemental sleeving, such as fiberglass, etc.

^e Total wire insulation thickness can be achieved by use of 1.2 mm (3/64 inch) insulation integral to the wire plus 0.8 mm (1/32 inch) thick supplemental sleeving, such as fiberglass, etc.

4.10.1.7 If wiring extends from the cabinet to a hinged door or other part that provides access to the product storage area, flexible conductors, such as the S series of cord specified in Item B of Table 4.9 or equivalent, shall be employed. The wiring shall be routed or protected to reduce the risk of damage to the insulation. If the wiring is exposed, it shall be provided with strain relief so that stress will not be transmitted to terminals or splices. See strain relief test, Clause 8.16.

4.10.1.8 With reference to Clause 4.10.1.7, wiring that is subjected to movement is to be tested by cycling the moving part through the maximum travel permitted by the design unless it is evident that the wiring will not be damaged. The duration of the test is to be as indicated in Clause 8.28.4 and may be run in conjunction with the door latch release test, Clause 8.28. Following this, the unit is to be subjected to the dielectric voltage-withstand test, Clause 8.8, while the door is moved one time from the closed to the maximum open position. After this test the wiring is to be visually examined for damage to determine if individual strands have penetrated the insulation.

4.10.2 Permanently-connected refrigerators

4.10.2.1 Except as indicated in Clauses 4.10.1.6, 4.10.1.7, and 4.10.2.2, wiring shall be of the type indicated in Group A of Table 4.9, and enclosed in conduit, electrical metallic tubing, metal raceways, control boxes, or the like. Fittings shall be constructed for use with the type of wiring enclosure employed in the application.

4.10.2.2 Cords or appliance wiring material of a type indicated in Group A or B of Table 4.9, may be employed if the wiring is enclosed by the cabinet to reduce the risk of (1) damage to the wiring, (2) ignition of flammable material, or (3) emission of flame or molten metal through openings in the cabinet. Wiring shall be separated from flammable material in accordance with Clause 4.8.1.4.

4.10.2.3 With regard to Clause 4.10.2.2, wiring shall be positively routed, isolated, or both from openings in the cabinet as follows:

- a) Openings Below Wiring – Wiring shall be located such that an opening is not located below the wiring within Space A in Figure 4.3 (that is, the space generated by a 5 degree angle) unless a barrier is placed between the wiring and the opening. The barrier does not have to be larger than the opening within the generated space.
- b) Openings Above Wiring – Wiring shall be located such that an opening is not located above the wiring within Space B in Figure 4.3 (that is, the space generated by a 30 degree angle) unless a barrier is placed between the wiring and the opening. The barrier does not have to be larger than the opening within the generated space.
- c) Openings in the Vertical Plane of the Enclosure – Wiring shall be located such that an opening in the vertical plane of the enclosure is not within 101.6 mm (4 inches) of the wiring unless a barrier is placed between the wiring and the opening.

Exception: A finned condenser coil is acceptable as a barrier in a vertical plane if the wiring cannot be contacted by a rod 6.4 mm (1/4 inch) in diameter and 50.8 mm (2 inches) long.