UL 484

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Room Air Conditioners

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UL Standard for Safety for Room Air Conditioners, UL 484

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Revisions: This Standard contains revisions through and including September 3, 2002.

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Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The following table lists the future effective dates with the corresponding item.

Effective Date	Items Effected
August 1, 2004	11.2.1.1, 11.2.1.2, 81.4

The new and revised requirements are substantially in accordance with UL's Bulletin(s) on this subject dated November 9, 2001. The bulletin(s) is now obsolete and may be discarded.

The revisions dated September 3, 2002 include a reprinted title page (page1) for this Standard.

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.

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

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that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

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

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

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12-14B	September 3, 2002
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22	October 28, 1998
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Standard for Room Air Conditioners

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April 27, 1993

The most recent designation of ANSI/UL 484 as an American National Standard (ANSI) occurred on June 4, 2002.

This ANSI/UL Standard for Safety, which consists of the Seventh Edition including revisions through September 3, 2002, is under continuous maintenance, whereby each revision is ANSI approved upon publication. Comments or proposals for revisions on any part of the Standard may by submitted to UL at any time. Written comments are to be sent to the UL Northbrook Standards Department, 333 Pfingsten Road, Northbrook, IL 60062.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc. and is not part of the ANSI approved standard.

The Department of Defense (DoD) has adopted UL 484 on February 5, 1993. 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 set of revised requirements.

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FOREWORD

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

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

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

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

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

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

INTRODUCTION

1 Scope

1.1 These requirements cover room air conditioners rated not more than 600 volts alternating current (ac) and intended for installation in accordance with the National Electrical Code, ANSI/NFPA 70.

1.2 For the purposes of this standard, a room air conditioner is a factory-made encased assembly designed as a unit primarily to provide free delivery of conditioned air to an enclosed space, room, or zone. This equipment is intended for installation in a window, through a wall, or as a console located in or adjacent to the room, zone, or space to be conditioned. These units employ hermetic refrigerant motor-compressors with factory-charged refrigeration systems and include means for circulating air. They may also have provision for heating and ventilation.

1.3 With regard to 1.2, a console or in-wall type room air conditioner may additionally serve a single adjacent room. Such units employ cabinet or enclosure constructions permitting attachment of an air discharge adapter or duct which extends into the adjacent room.

1.4 These requirements do not cover equipment intended for connection to duct systems for the purpose of providing central cooling, heating, or both.

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 General

2.1 Components

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

2.1.2 A component 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.

2.1.2 revised September 3, 2002

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

2.1.3 revised September 3, 2002

2.1.4 Specific components are 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.

2.1.4 revised September 3, 2002

2.2 Units of measurement

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

2.2.1 revised September 3, 2002

2.3 Terminology

2.3.1 The terms ″air conditioner″ and ″unit″ are used interchangeably and refer to all room air conditioners or any part thereof covered by this standard unless specifically noted otherwise.

2.4 Undated references

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

3 Glossary

3.1 For the purpose of this standard, the following definitions apply.

3.2 ACCESSORY – An optional electrical device or other component intended for installation in or connection to a room air conditioner for the purpose of modifying or supplementing the functions of the room air conditioner. It may be factory installed or intended for installation by the user or service personnel.

3.3 BARRIER – A partition for the insulation or isolation of electrical circuits or for isolation of electrical arcs or for isolation of moving parts or hot surfaces.

3.4 CIRCUITS ELECTRICAL –

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

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

1) A primary battery,

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

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

3.4 revised September 3, 2002

3.5 CONSOLE-TYPE ROOM AIR CONDITIONER – An assembly designed for installation in or adjacent to the room, zone, or space to be conditioned. It may provide free air delivery or air distribution by means of collars, sleeves, or the like, having a single air inlet and single air discharge opening. Air-cooled units may be provided with collars or sleeves extending through a wall, floor, or roof for condenser air inlet and discharge.

3.6 DESIGN PRESSURE – The maximum allowable working pressure for which the room air conditioner is designed.

3.7 ENCLOSURE – That part of a room air conditioner which by itself or in conjunction with barriers:

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

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

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

3.8 FUNCTIONAL PART – A part other than an enclosure or structural part which is necessary for the intended operation of the unit.

3.9 IN-WALL TYPE ROOM AIR CONDITIONER – An assembly designed for installation in and extending through a prepared wall opening.

3.10 MODULAR CONSTRUCTION – A type of design used with in-wall and console room air conditioners which permits individual sections of the unit, such as the enclosure, cooling system, heater-blower assembly, and the like, to be shipped separately from the factory as needed at the point of installation. See also 5.3.

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

3.12 STRUCTURAL PART – A part used in such manner that failure of the part may present a risk of electric shock or unintentional contact with moving parts.

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

3.14 WINDOW-TYPE ROOM AIR CONDITIONER – An assembly provided with mounting hardware designed for installation in a window.

3.15 AFCI – A device intended to mitigate the effects of arcing faults by functioning to deenergize the circuit where an arc-fault is detected.

3.15 added September 3, 2002

3.16 LCDI – A device provided in a power-supply cord that senses leakage current flowing between or from the integral cord conductors and interrupts the circuit at a predetermined level of leakage current.

3.16 added September 3, 2002

4 Installation and Operating Instructions

4.1 A room air conditioner shall be provided with instructions containing directions and information that the manufacturer considers necessary for installations, use, and maintenance of the room air conditioner. These instructions are to be included with each unit or with each shipment to the installer. Applicable information concerning minimum clearance for side openings in an enclosure of a unit intended for in-wall installation shall be included.

Exception: For split-system type units the instructions need only be packaged with one of the sections or shipment of sections.

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

4.3 With reference to 4.1, console-type units not provided with the necessary air discharge diffuser, air return grille, sleeve, collar, or the like, by the room air conditioner manufacturer, are to be evaluated for accessibility of uninsulated live parts, moving parts, and rain exposure on the basis that such diffusers, grilles, and the like, are not in place. Installation instructions are to include the room air conditioner manufacturer's recommendations for such parts.

4.4 With reference to 4.1, instructions for console or in-wall type units intended to serve an additional adjacent room shall include sufficient information to install the unit in this type of application. If the unit cabinet is designed for use with a duct extension and air discharge grille which are to be provided in the field, the installation instructions shall include the room air conditioner manufacturer's recommendations for such parts. Such units are to be evaluated for accessibility of uninsulated live parts and moving parts on the basis that the grille and duct extension are not in place and the cabinet is open at the point where the duct extension is to be connected.

4.5 Instructions for cord-connected room air conditioners shall include manufacturer's recommendations regarding the use of cord sets (extension cords). If use of an extension cord is not recommended, the instructions shall state this. Recommendations for an extension cord shall specify at least the use of a cord set with an equipment grounding conductor, grounding-type attachment plug, and grounding-type connector (load fitting); and the ampacity and voltage rating of the cord set.

4.6 Installation instructions for split-system type room air conditioners not provided with interconnecting tubing for field connection of the condensing sections and evaporating sections shall specify the maximum length of interconnecting tubing to be employed.

CONSTRUCTION

5 General

5.1 Ferrous metal parts used to support or retain electrical components in position shall be protected against corrosion by metallic and nonmetallic coatings, such as plating or painting.

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

5.2 Exposed unimpregnated asbestos material shall not be used in an air handling compartment. The unprotected edge of a gasket sandwiched between two parts is considered to be exposed.

5.3 The condensing and evaporating sections of split-system room air conditioners shall be provided with means that permit the field connection of the sections in a manner that results in a completely factory-charged system.

6 Assembly

6.1 Openings in the enclosure of a room air conditioner shall be designed or located to reduce the risk of unintentional contact with:

a) Uninsulated high-voltage live parts;

b) Moving parts, such as fan blades and blower wheels; and

c) Parts within the enclosure which exceed the temperature permitted by Table 38.1, E4.

The minor dimension of such openings shall not permit passage of a 1 inch (25.4 mm) diameter hemispherically-tipped rod, applied with a force of 5 pounds (22.2 N). In evaluating openings, parts of the

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enclosure, such as covers, panels, and grilles are to be removed unless tools are required for their removal or when exposed, a moving part is made inoperative or an uninsulated part is de-energized through the use of interlocking devices.

Exception: The requirement of (c) does not apply to parts, such as refrigerant tubing located in the outdoor section of the unit, provided that openings adjacent to the parts will not permit passage of a rod as described above.

6.2 An opening is acceptable if the probe illustrated in Figure 6.1 cannot contact uninsulated high-voltage live parts, moving parts, or hot parts. The probe shall be applied:

a) With a force of 2.5 pounds (11.1 N) along the major axis of the probe and

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

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

Exception No. 1: For film-coated wire, an opening which will not permit passage of 3/4 inch (19 mm) diameter rod is acceptable if the probe illustrated in Figure 6.2 cannot contact the wire.

Exception No. 2: A moving part is not to be considered when judging compliance with this requirement if:

a) The part is unlikely to be contacted through the opening because of the location of fixed components, such as baffles, water and refrigerant tubing, drain tubes, and the like, or

b) The unit chassis of a slide-out type construction must be withdrawn from the enclosure to expose the moving part.

Exception No. 3: In evaluating moving parts and hot surfaces, openings of less than 1/4 inch (6.3 mm) in guards are not to be considered if application of the probe illustrated in Figure 6.2 with a force of 5 pounds (22.2 N) does not result in:

a) Penetration to a depth permitting contact with the guarded part,

b) Breakage of the guard, or

c) Permanent distortion or permanent displacement which would defeat the purpose of the guard.

Figure 6.1
Articulate probe

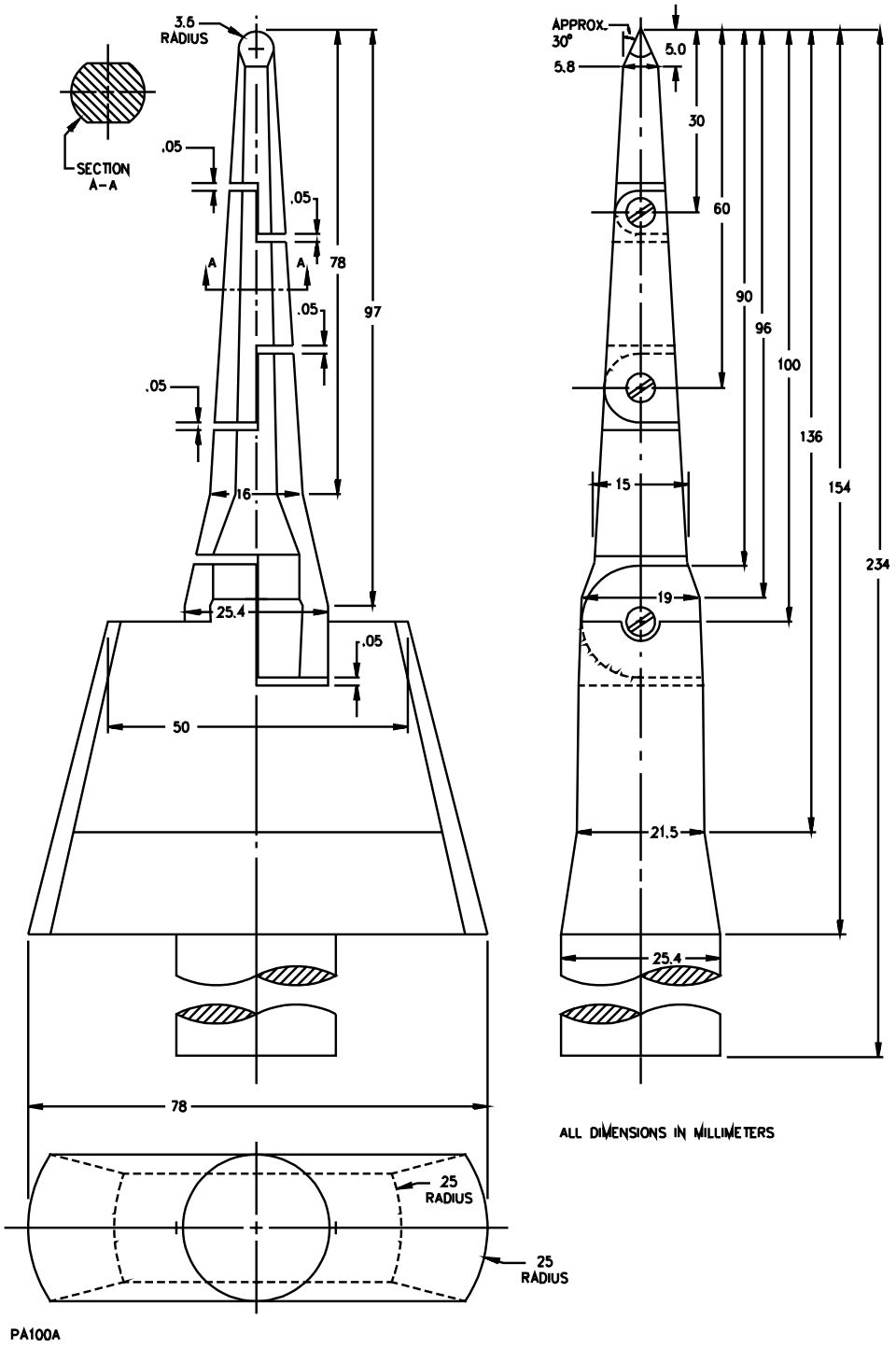
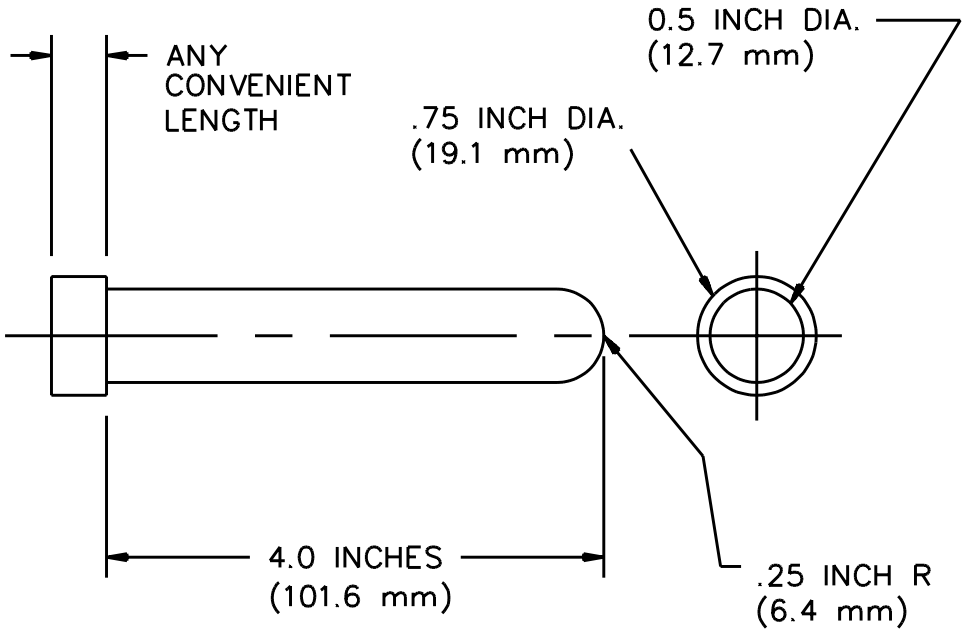


Figure 6.2
Probe for film-coated wire



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6.3 A heater element, as installed in the complete room air conditioner, shall be protected against mechanical damage. A heater element employing a copper or steel sheath that is at least 0.016 inch (0.41 mm) thick is considered to be protected against mechanical damage.

6.4 Open-type heater elements used in room air conditioners having air discharge from other than a vertical plane of the cabinet shall be protected by a screen, hardware cloth, or equivalent having openings no greater than 0.0156 square inch (0.1 cm^2), located above the heater element and any uninsulated terminals to reduce the risk of objects falling through the air discharge grille onto or near these uninsulated parts.

6.5 Uninsulated live parts and film-coated wire located:

a) In the room-side of a unit and

b) Below air openings in other than the vertical surface of the cabinet, shall be mounted or guarded so that spillage of liquid through the air opening will not result in a risk of fire or electric shock. See Spillage Test, Section 49.

Exception: The test is not applicable to units if, when installed in accordance with the manufacturer's instructions, the minimum dimension of a horizontal top surface of the cabinet is 3 inches (76.2 mm) or less.

6.6 Electrical controls:

a) Located in the room-side of a unit and

b) With the actuating member(s) extending through other than a vertical surface of the cabinet, shall be mounted or guarded so that spillage of liquid will not result in a risk of fire or electric shock. See Spillage Test, Section 49.

Exception: The test is not applicable to units if, when installed in accordance with the manufacturer's instructions, the minimum dimension of a horizontal top surface of the cabinet is 3 inches (76.2 mm) or less.

6.7 In addition to the requirements of 6.1 and 6.2, uninsulated high-voltage live parts inside the enclosure which are likely to be contacted by persons performing service operations, such as replacing fuses, resetting manual-reset devices, replacing air filters, oiling motors, or the like, shall be located, guarded, or enclosed to reduce the risk of unintentional contact unless tools are required to expose the live part. See 79.15.

6.8 Except as permitted in the Rain Test, Section 35, electrical components shall be located or enclosed so that accumulation or overflow of water will not wet uninsulated live parts.

6.9 A condensate pan shall be constructed and located so that overflow due to a blocked drain will not wet live parts or film-coated wire. An overflow spout, drain hole, cutout, or the like, in the condensate pan may be acceptable for preventing dripping of water on electrical parts. An Overflow Test, Section 48, is to be conducted if it is not evident that the room air conditioner complies with this requirement.

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

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

a) The switch is of a plunger or other type that does not tend to rotate when operated. A toggle switch is considered to be subject to forces that tend to turn the switch during the operation of the switch;

b) Means of mounting the switch make it unlikely that operation of the switch will loosen it;

c) Electrical spacings shall not be reduced below the minimum required values if the switch rotates; and

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

Exception No. 2: A lampholder of a type in which the lamp cannot be replaced, such as a neon pilot or indicator light in which the lamp is sealed in a nonremovable jewel, need not be prevented from turning if rotation cannot reduce electrical spacings below the minimum acceptable values. See Electrical Spacings, Sections 24 and 25.

6.11 The means for preventing rotation mentioned in 6.10 is to consist of more than friction between surfaces. A toothed lock washer that provides both spring take-up and an interference lock is acceptable as means for preventing a small stem-mounted switch or other device having a single-hole mounting means from turning.

6.12 An uninsulated current-carrying part and a part that supports a live part shall be secured so that it will be prevented from turning or shifting in position if such motion may result in a reduction of spacings below the minimum acceptable values. See Electrical Spacings, Sections 24 and 25. Friction between surfaces is not acceptable as a means to prevent shifting or turning of a live part, but a lock washer as described in 6.11 is acceptable.

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

7 Accessories

7.1 A room air conditioner having provisions for the use of accessories to be attached in the field shall comply with the requirements of this section, and shall comply with the requirements of this standard with or without the accessory installed.

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

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

7.3 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.

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

7.5 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 installation.

7.6 To determine the acceptability of the strain relief means, a 20 pound (9.1 kg) weight is to be suspended on the wiring so that the strain relief means will be stressed from any angle which the design permits. The load is to be applied for 1 minute. The strain relief is not acceptable if there is such movement of the wiring as to indicate that stress would have resulted on the wiring connections.

7.7 All terminals and wiring intended to be field-connected shall be identified on the accessory, on the room air conditioner if connections are made between the accessory and the room air conditioner, and on the wiring diagram(s).

7.8 The mounting location of the accessory shall be indicated on the room air conditioner.

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

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

8 Enclosures

8.1 General

8.1.1 Enclosures shall be formed and assembled so that they will have the strength and rigidity necessary to resist total or partial collapse resulting in a risk of electric shock, injury to persons, or damage to components in the refrigeration and electrical systems. Enclosures for individual components, outer enclosures, and combinations of the two are considered in determining compliance with this requirement.

8.1.2 Among the factors which are taken into consideration when evaluating an enclosure are:

a) Mechanical strength,

b) Resistance to impact,

c) Moisture-absorptive properties,

d) Flammability,

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

f) Resistance to corrosion.

For a nonmetallic enclosure or part of an enclosure, all of these factors, including the effect of exposure to weathering if for outdoor use, are considered with respect to aging. See Polymeric Materials, Section 9.

8.1.3 The enclosure(s) of a room air conditioner shall reduce the risk of mechanical damage to wiring, electrical components, and refrigerant tubing.

8.1.4 The enclosure shall reduce the risk of emission of molten metal, burning insulation, flaming particles, or the like, from falling through openings onto flammable material, including surfaces over which the room air conditioner is mounted.

8.1.5 An in-wall type room air conditioner shall be provided with an enclosure by the room air conditioner manufacturer. If marked in accordance with 79.11, the enclosure may be supplied separately.

8.1.6 The enclosure, including the base pan and other structural sections, such as bulkheads and partitions of window-type room air conditioners, shall be formed and assembled so that the complete unit will comply with the requirements of the Static Loading Test, Section 46, and Stability Test, Section 47.

8.1.7 The enclosure for a window-type room air conditioner having a slide-out chassis shall prevent the chassis from being pushed through the outdoor-end of the enclosure.

8.1.8 Wall sleeves for in-wall air conditioners shall have provision for securing the sleeve in the wall opening. The unit chassis shall be prevented from being pushed through the outdoor-end of the sleeve.

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

8.1.10 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 shall be such that a conduit bushing can be attached. If threads for the connection of conduit are not tapped all the way through a hole in an enclosure wall, conduit hub, or the like, there shall be not less than 3-1/2 threads in the metal and there shall be a rounded inlet hole for the conductors which shall:

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

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

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

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

8.1.13 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.

8.1.14 In measuring a 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 8.1 is in place, in conjunction with a single locknut installed on the outside of the enclosure.

Table 8.1
Knockout or hole sizes and dimensions of bushings

Trade size of conduit		Nominal knockout or hole diameter		Bushing dimensions			
				Overall diameter		Height	
Inches	(mm O.D.)	Inches	(mm)	Inches	(mm)	Inches	(mm)
1/2	(21.3)	7/8	(22.2)	1	(25.4)	3/8	(9.5)
3/4	(26.7)	1-3/32	(27.8)	1-15/64	(31.4)	27/64	(10.7)
1	(33.4)	1-23/64	(34.5)	1-19/32	(40.5)	33/64	(13.1)
1-1/4	(42.3)	1-23/32	(43.7)	1-15/16	(49.2)	9/16	(14.3)
1-1/2	(48.3)	1-31/32	(50.0)	2-13/64	(56.0)	19/32	(15.1)
2	(60.3)	2-15/32	(62.7)	2-45/64	(68.7)	5/8	(15.9)

8.1.15 Steel enclosures shall be protected against corrosion by metallic or nonmetallic coatings, such as plating or painting. Also see 8.2.1 – 8.2.6 for enclosures exposed to weather.

8.1.16 To reduce the risk of electric shock or injury to persons, a hinged panel or cover shall be positioned or arranged so that, when it is in an open position to facilitate service operations, it is not subject to falling or swinging due to gravity or vibration.

8.1.17 The assembly shall be arranged so that an overcurrent protective device, such as a fuse, can be replaced and manual-reset devices can be reset without removing parts other than a service cover(s) or panel(s), and the cover or door enclosing the device.

8.1.18 A required protective device shall not be accessible from outside the enclosure except by opening a door or cover.

Exception: The operating handle of a circuit breaker, the reset button of a manually resettable motor protector, the reset button of a manually resettable pressure switch, and similar parts may project outside the enclosure.

8.1.19 An opening in an outer enclosure around a handle, reset button, or other control member is acceptable if the clearance between the control member and the edge of the opening is not more than 1/8 inch (3.2 mm) for any setting or position of the control member.

8.1.20 Covers for enclosures of fuses in high-voltage circuits shall be hinged. Covers for enclosures of manual-reset overload protective device shall be hinged if it is necessary to open the cover to reset the device.

Exception: A hinged cover is not required where the only fuses enclosed are:

a) Supplementary type control circuit fuses, provided the fuses and control circuit loads, other than a fixed control circuit load, such as a pilot lamp, are within the same enclosure;

b) Supplementary type fuses of 2 amperes or less for auxiliary resistance heaters, such as crankcase heaters with a maximum rating of 100 watts;

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

d) Fuses in low-voltage circuits.

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

8.1.22 A spring latch, a magnetic latch, a dimple, or any other mechanical arrangement that will hold the door in place and will require some effort on the user's part to open, is considered to be means for holding the door in place as required in 8.1.21. When provided as the sole means for securing the cover or panel, a cover interlocking mechanism is considered to comply with the requirement of 8.1.21.

8.1.23 A door or cover giving direct access to fuses in other than low-voltage circuits shall shut closely against a 1/4 inch (6.4 mm) rabbet or shall have either turned flanges for the full length of four edges or angle strips fastened to it. Flanges or angle strips shall fit closely with the outside of the wall of the box proper and shall overlap the edges of the box not less than 1/2 inch (12.7 mm). A special construction, such as a fuse enclosure located within an outer enclosure, or a flange and rabbet combination, is acceptable.

8.1.24 Strips used to provide rabbets or angle strips fastened to the edges of a door shall be secured at not less than two points, not more than 1-1/2 inches (38.1 mm) from each end of each strip and at points between these end fastenings, not more than 6 inches (152 mm) apart.

8.2 Enclosures exposed to weather

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

Type of cabinet and enclosure	0.053 inch (1.35 mm) and heavier as specified by clause:	Lighter than 0.053 Inch (1.35 mm) as specified by clause:
Outer cabinets which protect motors, wiring or enclosed current-carrying parts	8.2.3	8.2.4
Inside enclosures which protect current-carrying parts other than motors	8.2.3	8.2.4
Outer cabinets which are the sole enclosure of current-carrying parts	8.2.4	8.2.4

8.2.2 Clause 8.2.1 is not applicable to a metal part, such as a decorative grille, which is not required for conformance with this standard.

8.2.3 To comply with the requirement of 8.2.1, one of the following coatings shall be used:

a) Hot dipped mill galvanized sheet steel conforming with the Coating Designation G60 or A60 in Table 1 of the Standard for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, ASTM A525–90, with not less than 40 percent of the zinc on any side, based on the minimum single spot test requirement in the ASTM specification. The weight of zinc coating may be determined by any recognized laboratory method. However, in case of question, the weight of coating shall be established in accordance with the Test for Weight of Coating on Zinc-Coated Iron or Steel Articles, ASTM A90–81. An A60 (alloyed) coating shall also comply with the requirement of 8.2.5;

b) A zinc coating, other than that provided on hot dipped mill galvanized sheet steel, uniformly applied to an average thickness of not less than 0.00041 inch (0.0104 mm) on each surface with a minimum thickness of 0.00034 inch (0.0086 mm). The thickness of the coating shall be established by the Metallic Coating Thickness Test, Section 59. An annealed coating shall also comply with the requirement of 8.2.5; or

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

8.2.4 To comply with the requirement of 8.2.1, one of the following coatings shall be used:

a) Hot dipped mill galvanized sheet steel conforming with the Coating Designation G90 and Table 1 of ASTM A525–90 with not less than 40 percent of the zinc on any side, based on the minimum single spot test requirements in the ASTM specification. The weight of zinc coating may be determined by any recognized laboratory method. However, in case of question, the weight of coating shall be established in accordance with the test method of ASTM A90–81;

b) A zinc coating, other than that provided on hot dipped mill galvanized sheet steel, uniformly applied to an average thickness of not less than 0.00061 inch (0.0155 mm) on each surface with a minimum thickness of 0.00054 inch (0.0137 mm). The thickness of the coating shall be established by the Metallic Coating Thickness Test, Section 59. An annealed coating shall also comply with the requirement of 8.2.5;

c) A cadmium coating of not less than 0.001 inch (0.025 mm) in thickness on both surfaces. The thickness of coating shall be established by the Metallic Coating Thickness Test, Section 59;

d) A zinc coating conforming with 8.2.3 (a) or (b), with one coat of outdoor paint as specified in 8.2.3 (c); or

e) A cadmium coating of not less than 0.00075 inch (0.0191 mm) in thickness on both surfaces with one coat of outdoor paint on both surfaces; or of not less than 0.0005 inch (0.013 mm) in thickness on both surfaces with two coats of outdoor paint on both surfaces. The thickness of the cadmium coating shall be established by the Metallic Coating Thickness Test, Section 59, and the paint shall be as specified in 8.2.3 (c).

Paragraph 8.2.4 revised August 6, 1996

8.2.5 An annealed zinc coating which is bent or similarly formed after annealing shall additionally be painted in the bent or formed area if the bending or forming process damages the zinc coating. If flaking or cracking of the zinc coating at the outside radius of the bent or formed section is visible at 25 power magnification, the zinc coating is considered damaged. Simple sheared or cut edges and punched holes are not considered to be formed, but extruded and rolled edges and holes shall comply with this requirement.

8.2.6 With reference to the requirement in 8.2.1, other finishes, including paints, special metallic finishes, and combinations of the two, may be accepted if comparative tests with galvanized sheet steel without annealing, wiping, or other surface treatment conforming with 8.2.3 (a) or 8.2.4 (a), as applicable, indicate they provide equivalent protection. Among the factors which are taken into consideration when judging the acceptability of such coating systems are exposure to salt spray, moist carbon dioxide-sulphur dioxide-air mixtures, moist hydrogen sulphide-air mixtures, ultraviolet light, and water.

8.2.7 Nonferrous enclosures may be employed without special corrosion protection. See 8.1.2.

8.2.8 If gaskets are required to seal electrical enclosures against the entrance of rain and condensate, they shall be held in place by mechanical fasteners or adhesives, except as indicated in 8.2.7, and shall comply with the requirements of 58.2 – 58.6. Sealing compounds required to seal electrical enclosures shall comply with the requirements of 58.7. Adhesives required to secure gaskets shall comply with the requirements of 58.8. Gaskets shall be neoprene, rubber, or thermoplastic. Other materials may be used if they have equivalent properties.

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

9 Polymeric Materials

9.1 General

9.1.1 The requirements in 9.1.2 – 9.4.14 cover polymeric materials used to form outer enclosures, structural or functional parts, thermal and acoustical insulation, and miscellaneous parts of a room air conditioner. Table 9.1 indicates the properties to be evaluated, depending on the material application. These requirements do not apply to materials used as electrical insulation nor to small parts, such as control knobs, buttons, insulating bushings, resilient mounts, clamps, and wiring straps.

9.1.2 If electrical spacings between uninsulated live parts and a polymeric material are less than required by Sections 24 and 25, the material shall comply with requirements of the Volume Resistivity Test, Section 75.

Table 9.1
Evaluation of properties of polymeric materials

Characteristics to be evaluated	Enclosures	Structural parts	Thermal and acoustical insulation	Functional parts	Clause references
Flammability:					
Source of ignition					
External	Yes				9.1.3
Internal	Yes	Yes	Yes	Yes	9.4.1–9.4.14; Sections 61–64
Heat deflection	Yes	Yes			Section 65
Water absorption	Yes	Yes			Section 66
Environmental Exposure:					
Air oven aging	Yes	Yes			67.1.1, 67.1.2
Ultraviolet light and					
Water exposure	Yes	Yes[a]			67.2.1, 67.2.2
Water immersion	Yes	Yes			67.3.1–67.3.3
Tensile strength	Yes	Yes			Section 68
Flexural strength	Yes	Yes			Section 69
Izod or tensile impact strength	Yes	Yes			Section 70 or 73
Impact	Yes	Yes			Section 74
Volume resistivity	Yes	Yes	Yes	Yes	9.1.2; Section 75

[a] Where exposed to the effects of weathering.

9.1.3 In addition to evaluating the material from the standpoint of possible ignition by sources within the room air conditioner, nonmetallic outer enclosures are also to be evaluated with regard to the effects of ignition by external sources. This generally involves intermittent flame tests and burning brand tests in accordance with Standard Tests for Fire Resistance of Roof Covering Materials, UL 790.

Exception No. 1: Intermittent flame tests may be waived if the enclosure material has a flame-spread index of 200 or less as determined by the Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source, ASTM E162-90 (Current Method).

Exception No. 2: Intermittent flame tests and burning brand tests may be waived if the enclosure material has a 5V flammability rating.

Exception No. 3: The intermittent flame and burning brand tests need not be conducted on RV type roof top air conditioners.

9.1.3 revised October 28, 1998

9.2 Material classification

9.2.1 Materials are classified with respect to flammability characteristics and are identified as 5V, V-0, V-1, V-2, HF-1, HF-2, HB, and HBF materials. Flammability characteristics are established by the tests specified in Sections 61 – 64.

9.2.1 revised October 28, 1998

9.3 Ignition sources

9.3.1 As used in 9.4.1 – 9.4.14, possible ignition sources within the unit are considered to be wiring and any electrical component, such as a switch, relay, transformer, motor winding, and the like, not enclosed in metal or in 5V material.

Exception: Wiring need not be isolated as indicated in 9.4.1 – 9.4.14 if it complies with the VW-1 flame test of the vertical flame test described in the reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581.

9.3.1 revised October 28, 1998

9.4 Material application

9.4.1 Polymeric parts which are depended upon for the support or isolation of electrical components and parts which are exposed to ignition sources within the unit shall be a 5V material.

9.4.1 revised October 28, 1998

9.4.2 Except as indicated in 9.4.7 – 9.4.9, a polymeric material which does not comply with the flammability requirements for 5V materials shall be V-0, V-1, or V-2. Such materials shall not be used for support or isolation of wiring or electrical components.

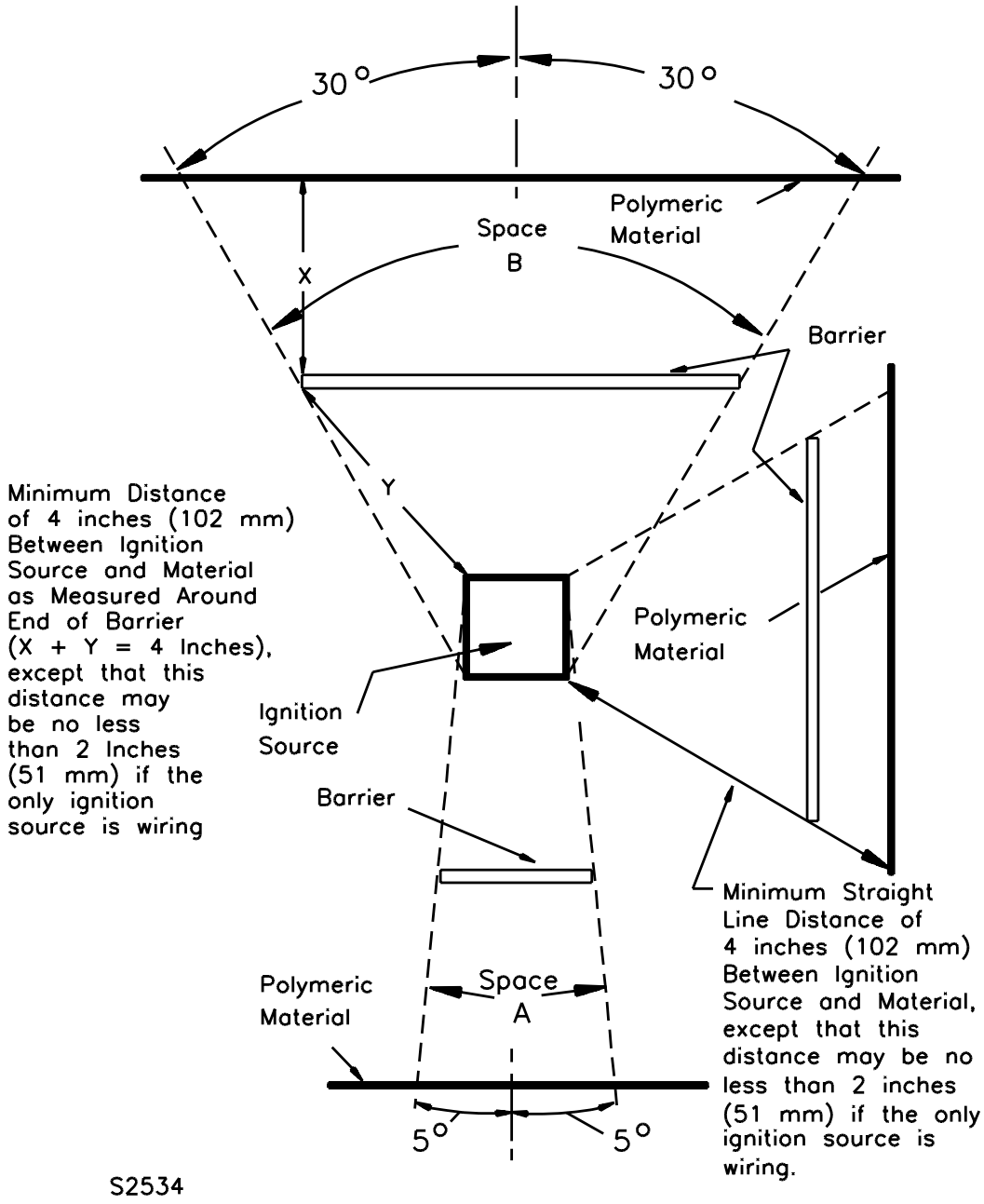
9.4.2 revised October 28, 1998

9.4.3 A V-0 or V-1 material may be used if it is not exposed to ignition sources. See 9.4.4 and 9.4.5. A V-2 material may be used if, in addition to being isolated from ignition sources in the same manner as V-0 and V-1 materials, there are no flammable materials, openings in the unit enclosure, or both, below the V-2 material within a volume defined by Space A of Figure 9.1.

9.4.3 revised October 28, 1998

Figure 9.1
Exposure to ignition

Figure 9.1 revised October 28, 1998



Space A – Represents the volume below the ignition source determined by a straight line that moves about the ignition source while remaining at an angle of 5° from the vertical and is always so oriented that the volume is maximum.

Space B – Represents the volume above the ignition source determined in the same manner as Space A, except that the angle is 30° from the vertical.

9.4.4 A material located below the ignition source and within Space A of Figure 9.1 may be isolated by means of a horizontal barrier, extending at least to the boundary surface of the space. A material located above the ignition source and within Space B of Figure 9.1 may be isolated by means of a barrier, extending at least to the boundary surface of the space, and so located that the minimum distance between the material and ignition source is 2 inches (50.8 mm) for wiring and 4 inches (102 mm) for electrical components.

9.4.5 A material located essentially in the vertical plane and adjacent to an ignition source is considered isolated from the ignition source if it is separated from wiring by a distance of 2 inches (50.8 mm) and from electrical components by a distance of 4 inches (102 mm). A barrier may be used for isolation provided the size of the barrier is such that the minimum straight-line distance between the material and ignition source is 2 inches (50.8 mm) for wiring and 4 (102 mm) inches for electrical components. See Figure 9.1.

9.4.6 If required by 9.4.4 or 9.4.5, a barrier shall be formed of metal or of a 5V material and shall be mechanically secured in place.

9.4.6 revised October 28, 1998

9.4.7 The requirements of 9.4.2 – 9.4.5 do not apply to polymeric materials completely enclosed in metal at least 0.010 inch (0.254 mm) thick nor to materials classified as V-0, V-1, V-2, HF-1, HF-2, HB, or HBF which are laminated between two metal surfaces if:

a) The thickness of the metal of each surface is not less than 0.010 inch (0.254 mm); and

b) The exposed vertical surface of the material has a width of no more than 3/8 inch (9.5 mm).

9.4.7 revised October 28, 1998

9.4.8 In the outdoor section of the unit, HB, HBF, and HF-1 materials may be used if:

a) They are isolated from ignition sources in accordance with 9.4.4 and 9.4.5, whichever is applicable, and

b) The distance between an ignition source and ventilation opening in the bulkhead is not less than 4 inches (102 mm).

When this requirement is applied to vent doors and vent door seals comprised of HB, HBF, or HF-1 materials, isolation from the ignition sources to the material is to be maintained for all normal positions of the vent door.

9.4.8 revised October 28, 1998

9.4.9 Except as indicated in 9.4.10, HB, HBF, and HF-1 materials may be used in the room air handling section of the unit only if all ignition sources in this section are completely enclosed in or isolated by metal or 5V material. The supply cord of a cord-connected unit and a heater element are excluded. If ventilation openings are provided in the bulkhead, HB and HBF materials in the room air handling section are to be additionally isolated from ignition sources in the outdoor section by a minimum distance of 4 inches (102 mm).

9.4.9 revised October 28, 1998

9.4.10 If HB and HBF materials are used in the room air handling section of the unit, leads to an electric air heater including leads to its thermal protective device, and the thermal protective device need not be enclosed provided that:

a) Individual lead lengths do not exceed 4 inches (102 mm) and

b) A metal or 5V material is interposed between the lead or thermal protective device and HB and HBF material to provide isolation.

A metal heat transfer surface may afford such isolation if it provides a minimum distance of 4 inches (102 mm), as measured through the heat transfer surface, between the heater lead or thermal protective device and HB and HBF material. Leads for other components need not be enclosed provided they are isolated as indicated above and the individual lengths of such leads do not exceed 1 inch (25.4 mm).

9.4.10 revised October 28, 1998

9.4.11 With reference to 9.4.10, if an automatic-reset thermal protective device has met the endurance test requirement of 100,000 cycles (see 50.1.2), the device need not be enclosed or isolated.

9.4.12 In the applications described in 9.4.8 – 9.4.10, HF-2 material may be used if there are no flammable materials, openings in the unit enclosure, or both, below the HF-2 material within a volume defined by Space A of Figure 9.1.

9.4.12 revised October 28, 1998

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9.4.13 With reference to 9.4.9 and 9.4.10, the acceptability of openings in a control compartment, other than those of minimum size for the passage of power supply cords and control shafts or rods, shall be judged on the basis of the necessity for their existence. On any one surface, the minor dimension of an opening shall not exceed 3/8 inch (9.5 mm) and the maximum area shall not exceed 0.25 square inch (161 mm^2). The area may be increased to a maximum of 1.0 square inch (645 mm^2) if a barrier of metal or 5V material is secured in place and interposed between ignition sources and flammable material. In any case, the maximum aggregate area of all openings in any one surface shall not exceed 1.0 square inch.

9.4.13 revised October 28, 1998

9.4.14 With reference to 9.4.13, wiring in the control compartment shall be routed away from any openings which expose the wire to flammable materials. In judging the need for barriers, consideration is to be given to grouped openings which have an aggregate area exceeding 0.25 square inch (161 mm^2).

10 Mounting Hardware

10.1 Each window-type room air conditioner shall be provided with mounting hardware to support the unit in the window. The mounting hardware shall be painted or otherwise protected against corrosion.

10.2 The mounting hardware and installation instructions for a window-type unit shall be shipped with the room air conditioner from the factory.

Exception: The mounting hardware and installation instructions may be shipped in a kit separate from the room air conditioner provided the kit is identified in accordance with 79.18 and 79.19.

11 Field Supply Connections

11.1 Permanently-connected units

11.1.1 Room air conditioners of the following types shall have provision for permanent connection to the power supply:

a) Units that have a rated-load current exceeding 40 amperes. The largest sum of concurrent loads shown on the nameplate is used to determine the rating;

b) Units requiring plumbing connections;

Exception No. 1: Units designed to be easily moved from one place to another in use.

Exception No. 2: Units that:

1) Require removal of the cooling chassis from the cabinet for servicing,

2) Require disconnection of the branch circuit wiring connections for removal of the cooling chassis, and

3) Permit removal of the cooling chassis without disassembly of plumbing.

c) Polyphase units;

d) Units rated in excess of 250 volts;

e) Units intended for duct or plenum connection;

Exception: Units that:

1) Require removal of the cooling chassis from the cabinet for servicing,

2) Require disconnection of the branch circuit wiring connections for removal of the cooling chassis, and

3) Permit removal of the cooling chassis without disassembly of ducts.

f) Units requiring line voltage field-wired controls;

g) Units provided with means for interconnection of the condensing and evaporating sections in the field; and

h) Units requiring 120/208 or 120/240 volts, 3-wire supply circuits.

11.1.2 A room air conditioner that is intended for permanent connection to the power supply shall have provision for connection of one of the wiring systems that, in accordance with the National Electrical Code, ANSI/NFPA 70–1990, would be acceptable for it.

11.1.3 A knockout for connection of a field-wiring system to a field-wiring compartment shall accommodate conduit of the trade size determined by applying Table 11.1.

Table 11.1
Trade size of conduit in inches

Wire size		Number of wires				
AWG	(mm^2)	2	3	4	5	6
14	(2.1)	1/2	1/2	1/2	1/2	1/2
12	(3.3)	1/2	1/2	1/2	3/4	3/4
10	(5.3)	1/2	1/2	1/2	3/4	3/4
8	(8.4)	3/4	3/4	1	1	1-1/4
6	(13.3)	3/4	1	1	1-1/4	1-1/4
4	(21.2)	1	1	1-1/4	1-1/4	1-1/2
3	(26.7)	1	1-1/4	1-1/4	1-1/2	1-1/2
2	(33.6)	1	1-1/4	1-1/4	1-1/2	2
1	(42.4)	1-1/4	1-1/4	1-1/2	2	2
1/0	(53.5)	1-1/4	1-1/2	2	2	2-1/2

NOTES

1 This table is based on the assumption that all conductors will be of the same size and there will be no more than six conductors in the conduit. If more than six conductors will be involved or if all of them are not of the same size, the internal cross-sectional area of the smallest conduit that may be used is determined by multiplying by 2.5 the total cross-sectional area of the wires, based on the cross-sectional area of Type THW wire.

2 1 inch equals 25.4 mm.

11.1.4 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 unit 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.

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

11.1.6 Space shall be provided in the field-wiring compartment or outlet box for installation of the number and size of conductors required by 11.1.8 using Type TW or THW wire, when at least a 6 inch (150 mm) length of each conductor is brought into the wiring compartment. If necessary, a trial installation is to be made.

Exception: Conductors other than Type TW or THW may be used if specified in the installation instructions.

11.1.7 As used in 11.1.8 – 11.1.21, 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 room air conditioner is installed.

11.1.8 A room air conditioner shall be provided with field-wiring terminals or leads for the connection of conductors having an ampacity of not less than that indicated in 80.6. It is assumed that branch circuit conductors rated 140°F (60°C) will be used when the required circuit ampacity is 100 amperes or less and that conductors rated 167°F (75°C) will be used when the required ampacity is more than 100 amperes.

11.1.9 If field-installed power supply conductors are to be connected to the terminals or integral leads of a wiring device which has a marked electrical rating, such as a general-use receptacle, the wiring device shall have a marked rating not less than the circuit to which it will be connected.

11.1.10 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 to less than those required by Sections 24 and 25. This may be accomplished by means such as two screws or rivets; by square shoulders or mortices; by a dowel pin, lug, or offset; or by a connecting strap or clip fitted into an adjacent part.

11.1.11 For No. 8 AWG (8.4 mm^2) and larger conductors, pressure wire connectors shall be used. For No. 10 AWG (5.3 mm^2) and smaller conductors, the parts to which wiring connections are made may consist of clamps or wire binding screws with cupped washers, terminal plates, or the equivalent, to hold the wire in position.

11.1.12 A wire binding screw at a field-wiring terminal shall be not smaller than No.8 (4.2 mm diameter).

Exception: A No. 6 (3.5 mm diameter) screw may be used for the connection of one No. 14, 16, or 18 AWG (2.1, 1.3, or 0.82 mm^2) conductor.

11.1.13 It should be noted that according to the National Electrical Code, ANSI/NFPA 70-1990, No. 14 AWG (2.1 mm^2) is the smallest conductor which the installer may use for branch circuit wiring and thus is the smallest conductor that may be anticipated at a terminal for the connection of a power supply wire.

11.1.14 A terminal plate for a wire binding screw shall be metal not less than 0.030 inch (0.76 mm) thick for No. 14 AWG (2.1 mm^2) or smaller wire and not less than 0.050 inch (1.27 mm) thick for a wire larger than No. 14 AWG. In either case, there shall be not less than two full threads in the metal.

11.1.15 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 when tightened in accordance with the torques indicated in the Standard for Wire Connectors and Soldering Lugs for Use With Copper Conductors, UL 486A.

11.1.16 Upturned lugs or a cupped washer shall be capable of retaining a conductor of the size mentioned in 11.1.8, but no smaller than No. 14 AWG (2.1 mm^2), under the head of the screw or the washer.

11.1.17 A wire binding screw shall thread into metal.

11.1.18 A field-wiring terminal intended for the connection of a grounded conductor shall be of a metal, or plated with a metal, which 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 conductor shall be finished to show a white or natural gray color, shall be readily distinguishable from other leads, and no other lead shall be so identified.

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

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

11.1.20 Leads intended for connection to an external circuit shall be provided with strain relief if stress on the lead may be transmitted to terminals, splices, or internal wiring. Acceptability of the strain relief shall be determined in accordance with 7.6.

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

11.2 Cord-connected units

11.2.1 A room air conditioner intended for cord connection to the power supply shall be equipped with a flexible cord having an equipment grounding conductor and with a grounding-type attachment plug.

11.2.1.1 A cord-connected single phase room air conditioner shall be provided with a factory installed LCDI or AFCI protection to reduce the risk of fire due to arcing faults in the power-supply cord. The LCDI or AFCI shall be installed as an integral part of the attachment plug or located in the supply cord within 300 mm (12 in.) of the attachment plug.

Added 11.2.1.1 effective August 1, 2004

11.2.1.2 Compliance with 11.2.1.1 shall be accomplished by the use of an integral protective device that de-energizes all current-carrying parts when arcing faults are detected within the power supply cord. The AFCI and LCDI shall comply with the Standard for Arc-Fault Circuit-Interrupters, UL 1699.

Added 11.2.1.2 effective August 1, 2004

11.2.2 The rating of the attachment plug shall not be less than 125 percent of the marked rating of the room air conditioner and not less than the total current measured during the Temperature and Pressure Test, Section 38, and the Temperature Test – Resistance Heat, Section 44. The total current shall include the current drawn by accessories intended for use with the room air conditioner.

11.2.3 A cord-connected room air conditioner shall employ grounding-type attachment plugs which conform to American National Standards designated in the following table:

Attachment Plug Rating		
Amperes	**Volts**	**ANSI Designation**
15	125	NEMA WD6–1988
20	125	NEMA WD6–1988
15	250	NEMA WD6–1988
20	250	NEMA WD6–1988
30	250	NEMA WD6–1988
50	250	NEMA WD6–1988

11.2.4 A cord-connected room air conditioner shall employ a Type S, SE, SEO, SEOO, SEW, SEOW, SEOOW, SO, SOO, SOW, SOOW, ST, STO, STOO, STW, STOW, STOOW, SJ, SJE, SJEO, SJEOO, SJEW, SJEOW, SJEOOW, SJO, SJOO, SJOW, SJOOW, SJT, SJTO, SJTOO, SJTW, SJTOW, SJTOOW, SP-3, SPE-3, or SPT-3 power supply cord having a voltage rating not less than that of the room air conditioner. The ampacity of the cord, as given in the National Electrical Code, ANSI/NFPA 70, shall be not less than that required by the ampere input measured in the Temperature and Pressure Test, 38, and the Temperature Test – Resistance Heat, 44. The ampere input value shall include the current drawn by accessories intended for use with the room air conditioner.

Exception: A power supply cord, other than the Types identified in 11.2.4, may be employed if it has comparable mechanical and electrical properties and the same voltage and ampacity as the cord Type it is replacing.

11.2.4 revised September 3, 2002

11.2.5 The length of a power supply cord shall be as follows:

Unit Rating		Cord length			
		Minimum		Maximum	
Volts	Amperes	feet	(m)	feet	(m)
0 – 125	7.5 or Less	6	(1.8)	10	(3)
0 – 125	7.6 or More	4	(1.2)	10	(3)
126 – 250	All	4	(1.2)	6	(1.8)

The length is to be measured between any point at which the cord exits the room air conditioner cabinet and the attachment plug.

Exception: For a room air conditioner intended only for in-wall installation, the length of the power supply cord shall be not less than 18 inches (457 mm).

11.2.6 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. If the strain relief is metallic, it shall not contact uninsulated live parts or reduce spacings within the enclosure if the cord is moved inward.

11.2.7 To determine the adequacy of the strain relief, a 35 pound (15.9 kg) weight is to be suspended on the cord and supported by the room air conditioner so that the strain relief means will be stressed from any angle which the design of the room air conditioner permits. The load is to be applied for 1 minute. The strain relief is not acceptable if there is such movement of the cord as to indicate that stress would have resulted on the cord connections.

11.2.8 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 which 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.

11.3 Grounding

11.3.1 A room air conditioner shall have provision for grounding as follows:

a) In a permanently connected room air conditioner, an equipment grounding terminal or lead; or

b) In a cord-connected room air conditioner, an equipment grounding conductor in the power supply cord.

11.3.2 On a permanently-connected room air conditioner, a terminal solely for connection of an equipment grounding conductor shall be capable of securing a conductor of the size required by the National Electrical Code, ANSI/NFPA 70.

11.3.2 revised September 3, 2002

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

11.3.3 revised November 12, 1993

11.3.4 On a permanently-connected room air conditioner, a wire binding screw intended for the connection of an equipment grounding conductor shall have a green-colored head that is hexagonal, slotted, or both. Except as indicated in 11.3.5, a pressure wire connector intended for connection of such a conductor shall be plainly identified such as by being marked G, GR, GROUND, or GROUNDING, or by a marking on a wiring diagram provided on the room air conditioner. The wire binding screw or pressure wire connector shall be secured to the frame or enclosure of the room air conditioner and shall be located so that it is unlikely to be removed during service operations, such as replacing fuses, resetting manual-reset devices, or oiling motors.

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

11.3.6 On a permanently-connected room air conditioner, 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.

11.3.7 On a cord-connected room air conditioner, the grounding conductor of the power supply cord shall be finished with a continuous green color or with a continuous green color with one or more yellow stripes, and no other conductor shall be so identified. The grounding conductor shall be secured to the frame or enclosure of the room air conditioner by a positive means, such as clamping, bolting, or screw connection, that is not likely to be removed during any servicing operation not involving the power supply cord. The grounding conductor shall be connected to the grounding blade of the attachment plug.

12 Internal Wiring

12.1 General

12.1.1 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 Sections 38, 43, and 44.

Exception: If it can be determined that the wiring will not be exposed to heat from radiating sources or heated components, and if the ampacity of the conductors is in accordance with Table 12.1 and 12.2, the temperature tests on the wiring may be waived.

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12.1.2 With reference to the exception in 12.1.1, high-voltage circuit conductors supplying one motor shall have an ampacity not less than 125 percent of the motor full load current rating. Conductors supplying more than one motor shall have an ampacity not less than 125 percent of the full load current rating of the largest motor plus the full load current rating of any other motors supplied. Conductors supplying a motor load and other loads shall have any ampacity not less than 125 percent of the motor full load current rating plus the marked current ratings or measured inputs of the additional loads supplied.

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

12.1.4 Wire insulation shall be rated for the potential involved and for the temperature to which it may be subjected in use. The required temperature rating for wiring is based on the temperatures measured in the Temperature and Pressure Test, Section, 38; Temperature Test – Steam or Hot Water Heat, Section 43; and Temperature Test – Resistance Heat, Section 44.

12.2 High-voltage circuits

12.2.1 Internal wiring shall be of the type indicated in Table 12.1. The insulation of wires or cords connected to fan motors and other auxiliary motors shall be of an oil resistant type, such as Type SJO, SJT, SPT-3, or appliance wiring materials having oil resistant insulation.

Table 12.1
Typical wiring materials

Group	Type of wire cord, or cable[a]	Wire size		Insulation thickness	
		No. AWG	(mm^2)	Inch	(mm)
A	Thermoplastic appliance wiring material, with insulation thicknesses shown at the right corresponding to wire sizes indicated; or Type AC, ACL, ACT, RF-2, FF-2, FFH-2, TF, TFF, TFN, TFFN, SF-2, SFF-2, RH, RHH, RHW, THW, XHHW, MTW, THW-MTW, THWN, PF, PGF, PFF, PGFF, TW	10 and smaller	(5.3)	2/64	(0.8)
		8	(8.4)	3/64	(1.2)
		6	(13.3)	4/64	(1.6)
		4	(21.2)	4/64	(1.6)
		3	(26.7)	4/64	(1.6)
		2	(33.6)	4/64	(1.6)
B	Appliance wiring material[a] having thermoplastic, rubber, or neoprene insulation, with insulation thicknesses shown at right corresponding to the wire sizes indicated; or cord Types S, SE, SO, SOO, ST, STO, STOO, SJ, SJE, SJO, SJOO, SJT, SJTO, SJTOO, SP-3, SPE-3, SPT-3	18	(0.82)	4/64	(1.6)
		16	(1.3)	4/64	(1.6)
		14	(2.1)	5/64	(2.0)
		12	(3.3)	5/64	(2.0)
		10	(5.3)	5/64	(2.0)
		8	(8.4)	6/64	(2.4)
		6	(13.3)	8/64	(3.2)
		4	(21.2)	9/64	(3.6)
		2	(33.6)	10/64	(4.0)

[a] Appliance wiring material acceptable for refrigeration use.

12.2.2 Wiring of the type indicated in Group A of Table 12.1, shall be 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.

Exception: Neoprene or thermoplastic insulated wiring material in Group A of Table 12.1 need not be enclosed as indicated above, if all of the following conditions are met:

a) Wiring is not subject to movement by air or vibration. See 12.4.1;

b) Where practicable, individual leads are bunched together to form a cable;

c) Wiring is secured to fixed panels or other surfaces at intervals to assure proper routing and to reduce the likelihood of hooking of slack during routine service, such as replacing air filters, operating reset mechanisms, oiling motors, replacing fuses, adjusting the settings of controls, or the like;

d) Wiring is located in a compartment which is provided with a complete base pan or similar bottom closure;

e) Wiring cannot be contacted through openings in the outer enclosure or cabinet by the probe illustrated in Figure 6.2; and

f) Wiring is not located in a compartment where plumbing connections are made at the point of installation.

12.2.3 Cords or appliance wiring material of a type indicated in Group B of Table 12.1, may be employed if the wiring is enclosed by the cabinet to reduce the risk of damage to the wiring, ignition of flammable material, or emission of flame or molten metal through openings in the cabinet.

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

Table 12.2
Wiring materials ampacities

Wire size		
mm^2	**AWG**	**Ampacity**
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

NOTE – The ampacities shown apply to appliance wiring materials. For types of wires other than appliance wiring materials, the ampacity shall be determined from Table 310-16 and 310-17 in the National Electric Code, ANSI/NFPA 70-1990, for the type of wire employed. The correction factors of the referenced tables need not be applied.

12.3 Low-voltage circuits

12.3.1 If grounding, short-circuiting, or damaging of low-voltage wiring may cause malfunctioning of a pressure-limiting device, motor overload protective device or other protective device that may result in a risk of fire, electric shock, or injury to persons, such wiring shall be enclosed as indicated in 12.2.2 or shall be Type SPT-2 or SP-2 cord or one of the types indicated in Group B of Table 12.1. Wires of types indicated in Group A of Table 12.1 or low-energy safety control wire, may be used if such wiring is located in a cavity or compartment of the air conditioner and is shielded against damage.

12.4 Wiring method

12.4.1 All wires and cords shall be routed and supported to reduce the risk of damage due to:

a) Sharp edges,

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

c) Moving parts, and

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

Clamping means shall have smooth, rounded surfaces.

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

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

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

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

12.4.2 All wires and cords shall be routed and supported so that they will not be immersed in water unless the insulation is rated for this purpose. Wiring shall be arranged to prevent water caused by condensation or rain exposure from entering wiring enclosures and electrical enclosures.

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

12.4.4 Holes for passage of wires or cords through walls, panels, or barriers shall have smooth, rounded surfaces or shall be provided with smoothly rounded bushings. Bushings shall be fabricated from material such as ceramic, phenolic, cold-molded composition, or fiber.

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

12.4.6 Splices shall be located within the unit enclosure. They shall be secured to a fixed member or located in a separate enclosure if they are subject to flexing, motion, or vibration due to air movement, or are likely to be moved during service operations, such as replacing fuses, resetting manual-reset devices, or oiling motors.

12.4.7 A splice shall be provided with electrical insulation equivalent to that of the conductors if permanence of spacing between the splice and other metal parts cannot be maintained. Thermoplastic tape wrapped over the sharp ends of the wires is not acceptable.

12.4.8 Splicing devices such as pressure-type wire connectors may be employed if they comply with the Standard for Wire Connectors and Soldering Lugs for Use With Copper Conductors, UL 486A.

12.4.9 Quick-connecting assemblies shall form a secure electrical connection, such as by detents in the mating parts, and shall be capable of carrying the current involved. Securement of connections may be determined by engagement/disengagement tests as specified in the Standard for Electrical Quick-Connect Terminals, UL 310.

12.4.10 Wire binding screws shall thread into metal. At terminals, stranded conductors shall be secured by soldered or pressure-type terminal connectors or the conductors shall be soldered or otherwise assembled to prevent loose strands after assembly. Soldered connections shall be made mechanically secure before being soldered. Open-slot type connectors shall not be used unless they prevent disconnection resulting from loosening of the clamping means. The shanks of terminal connectors shall be protected by electrical insulation if the spacings may be reduced below the minimum acceptable values by loosening of the clamping means. The insulating material shall be secured in position. The thickness of the insulation on the shanks shall be not less than 0.028 inch (0.71 mm) except as permitted by 24.6.

12.5 Short circuit protection

12.5.1 Conductors of motor circuits having permanently-connected room air conditioners having two or more thermal- or overcurrent-protected motors wired for connection to one supply shall withstand the conditions of the Limited Short Circuit Test, Section 52.

Exception: Conductors which comply with one or more of the following are considered acceptable without test:

a) Conductors that have an ampacity of not less than one-third the ampacity of the branch circuit conductors as determined in 80.6;

b) Conductors that are No. 18 AWG (0.82 mm^2) or larger and not more than 4 feet (1.2 m) in length and provided that the circuit will be protected by a fuse or HACR Type circuit breaker rated not more than 60 amperes;

c) Conductors that serve as jumper leads between controls, provided that:

1) The length of each lead does not exceed 3 inches (76.2 mm), or

2) The conductors are located in an electrical control enclosure; or

d) A conductor connected in a circuit with a fixed impedance on each side of the conductor so that high fault current is not likely to occur in it (such as a lead from a motor running capacitor to the start winding of a permanent-split-capacitor motor).

13 Separation of Circuits

13.1 Unless provided with insulation rated for the highest voltage involved, insulated conductors of different circuits (internal wiring including wires in a wiring compartment) shall be separated by barriers or shall be segregated; and shall, in any case, be separated or segregated from uninsulated live parts connected to different circuits.

13.2 Segregation of insulated conductors may be accomplished by clamping, routing, or other means which assures permanent separation from insulated or uninsulated live parts of a different circuit.

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

13.4 Field-installed conductors of a high-voltage circuit or a low-voltage circuit with National Electrical Code, ANSI/NFPA 70-1990, Class 1 wiring shall be segregated or separated by barriers as follows:

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

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

13.5 Field-installed conductors of a low-voltage circuit with National Electrical Code, ANSI/NFPA 70-1990, Class 2 wiring shall be segregated or separated by barriers as follows:

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

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

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

14 Bonding for Grounding

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

14.2 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 following metal parts need not be grounded:

a) Adhesive-attached metal-foil markings, screws, handles, or the like, which 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, which are positively separated from wiring and uninsulated live parts;

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

d) Panels and covers which are insulated from electrical components and wiring by an insulating barrier of vulcanized fiber, varnished cloth, phenolic composition, or similar materials not less than 0.028 inch (0.71 mm) 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.

14.3 The metal enclosure of a room air conditioner having a slide-out chassis is considered to be acceptably grounded if the resistance between the point of connection of the equipment grounding means and enclosure does not exceed 0.1 ohm. Unless a separate grounding conductor is used, this will require penetration of nonconductive coatings between the enclosure and equipment grounding means when the chassis is inserted in the enclosure. In such cases, metal-to-metal contact shall be maintained at any point of insertion or withdrawal of the chassis.

14.4 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.

14.5 A separate component bonding conductor shall be made 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 painting or plating. A separate bonding conductor or strap shall:

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

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

14.6 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 14.9.

14.7 With reference to 14.6, 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.

14.8 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 power supply cord, may employ a quick-connect terminal of the dimensions specified below if the connector is not likely to be displaced and the component is limited to use on a circuit having a branch circuit protective device rated as indicated in Table 14.1.

14.9 A connection that depends upon the clamping action exerted by rubber or other nonmetallic material may be acceptable if it complies with the provisions of the Limited Short-Circuit Test, Section 52, and the Current Overload Test – Bonding Conductors and Connections, Section 53, under any normal degree of compression permitted by a variable clamping device and also following exposure to the effects of oil, grease, moisture, and thermal degradation, which may occur in service. A clamping device is to be considered with particular emphasis on the likelihood of the clamping device being reassembled in its intended fashion.

Table 14.1
Internal terminal connections for bonding

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

14.10 Except as permitted by 14.13 and 14.14, a bonding conductor or strap on a cord-connected room air conditioner shall have a cross-sectional area not less than that of the grounding conductor of the supply cord.

14.11 On a permanently-connected room air conditioner, the size of a conductor employed to bond an electrical enclosure or motor frame shall be based on the rating of the branch circuit overcurrent device to which the unit will be connected. Except as permitted by 14.13 and 14.14, the size of the conductor or strap shall be in accordance with Table 14.2.

14.12 A conductor, such as a clamp or strap, used in place of a separate wire conductor as indicated in 14.11, is acceptable provided the minimum cross-sectional conducting area is equivalent to the wire sizes indicated in Table 14.2.

14.13 With regard to 14.10 and 14.11, a smaller conductor may be used if the bonding conductor and connection comply with the provisions of the Limited Short-Circuit Test, Section 52, and the Current Overload Test – Bonding Conductors and Connections, Section 53.

14.14 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.

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

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

Table 14.2
Bonding wire conductor size

Rating of overcurrent device	Size of bonding conductor[a]			
	Copper wire		Aluminum wire	
Amperes	AWG	(mm^2)	AWG	(mm^2)
15	14	(2.1)	12	(3.3)
20	12	(3.3)	10	(5.3)
30	10	(5.3)	8	(8.4)
40	10	(5.3)	8	(8.4)
60	10	(5.3)	8	(8.4)
100	8	(8.4)	6	(13.3)
200	6	(13.3)	4	(21.2)

[a] Or equivalent cross-sectional area.

ELECTRICAL COMPONENTS

15 Capacitors

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

Exception: The individual container of a capacitor may be of sheet metal having a thickness less than that mentioned above or may be of material other than metal if the capacitor is mounted within the enclosure of the room air conditioner or within an enclosure which houses other parts of the room air conditioner.

15.2 If exposed to the effects of weathering, ferrous metal capacitor enclosures shall be protected against corrosion in accordance with 8.2.1. Also see 8.1.15.

15.3 If the container of an electrolytic capacitor is metal, the container shall be considered as a live part and shall be provided with moisture-resistant electrical insulation to isolate it from dead metal parts and to prevent contact during servicing operations. The insulating material shall be not less than 0.028 inch (0.71 mm) thick except as indicated in 24.6.

15.4 A capacitor employing a liquid dielectric medium more combustible than askarel shall be protected against expulsion of the dielectric medium when tested in accordance with the applicable performance requirements of this standard, including faulted overcurrent conditions based on the circuit in which it is used. See Limited Short-Circuit Test, Section 52.

Exception: If the available fault current is limited by other components in the circuit, such as a motor start winding, the capacitor may be tested using a fault current less than the value specified in Table 52.1 but not less than the current established by dividing the circuit voltage by the impedance of the other component(s).

16 Current-Carrying Parts

16.1 All current-carrying parts shall be made of silver, copper, a copper alloy, or other material acceptable for use as an electrical conductor.

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

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

16.3 Ferrous metal parts provided with a corrosion-resistant coating or stainless steel may be used for a current-carrying part:

a) If permitted in accordance with 2.1 or

b) Within a motor.

The use of ferrous materials not inherently protected or provided with a corrosion-resistant coating for current-carrying parts elsewhere in the room air conditioner is not acceptable.

17 Electric Air Heaters

17.1 Heater elements

17.1.1 The supporting means for an open-type heating element shall be such that sagging or loosening due to continuous heating of the element or flexing of the element supports and related wiring due to alternate heating and cooling of the element does not result in a reduction of required electrical spacings or contact with flammable materials.

17.1.2 Metal tubing forming a heater element sheath shall be constructed of corrosion-resistant material or shall be plated, dipped, or coated to resist external corrosion and shall be acceptable for the temperatures to which it is subjected. Also see 6.3 and 17.1.3.

17.1.3 Uncoated copper tubing may be employed for temperatures of 200°C (392°F) or less. Metallic-coated copper tubing is acceptable for temperatures below the melting temperature of the coating. Uncoated or oxide-coated steel tubing is not considered acceptable as a heater sheath. Plated steel tubing may be employed if the coating is determined to be corrosion resistant and will withstand the temperatures to which it may be subjected. Aluminum tubing may be employed if the alloy withstands a burnout test without melting or other failure. Stainless steel tubing of the austenitic grades, such as ASTM Type 304, is generally acceptable for heater sheaths.

17.1.4 Insulating materials, such as washers and bushings, which are integral parts of a heating element, shall be made of moisture-resistant materials which will not be damaged by the temperatures to which they will be subjected in the room air conditioner.

17.1.5 Insulating material employed in a heating element shall be acceptable as the sole support of live parts. Materials, such as magnesium oxide, may be used in conjunction with other insulating materials if located and protected so that mechanical damage is prevented and if not subject to absorption of moisture.

17.1.6 A sheath-type heater assembly shall be sealed to prevent entrance of moisture. See Insulation Resistance Test, Section 55. Molded seal caps, vulcanized to the heater leads and heater sheath, shall have a wall thickness equivalent to that required for the heater leads.

17.1.7 A rubber, neoprene, or thermoplastic heater terminal seal shall have aging properties acceptable for temperatures measured during heating tests. See Accelerated Aging Test – Electric Heaters, Section 56.

17.2 Heater overtemperature control

17.2.1 If malfunction could result in a risk of fire, electric heaters shall be provided with a temperature-limiting control or a replaceable thermal cutoff. See Abnormal Tests – Resistance Heat, Section 45. Thermal cutoffs shall comply with the Standard for Thermal Cutoffs for Use in Electrical Appliances and Components, UL 1020.

17.2.2 With reference to 17.2.1, a temperature-limiting control is defined as a control which is intended to prevent abnormal temperatures.

17.2.3 A thermal cutoff shall be secured in place and located so that it is accessible for replacement. Wiring connected to a thermal cutoff shall be secured so that replacement of the thermal cutoff will not result in displacement or disturbance of internal wiring other than leads to the cutoff itself or to a heating element assembly on which the cutoff is mounted.

17.3 Heater overcurrent protection

17.3.1 A unit that employs resistance-type heating elements rated at more than 48 amperes shall have the heating elements subdivided. Each subdivided load shall not exceed 48 amperes and shall be protected at no more than 60 amperes.

17.3.2 The overcurrent protective devices required by 17.3.1 shall:

a) Be provided as part of the unit,

b) Be provided for all ungrounded conductors, and

c) Have a voltage rating not less than the circuit in which they are used.

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

18 Fuseholders and Circuit Breakers

18.1 Fuseholders

18.1.1 A fuseholder shall be constructed, installed, or protected so that adjacent uninsulated high-voltage live parts, other than the screw shell of a plug fuseholder, cartridge fuse clips, or wiring terminals to the fuseholder, will not be exposed to contact by persons removing or replacing fuses. A separation of less than 4 inches (102 mm) from the insulating body of a fuse is considered to be adjacent. A barrier of vulcanized fiber or similar material employed as a guard for uninsulated high-voltage live parts shall be not less than 0.028 inch (0.71 mm) thick.

18.1.2 A plug fuseholder in a room air conditioner intended to be connected to a 120 volt or a 120/240 volt, 3-wire circuit shall be wired in the ungrounded conductor with the screw shell connected toward the load.

18.1.3 Plug fuseholders of the Edison-base type shall be used only if provided with an adapter designed for Type S fuses.

18.2 Circuit breakers

18.2.1 Circuit breakers used to protect circuits having more than one ungrounded conductor and no grounded neutral shall be of the multipole common trip type arranged to open all ungrounded conductors. The use of external handle ties does not in itself constitute a common trip mechanism.

19 Insulating Material

19.1 Material for the mounting of uninsulated live parts shall be of moisture resistant material, such as porcelain, phenolic, cold-molded composition, or other materials which comply with the applicable requirements pertaining to materials used as direct support of live parts, as specified in the requirements for polymeric materials – use in electrical equipment evaluations, UL 746C.

19.2 Vulcanized fiber may be used for insulating bushings, washers, separators, and barriers, but not as the sole support for uninsulated live part where shrinkage, current leakage, or warpage may introduce a risk of fire or electric shock.

20 Motors and Motor Overload Protection

20.1 All motors shall be protected against overload by thermal or overcurrent protective devices.

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

Paragraph 20.1 revised October 28, 1998

20.2 For a motor other than a hermetic refrigerant motor-compressor, overload protection is obtained if the protection is provided by a separate overcurrent device that is responsive to motor current and is rated or set to trip at no more than the percentage of the motor nameplate full-load current rating shown in column A of the following table. For an overload relay, if the percentage protection indicated in column A does not correspond to the percentage value resulting from selection of a standard size relay, the next higher size of overload relay may be used, but not higher than will provide the percentage protection indicated in column B.

	Maximum Percentage Protection	
	A	B
Motor with a marked service factor no less than 1.15	125	140
Motor with a marked temperature rise no more than 40°C	125	140
Any other motor	115	130

20.3 A hermetic refrigerant motor-compressor complies with the requirement of 20.1 if the protection conforms with (a), (b), (c), or (d) below:

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

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

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

2) Will not permit a continuous current in excess of 156 percent of the rated-load current of the motor compressor (or 156 percent of the branch-circuit selection current, if this value is marked on the unit nameplate).

See Maximum Continuous Current Test – Motor-Compressor Protection Devices, Section 51.

Exception: The limitation in (b) (2) does not apply to units as described in 20.5.

c) A fuse or circuit breaker responding to motor current and rated at no more than 125 percent of the rated-load current of the motor-compressor. The unit shall be capable of starting and operating as intended with the fuse or circuit breaker provided.

d) A protective system that:

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

2) Will not permit a continuous current in excess of 156 percent of the rated-load current of the motor-compressor (or 156 percent of the branch-circuit selection current if this value is marked on the unit nameplate).

See Section 51. All components of the protective system shall be provided as part of the unit.

Exception: The limitation in d (2), does not apply to units as described in 20.5.

20.4 For a permanently-connected room air conditioner, the rated-load current of the motor-compressor is the value marked on the unit nameplate. For a cord-connected room air conditioner, the rated-load current of the motor-compressor is the current drawn by the motor-compressor during the Temperature and Pressure Test, Section 38.

Exception: If a permanently-connected unit is marked with a single ampere rating, the rated-load current of the motor-compressor is determined in the same manner as for cord-connected units.

20.5 A room air conditioner employing a motor-compressor equipped with a thermal protective device is not required to meet the 156 percent limitation specified in b (2), or d (2) of 20.3 if:

a) The unit is intended for connection to a 15 or 20 ampere, 120 volt; or a 15 ampere, 208 or 240 volt, single-phase branch circuit; or

b) The unit is:

1) Cord-and-attachment plug-connected;

2) Intended for connection to a 30 ampere or larger, 120 volt or a 20 ampere or larger, 208 or 240 volt, single-phase branch circuit; and

3) Employs a compressor motor controller(s) having a full-load current rating not less than 80 percent of the attachment plug rating.

20.6 Thermal protective devices used with nonhermetic motors shall comply with the Standard for Overheating Protection for Motors, UL 2111.

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

Paragraph 20.6 revised October 28, 1998

20.7 3-phase motors shall be provided with overload protection as follows:

a) Three overcurrent units, other than fuses, rated in accordance with 20.2 or 20.3 (a) or (c); or

b) Thermal protectors, combinations of thermal protectors and overcurrent units, or other methods of protection may be employed where the specific protective arrangement has been investigated and found to provide protection under primary single-phase failure conditions when supplied from transformers connected wye-delta or delta-wye. Assemblies so investigated shall be marked as described in 80.13.

20.8 Fuses shall not be used as motor overload protective devices unless the motor is protected, in accordance with 20.2 or 20.3 (c), by the largest size fuse which can be inserted in the fuseholder.

20.9 Overcurrent protective devices and thermal protective devices for motors shall comply with applicable short-circuit requirements for the class of protective device and shall, in addition, comply with the requirements of the Limited Short-Circuit Test, Section 51.

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

20.11 Motors having openings in the enclosure or frame shall be arranged to prevent particles from falling out of the motor onto flammable material within or under the assembly.

20.12 The requirement in 20.11 will necessitate the use of a barrier of nonflammable material under an open-type motor unless:

a) The structural parts of the motor or of the room air conditioner, such as the bottom closure, provide the equivalent of such a barrier; or

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

1) Open main winding;

2) Open starting winding;

3) Starting switch short-circuited; and

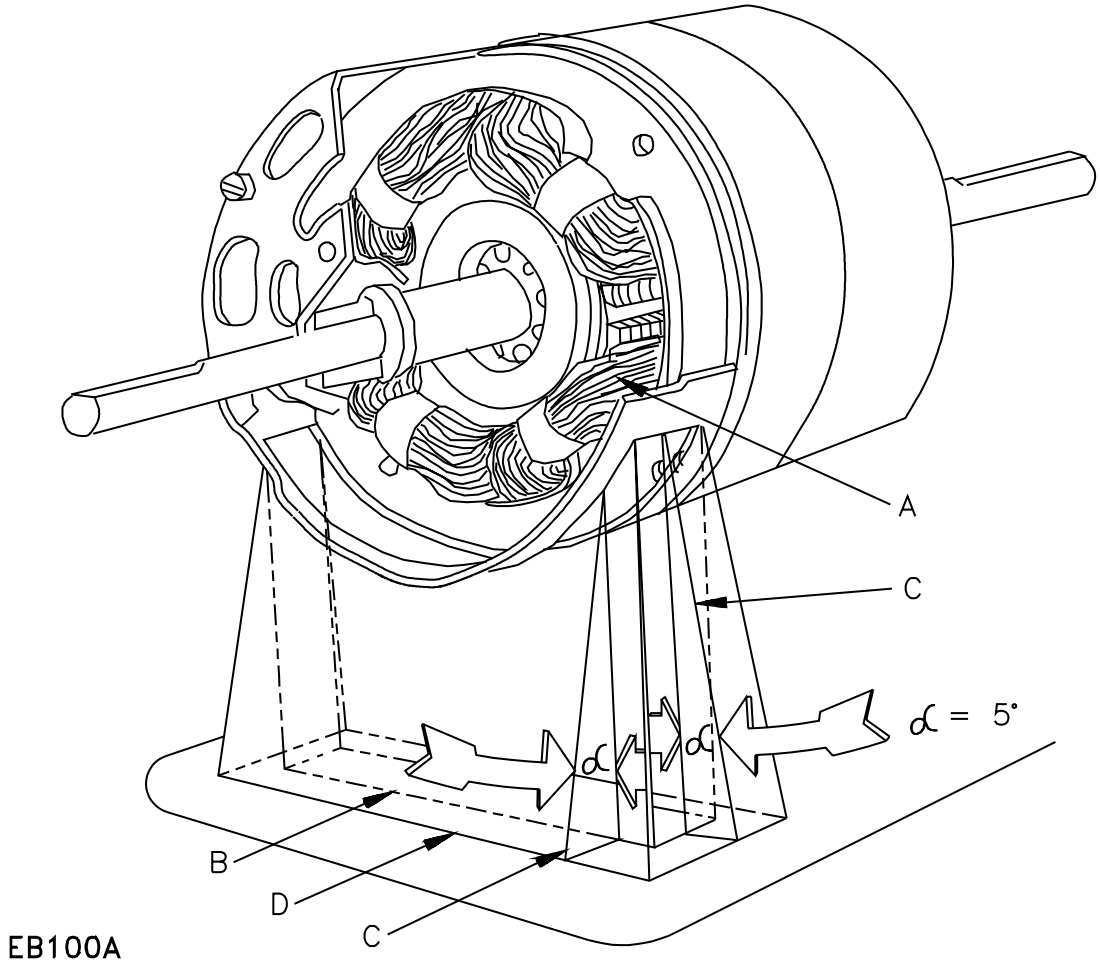
4) Capacitor shorted, (permanent-split capacitor type); or

c) The motor is provided with a thermal protector (a protective device that is sensitive to temperature and current) that will prevent the temperature of the motor windings from becoming more than 257°F (125°C) under the maximum load under which the motor will run without causing the protector to cycle, and from becoming more than 302°F (150°C) with the rotor of the motor locked.

20.13 The barrier mentioned in 20.12 shall be horizontal, shall be located as indicated in Figure 20.1, and shall have an area not less than that described in that illustration. Openings for drainage, ventilation, or the like, may be employed in the barrier provided that such openings will not permit molten metal, burning insulation, or the like, to fall on flammable material.

Figure 20.1
Location and extent of barrier

Figure 20.1 revised October 28, 1998



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

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

C – Inclined line which traces out minimum area of the barrier. When moving, the line is to be always:

a) Tangent to the motor winding,

b) Five degrees from the vertical, and

c) So oriented that the area traced out on a horizontal plane is maximum.

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

21 Switches and Controllers

21.1 Each motor shall be provided with a controller. A motor controller is defined as any switch or device normally used to start and stop a motor.

Exception: Motors rated 1/8 horsepower (hp) (93 W output) or less that are normally left running need not be provided with a controller.

21.2 A cord-connected room air conditioner shall be provided with a manually-operable controller that de-energizes:

a) All loads or

b) Any motor load exceeding the values shown in Table 21.1.

Such controllers shall have a marked off position (the use of the international symbol "O" may be used) and, when the controller does not de-energize all loads, the room air conditioner shall be marked to indicate which loads are controlled. Other than as noted in 21.4, the controller shall be accessible without the use of tools.

Exception No. 1: The attachment plug and receptacle may serve as the controller if the marked ampere rating of the unit or the motor does not exceed the values shown in Table 21.1 for the voltage indicated.

Exception No. 2: Room air conditioners employing solid state controllers that de-energize all loads except LEDs, timers, memory circuits, and the like need not be marked to indicate which loads are controlled.

21.2 revised September 3, 2002

Table 21.1
Ampere rating of the unit or motor

Amperes	Rated voltage
7.2	115
4.0	208
3.6	230

21.3 On a cord-connected room air conditioner, a manually-operated switch with a marked off position (the use of the international symbol "O" may be used) that controls a hermetic refrigerant motor-compressor with or without other loads shall have a current rating that is at least 115 percent of the sum of:

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

b) The rated current for other controlled loads. See 20.4.

21.3 revised September 3, 2002

21.4 On a cord-connected institutional-type room air conditioner where restricted access to controls is necessary, the controller required by 21.2 may be located behind a lockable access door or panel. The unit shall be constructed so that normal installation will result in the supply cord and attachment plug of the unit and the branch circuit receptacle supplying the unit being located within the confines of the unit in such a manner that access is limited by a tool or key.

21.5 A controller is not required for any supply circuit of a permanently-connected room air conditioner where the circuit supplies:

a) Two or more motors or

b) A motor(s) and other load(s) if, in either case, the marked maximum size of the supply circuit protective device for that circuit does not exceed 20 amperes at 125 volts or less or 15 amperes at 126 – 600 volts, and if the rating of any motor in the circuit does not exceed 1 horsepower (746W output) and does not exceed 6 full-load amperes.

21.6 A switch or other control device shall be rated for the load which it controls as determined by the Temperature and Pressure Test, Section 38, and the Temperature Test – Resistance Heat, Section 44.

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

21.8 On a permanently connected room air conditioner, a manually-operated switch with a marked off position (the use of the international symbol “O” may be used) that controls a hermetic refrigerant motor-compressor with or without other loads shall have a current rating that is at least 115 percent of the sum of:

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

b) The rated current for other controlled loads, as shown on the air conditioner nameplate. See 20.4.

21.8 revised September 3, 2002

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

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

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

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

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

21.12 With reference to 21.10 and 21.11, the locked-rotor load of a hermetic motor-compressor is determined from the locked-rotor current rating of the motor-compressor at the test voltage specified in Table 33.1 for ″All Other Tests.″ If the motor-compressor rated voltage is less than the test voltage, the motor-compressor rated locked-rotor current is to be increased by the ratio of the normal test voltage to the rated voltage in determining compliance with 21.10 and 21.11.

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

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

21.14 If a control device, such as a switch, thermostat, combination thermostat and control switch, or remote control assembly, interrupts the main power supply circuit to a heater in a permanently-connected unit and if the control device has a marked ON (the use of the international symbol “|” may be used) or OFF position, or is marked with another wording or symbol, such as NO HEAT, COLD, O, or similar marking, that conveys the same meaning as the word OFF, it shall disconnect the element or elements it controls from all ungrounded conductors of the power supply circuit when placed in that position. This requirement applies to a thermostat in a remote control assembly but does not apply to a remote control device in a low-voltage circuit, such as a room thermostat.

21.14 revised September 3, 2002

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

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

21.16 Room air conditioner controls shall be arranged so that the heating element is not energized when the unit is operating during a cooling cycle.

Exception: This requirement may be waived provided it can be shown by test that no risk of fire or electric shock exists if a heater is energized while the unit is operating on the cooling cycle. See 36.3.

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

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

21.18 effective March 10, 1994

22 Transformer Protection

22.1 High-voltage transformer

22.1.1 General

22.1.1.1 A transformer (including an autotransformer), other than one as described in 22.1.3.4 is considered to be a high-voltage transformer and shall:

a) Be provided with thermal overload protection in accordance with the requirements in 22.1.2.1,

b) Be protected by an overcurrent device in accordance with the requirements in 22.1.3.1, or

c) Comply with the Burnout Test – High-Voltage Transformers, Section 70.

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

22.1.2 Thermal protection

22.1.2.1 If a high-voltage transformer is provided with a thermal overload protective device, the device shall be arranged to interrupt primary current and shall limit temperatures of the transformer windings, under overload conditions, to that permitted for the class of insulation employed in the windings. See Overload Test – High-Voltage Transformers, Section 71.

Exception: If the thermal overload protective device provided is a nonrenewable thermal cutoff, a burnout test is to be conducted in place of the overload test. See Burnout Test – High-Voltage Transformers, Section 70.

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

22.1.3 Overcurrent protection

22.1.3.1 If a high-voltage transformer is protected by an overcurrent device, such protection shall comply with the requirements specified in 22.1.3.2, 22.1.3.3, and 22.2.1 – 22.2.3.

22.1.3.2 Except as noted in 22.1.3.3, a high-voltage transformer shall be protected by an overcurrent device(s) located in the primary circuit and rated or set as indicated in Table 22.1. See 22.2.1.

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

22.1.3.2 revised September 3, 2002

Table 22.1
Rating of overcurrent device

Rater primary current, Amperes		Maximum rating of overcurrent device, percent of transformer primary current rating
Transformer other than an autotransformer	**Autotransformer**	
Less than 2	–	300[a]
2 or more, less than 9	Less than 9	167
9 or more	9 or more	125

[a] May be increased to 500 percent if transformer supplies a motor control circuit.

22.1.3.3 If the circuit supplying a transformer other than an autotransformer is provided with overcurrent protection rated or set at not more than 250 percent of the rated primary current of the transformer, additional overcurrent protection is not required in the primary circuit provided the secondary circuit is protected at not more than 125 percent of the rated secondary current of the transformer. See 22.2.2.

Exception No. 1: If the rated secondary current of the transformer is 9 amperes or more and 125 percent of this current does not correspond to a standard rating of fuse or circuit breaker, the next higher standard rating of protective device may be used in the secondary circuit. Standard ratings of protective devices are specified in Section 240-6 of the National Electrical Code, ANSI/NFPA 70-1990.

Exception No. 2: If the rated secondary current of the transformer is less than 9 amperes, the overcurrent device(s) in the secondary circuit may be rated or set at not more than 167 percent of the rated secondary current.

22.1.3.4 A transformer that directly supplies a National Electrical Code, ANSI/NFPA 70-1990, Class 2 circuit (see 3.4) 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).

22.2 Overcurrent protective device

22.2.1 Overcurrent protection in the primary circuit of a transformer, as described in 22.1.3.2, need not be provided as part of the unit if, based on the marked rating or ratings of the unit, the rating of the branch circuit overcurrent protective device or devices does not exceed the values specified in 22.1.3.2.

22.2.2 Overcurrent protection in the secondary circuit of a transformer, as required by 22.1.3.3, shall be provided as part of the unit.

22.2.3 A required transformer overcurrent protective device(s) provided as part of the unit shall:

a) Be provided for all ungrounded conductors,

b) Be sized in accordance with requirements in 22.1.3.2 and 22.1.3.3, as applicable, and

c) Have a voltage rating not less than the circuit in which it is used.

The device(s) shall be a circuit breaker acceptable for branch circuit protection or a fuse acceptable for branch circuit protection, such as a Class CC, G, H, J, K, L, R, or T cartridge fuse or Type S plug fuse. See 79.20.

Exception: If a transformer supply is tapped from a circuit supplying other loads in the unit, a device used for overcurrent protection may be of the supplementary type provided it has a short-circuit rating acceptable for the circuit in which it is used. See Table 52.1. If the supplementary type device is a fuse, the unit shall be marked in accordance with the requirements in the exception to 79.20.

23 High-Voltage Control Circuit Conductor Overcurrent Protection

23.1 General

23.1.1 For the purpose of these requirements, a ″control circuit″ is one that carries electric signals directing the performance of a controller which, in turn, governs power delivered to a motor or other load in the unit. A control circuit does not carry main power current. If a control-circuit is supplied through a transformer provided as part of the unit, see Transformer Protection, Section 22, for additional requirements.

23.2 Direct-connected high-voltage control circuit

23.2.1 For the purpose of these requirements, a ″direct-connected high-voltage control circuit″ is one that is supplied from a branch circuit separate from a branch circuit that supplies other loads within the unit. It is not tapped from the load side of the overcurrent device or devices of any controlled circuit within the unit. See 80.20.

23.3 Tapped high-voltage control circuit

23.3.1 For the purpose of these requirements, a ″tapped high-voltage control circuit″ is one that is tapped within the unit from the load side of the overcurrent device or devices for the controlled load.

23.3.2 A tapped high-voltage control circuit conductor shall be provided with overcurrent protection. The rating of the overcurrent protective device or devices shall not exceed the applicable value specified in Table 23.1.

Exception No. 1: Nos. 18, 16, and 14 AWG (0.82, 1.3, and 2.1 mm^2) conductors that do not exceed 4 feet (1.2 m) in length between points of opposite polarity may be protected by fuses or ″HACR Type″ circuit breakers rated 60 amperes or less.

Exception No. 2: An overcurrent protective device of a higher rating may be used if the conductors withstand short-circuiting when tested as specified in the Limited Short-Circuit Test, Section 52.

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

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

a) This protection is in accordance with requirements specified in Transformer Protection, Section 22, and

b) The rating of the device does not exceed the applicable value specified in Table 23.1 multiplied by the ratio of secondary-to-primary rated transformer voltage.

Exception No. 5: A control circuit conductor that is tapped from the main power circuit at a point outside of the control equipment enclosure shall be protected as specified in Column A of Table 430-72(b) of the National Electrical Code, ANSI/NFPA 70-1990.

23.4 Overcurrent protective device

23.4.1 Overcurrent protection for a tapped high-voltage control circuit conductor, as required by 23.3.2 shall be provided as part of the unit.

Table 23.1
Overcurrent protective device rating for control circuit conductors

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

[a] Includes copper-clad aluminum.

[b] 400 percent of value specified for 60°C conductors in Table 310-17 of National Electrical Code, ANSI/NFPA 70–1990.

[c] 300 percent of value specified for 60°C conductors in Table 310-16 of National Electrical Code, ANSI/NFPA 70–1990.

Exception: The overcurrent device(s) need not be provided as part of the unit if, based on the marked rating(s) of the unit, the rating of the branch circuit overcurrent protective device(s) does not exceed the values specified in Table 23.1.

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

a) Be provided for all ungrounded conductors,

b) Be sized in accordance with requirements in 23.3.2, and

c) Have a voltage rating not less than the circuit in which it is used. The device(s) shall be a circuit breaker acceptable for branch circuit protection, or a fuse acceptable for branch circuit protection, such as a Class CC, G, H, J, K, L, R, or T cartridge fuse or Type S plug fuse. See 79.20.

Exception: If the control-circuit is tapped from a circuit supplying other loads in the unit, a device used for overcurrent protection may be of the supplementary type provided it has a short-circuit rating acceptable for the circuit in which it is used. See Table 52.1. If the supplementary type device used is a fuse, the unit shall be marked in accordance with the exception to 79.20.

ELECTRICAL SPACINGS

24 High-Voltage Circuits

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

24.1 revised May 2, 1996

24.2 Unless specifically noted otherwise, the spacings between uninsulated live parts of opposite polarity and between an uninsulated live part and a dead metal part shall be not less than the values indicated in Table 24.1.

Table 24.1
Electrical spacings in refrigerated and/or air-handling compartments

Table 24.1 revised May 2, 1996

Ratings		Minimum spacing					
		Through air[a]		Over surface[a]		To enclosure[c]	
Volt-Amperes	Volts	inches	(mm)	inches	(mm)	inches	(mm)
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 the above Table, Wiring terminals are those connected in the field and not factory wired.

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

24.3 The ″Through Air″ and ″Over Surface″ spacings given in Tables 24.1 and 24.2 at an individual component part are to be based on the total volt-amperes (VA) consumption of the load or loads which the component controls. For example, spacings at a component which controls only the compressor motor are based on VA of the compressor motor. Spacings at a component which simultaneously controls several concurrent loads are based on the sum of the VA of the loads so controlled. Spacings at a component which controls several nonconcurrent loads are based on the VA of the largest load. The VA values for the loads referred to above are to be determined by the marked rating of the loads, except that for loads which are not required to have a marked rating, the measured input is to be used in determining the volt-ampere values.

24.3 revised May 2, 1996

24.3.1 With reference to 24.2 and 24.3, the spacings To Enclosure are not to be applied to an individual enclosure of a component part within an outer enclosure or cabinet.

24.3.1 added May 2, 1996

24.3.2 The spacings indicated in Table 24.2 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 24.1 apply.

24.3.2 added May 2, 1996

Table 24.2
Spacings in non-refrigerated and/or non-air handling compartments

Table 24.2 added May 2, 1996

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

NOTE – See paragraph 24.3.2.

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

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

24.4 revised May 2, 1996

24.5 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 38, exceeds 500 volts, the developed potential is to be used in determining spacings for the parts affected.

24.6 An insulating liner or barrier of fiber or similar material, employed where spacings would otherwise be less than the required values, shall be no less than 0.028 inch (0.7 mm) thick and shall be so located or of such material that it will not be adversely affected by arcing.

Exception No. 1: Fiber no less than 0.013 inch (0.3 mm) thick may be used in conjunction with an air spacing of no less than 50 percent of the spacing required for air alone.

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

No Text on This Page

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

24.7 added May 2, 1996

24.8 The spacing between uninsulated live terminals of the component in an electric-discharge lamp circuit and a dead metal part or enclosure shall not be 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.

24.8 added May 2, 1996

25 Low-Voltage Circuits

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

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

25.3 The spacings for low-voltage electrical components that 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 a risk of fire, electric shock, or injury to persons, shall comply with the following:

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

25.4 The spacings in low-voltage circuits which do not contain devices of the type indicated in the previous paragraphs are not specified.

25.4 revised May 2, 1996

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.

26.1 revised February 5, 1998

27 Pump-Down Capacity

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

28 Refrigerant Tubing and Fittings

28.1 Copper or steel tubing used to connect refrigerant-containing components shall have a wall thickness not less than indicated in Table 28.1.

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

28.2 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.

28.3 Tubing forming part of components, such as evaporators or condensers, where protection is afforded by inherent construction shall be judged by the strength test requirements specified in Section 60.

Table 28.1
Minimum wall thickness for copper and steel tubing

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

[a] Within the appliance.

28.4 Special alloys or constructions used in refrigerant-containing components, including tubing with a wall thickness less than indicated in 28.1 may be acceptable. Among the factors taken into consideration when judging the acceptability are:

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 15-1989, as compared to tubing of the minimum wall thicknesses indicated in Table 28.1.

28.5 Tubing connections shall be made by means of flare-type fittings with steel or forged brass nuts, by soldering or brazing, or by equivalent means. Tube fittings shall conform to the Standard for Refrigeration Flare-Type Fittings, ANSI/SAE J513-Jun90.

29 Refrigerant-Containing Parts

29.1 Parts subjected to refrigerant pressure shall withstand, without failure, the pressure indicated in the Strength Tests – Pressure Containing Components, Section 60.

29.2 Parts subjected to refrigerant pressure shall be constructed of corrosion-resistant material, such as copper or stainless steel, or shall be protected against external corrosion by means such as plating or painting.

29.3 Pressure vessels over 6 inches (152 mm) inside diameter shall be designed, tested, and stamped in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, for a working pressure in compliance with the Performance section of this standard.

29.4 Pressure vessels bearing the ASME Code ″U″ symbol complying with 29.3 are considered acceptable without tests.

29.5 Pressure vessels bearing the ASME Code ″UM″ symbol shall be tested to determine compliance with the Strength Tests – Pressure Containing Components, Section 60. The manufacturer shall submit evidence of compliance of these vessels with the ASME Boiler and Pressure Vessel Code, Section VIII.

30 Pressure-Limiting Device

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

30.1 revised June 24, 1997

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

30.2 revised June 24, 1997

*30.3 *Deleted June 24, 1997**

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

30.4 revised June 24, 1997

31 Pressure Relief

31.1 General

31.1.1 A room air conditioner shall be constructed so that pressure due to fire, or other abnormal conditions, will be relieved. Pressure-relief devices, fusible plugs, or soldered or brazed tubing joints may be employed for this purpose.

31.1.1 revised June 24, 1997

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

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

31.1.4 A room air conditioner with a pressure vessel exceeding 3 cubic feet (0.08 m^3) internal gross volume, shall be protected by a pressure-relief device.

31.1.5 All pressure-relief devices and fusible plugs shall be connected as close as practicable or directly to the pressure vessel or parts of the system protected. Pressure-relief devices shall be connected above the liquid-refrigerant level, installed so that they are accessible for inspection and repair, and arranged so that they cannot be readily rendered inoperative. Fusible plugs may be located above or below the liquid-refrigerant level. There shall be no stop valves between the pressure-relief means and the parts or section of the system protected.

31.1.5 revised June 24, 1997

31.2 Required discharge capacity

*31.2.1 *Deleted June 24, 1997**

31.3 Relief valves

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

31.3.2 Pressure-relief valves shall be set to start to function at a pressure not to exceed the design pressure of the parts of the system protected.

31.3.3 The marked discharge capacity shall be not less than the minimum required discharge capacity as computed from 31.2.1.

31.4 Fusible plugs or rupture members

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

31.4.1 effective June 24, 1998

31.4.2 Fusible plugs and rupture members shall comply with the Standard for Refrigerant-Containing Components and Accessories, UL 207, applicable to such devices.

31.4.3 Rupture members shall have a nominal rated rupture pressure not to exceed the design pressure of the parts of the system protected.

PERFORMANCE

32 Instrumentation

32.1 Temperature measurements

32.1.1 Temperatures are to be measured by thermocouples, except that the change-in-resistance method may be used to measure the temperature of motor windings or of coils. The thermocouples are to consist of Nos. 24 – 30 AWG (0.21 – 0.5 mm^2) wires. The thermocouples and related instruments are to be accurate and calibrated. The thermocouple wire is to conform to the requirements for ″special thermocouples″ as listed in the Table of Limits of Error of Thermocouples in the Standard for Temperature Measurement Thermocouples, ANSI MC96.1-1982.

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

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

32.1.4 If the temperature of a copper motor winding or coil is to be determined by the change-in-resistance method the following formula shall be used:

$$T = \frac{R}{r}(234.5 + t) - 234.5$$

In which:

T is the temperature to be determined in degrees C.

t is the known temperature in degrees C.

R is the resistance in ohms at the temperature to be determined.

r is the resistance in ohms at the known temperature.

32.1.5 When it is necessary to de-energize the winding before measuring R, the value of R at shutdown is to be determined by taking several resistance measurements at short intervals, beginning as quickly as possible after the instant of shutdown. A curve of the resistance values and the time is to be plotted and extrapolated to give the value of R at shutdown.

32.2 Pressure measurements

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

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

33 Test Voltage

33.1 Unless otherwise specified, room air conditioners shall be tested at 60 hertz voltages maintained at the unit supply connections in accordance with Table 33.1.

Exception: Units rated at other than 60 hertz frequencies are to be tested at their rated voltages and frequencies.

34 Leakage Current Test – Cord-Connected Room Air Conditioners

34.1 The leakage current of a cord-connected room air conditioner shall be no more than 0.75 milliamperes when tested in accordance with 34.6 – 34.8.

34.2 Leakage current refers to all currents, including capacitively-coupled currents, which may be conveyed between exposed conductive surfaces of a room air conditioner and ground or other exposed conductive surfaces.

Table 33.1
Test voltages

Nameplate Voltage rating	Test voltage	
	Input test	All other tests[a]
110 to 120	115	120
208	208	208
220 to 240	230	240
254 to 277	Rated	277
440 to 480	Rated	480
550 to 600	Rated	600

[a] These voltages are nominal for the Rain Test, Section 35, Condenser Fan Motor Failure Test, Section 41, and Condenser Water Failure Test, Section 42.

34.3 All exposed conductive surfaces are to be tested for leakage currents. The leakage currents from these surfaces are to be measured to the grounded supply conductor individually as well as collectively and from one surface to another where simultaneously accessible. Parts are considered to be exposed surfaces unless guarded by an enclosure providing protection in accordance with 6.1 and 6.2. Surfaces are considered to be simultaneously accessible when they can be readily contacted by one or both hands of a person at the same time. These measurements do not apply to terminals operating at voltages which are considered to be low-voltage.

34.4 If a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using metal foil with an area of 3.9 by 7.8 inches (100 by 200 mm) in contact with the surface. Where the surface is less than 3.9 by 7.8 inches, the metal foil is to be the same size as the surface. The metal foil is not to remain in place long enough to affect the temperature of the room air conditioner.

34.5 The measurement circuit for leakage current shall be as shown in Figure 34.1. The measurement instrument is defined in (a) – (c) and, unless it is being used to measure leakage from one part of a room air conditioner to another, the meter is to be connected between the accessible parts and the grounded supply conductor. The meter which is actually used for a measurement need only indicate the same numerical value for a particular measurement as would the defined instrument. The meter used need not have all of the attributes of the defined instrument.

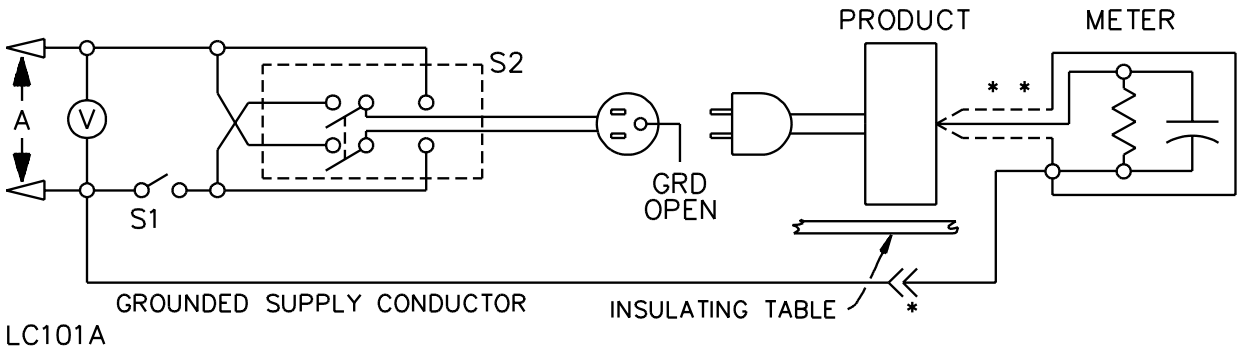
a) The meter is to have an input impedance of 1500 ohms resistive shunted by a capacitance of 0.15 microfarad.

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

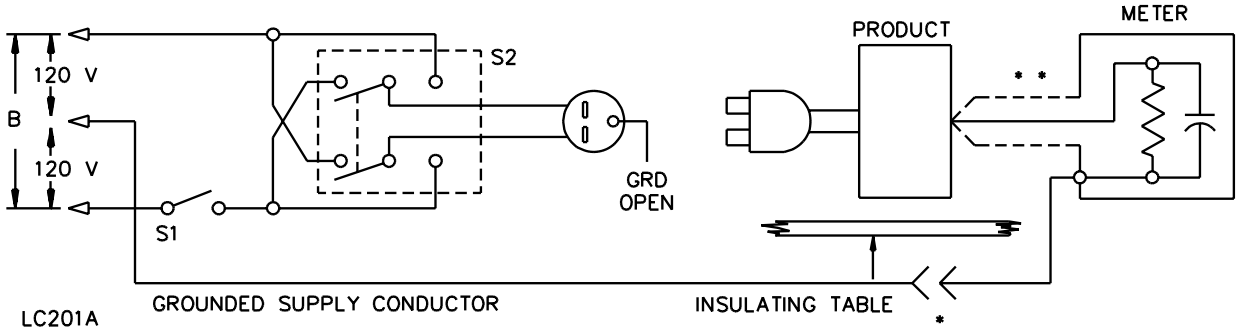
c) Over a frequency range of 0 – 100 kilohertz, the measurement circuitry is to have a frequency response (ratio of indicated to actual value of current) that is equal to the ratio of the impedance of a 1500 ohm resistor shunted by a 0.15 microfarad capacitor to 1500 ohms. At an indication of 0.75 milliamperes,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

Figure 34.1
Leakage current measurement circuits

Figure 34.1 revised October 28, 1998



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



B – 240 or 208 volt product intended for connection to 3 wire grounded neutral power supply.

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

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

34.6 The room air conditioner is to be prepared and conditioned for leakage current measurement as follows:

a) The grounding conductor is to be open at the attachment plug and the test unit is to be isolated from ground.

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

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

d) The supply voltage is to be adjusted to the voltage indicated in Table 33.1.

e) Water-cooled units are to be tested with water flowing through the condenser at a rate required for operation of the system.

34.7 With reference to the measuring circuit in Figure 34.1, the leakage current test sequence shall be as described in (a) – (d) below. If the compressor stalls during sequence B or C due to changing the position of switch S2, the sequence is to be conducted in its entirety in one position of switch S2 and then repeated in the second position of switch S2.

a) With switch S1 open, the unit is to be connected to the measuring circuit. The leakage current is to be measured using both positions of switch S2 and with manually-operated unit switching devices successively placed in each mode (fan only, cooling, heating, and the like).

b) With unit controls set for maximum cooling and maximum fan speed, switch S1 is to be closed to energize the unit. Within 5 seconds, leakage current is to be measured using both positions of switch S2. Following this and using both positions of switch S2, manual switching devices are to be operated as quickly as possible through all cooling modes, but not in the ″off″ position, to determine the maximum leakage current condition.

c) With switching devices set at the position which causes the highest leakage current, the unit is to be operated continuously until the measured leakage current stabilizes or decreases. Both positions of switch S2 are to be used.

d) Following (c), switch S1 is to be opened to de-energize the unit. Measurement of leakage current is to continue, using both positions of switch S2, until values stabilize or begin to decrease.

34.8 A room air conditioner with provision for reverse cycle heating, resistance heating, or both shall be tested in all modes of heating operation. The test sequence shall be in accordance with (b) – (d) of 34.7 except that unit switching devices shall be set for the heating mode. It may be necessary to shunt some unit controls in order to energize all heating loads.

35 Rain Test

35.1 The section of a room air conditioner exposed to weather shall be subjected to rain exposure without creating the risk of electric shock.

35.2 The room air conditioner is to be conditioned in an ambient temperature of 70 – 80°F (21.1 – 26.7°C) and 20 – 50 percent relative humidity for not less than 8 hours. The insulation resistance of the unit is then to be measured by the series-voltmeter method, or equivalent means, using a nominal 500-volt dc circuit. The insulation resistance shall not be less than 2 megohms. Air heating elements, if any, which comply with the requirement of 55.1.1 are to be disconnected. The unit is to be installed in accordance with the manufacturer’s instructions.

35.3 The rain test apparatus is to consist of three spray heads mounted in a water supply pipe rack as shown in Figure 35.2. Spray heads are to be constructed in accordance with the details shown in Figure 35.1. The water pressure is to be maintained at 5 psi (34 kPa) at each spray head. The distance between the center nozzle and the test unit is to be approximately 5 feet (1.5 m). The unit is to be brought into the focal area of the three spray heads in such a position and under such conditions that the greatest quantity of water will enter the unit. The spray is to be directed at an angle of 45 degrees to the vertical toward openings closest to current-carrying parts. The unit is to be operated so that electrical components located in the outdoor section are energized. It may be necessary to operate the unit under various modes of operation or de-energize the unit if more adverse conditions could result. In any case, each exposure is to be for 1 hour and if more than one exposure is required, the unit is to be reconditioned as indicated in 35.2 before repeating the test.

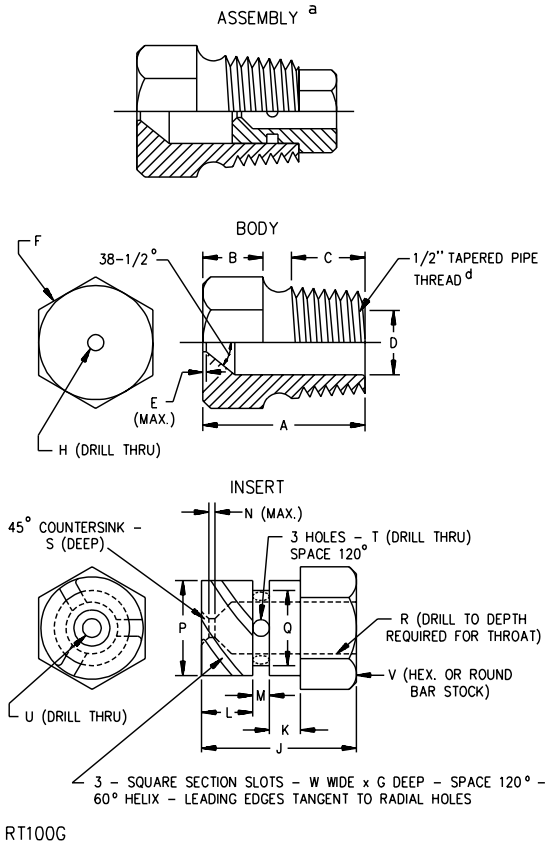
35.3 revised October 28, 1998

No Text on This Page

35.4 After each exposure, the unit shall have an insulation resistance between live parts and dead metal parts of not less than 0.5 megohms. The insulation resistance is measured 1 minute after application of the voltage obtained by using the series-voltmeter method, or equivalent means, and a nominal 500-volt dc circuit. Air heating elements, if any, which comply with the requirements of 55.1.1 are to be disconnected. After measurement of the insulation resistance, the complete unit, including air heating elements, shall comply with the requirements of the Dielectric Voltage-Withstand Test, Section 40.

Figure 35.1
Rain-test spray head

Figure 35.1 revised October 28, 1998



Item	inch	(mm)	Item	inch	(mm)
A	1-7/32	(31.0)	N	1/32	(0.80)
B	7/16	(11.0)	P	.575	(14.61)
C	9/16	(14.0)		.576	(14.63)
D	.578	(14.68)	Q	.453	(11.51)
	.580	(14.73)		.454	(11.53)
E	1/64	(0.40)	R	1/4	(6.35)
F	c	c	S	1/32	(0.80)
G	.06	(1.52)	T	(No. 35)[b]	(2.80)
H	(No. 9)[b]	(5.0)	U	(No. 40)[b]	(2.50)
J	23/32	(18.3)	V	5/8	(16.0)
K	5/32	(3.97)	W	0.06	(1.52)
L	1/4	(6.35)			
M	3/32	(2.38)			

[a] Nylon Rain – Test Spray Heads are available from Underwriters Laboratories Inc.

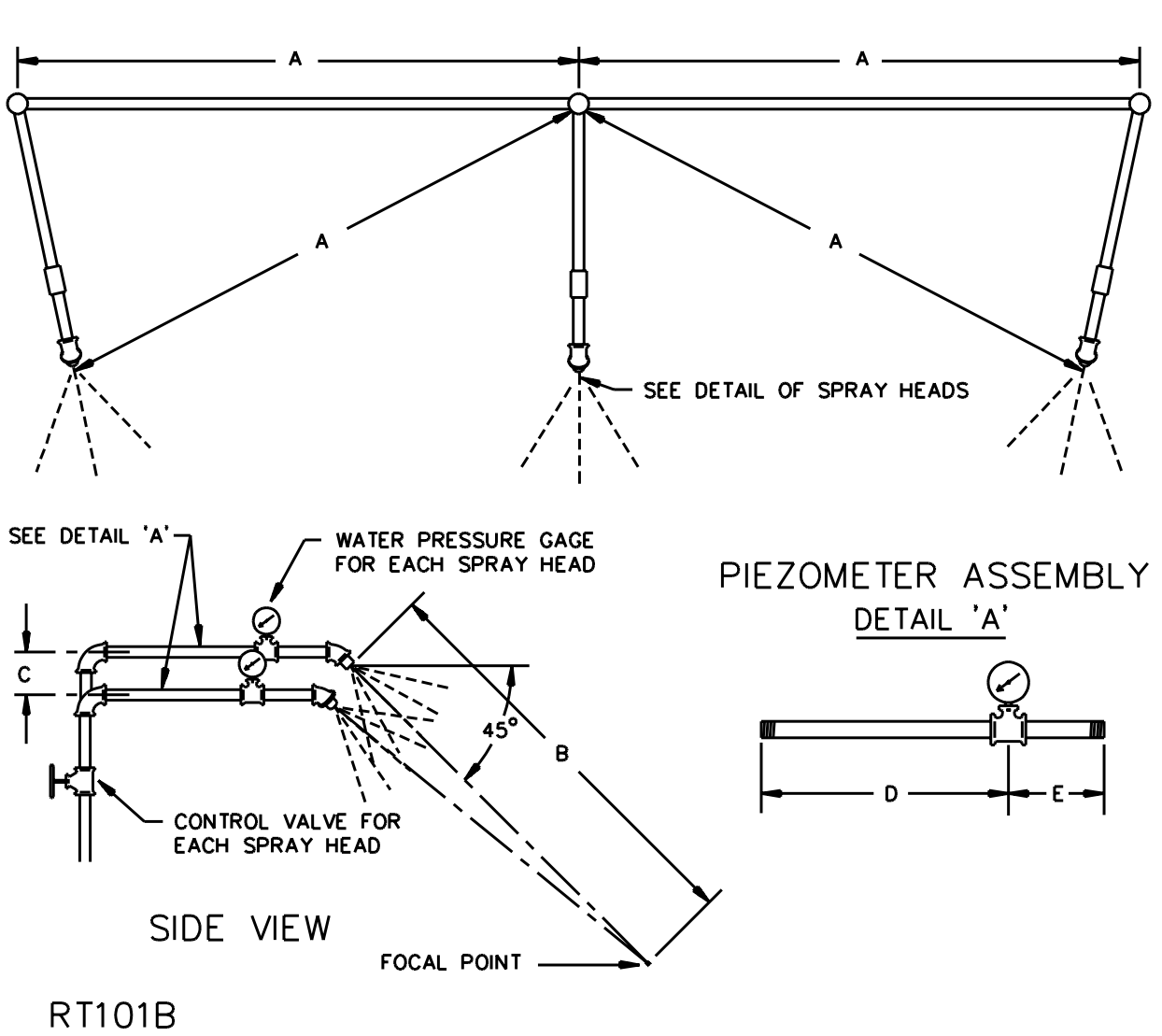
[b] Drill size per ASME B 94.11 (1993), Twist Drills

[c] Optional – To serve as wrench grip.

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

Figure 35.2
Rain-test spray head piping

Figure 35.2 revised October 28, 1998



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

36 Test Conditions for Input Test and Temperature-Pressure Test

36.1 The room air conditioner is to be prepared for test by attachment of pressure gauges to the high- and low-pressure sides of the refrigeration system. Thermocouples are to be secured to components, such as the motor-compressor enclosure, fan motor windings, conductor insulation, enclosure surfaces, and the like, as indicated in Table 38.1. The temperature of motor windings or of coils may be measured by the change-in-resistance method, but the primary method of temperature measurement is to be the thermocouple method.

36.2 The unit is to be installed in the test room(s) in accordance with the manufacturer's instructions. Dampers, louvers, and switches are to be set in accordance with the manufacturer's instructions to produce maximum cooling (or heating). An accessory for use with the room air conditioner is to be installed and tested with the unit if use of the accessory will affect input current, temperatures, or pressures.

36.3 If the controls of a room air conditioner are designed to permit operation of an electric heater during the cooling cycle (see 21.16), the unit is also to be tested under this condition. If the control function is dependent on temperature, the test ambient temperature is to be adjusted to the maximum condition under which this operation may occur.

36.4 If a unit is intended for use with air delivery and return collars, sleeves, or the like, the unit is to be tested as a free air delivery unit under cooling conditions, with the appropriate air discharge louver or diffuser and air return grille attached directly to the unit. When tested under heating conditions, the unit is to be tested for either free air delivery or with collars, sleeves, and the like, installed in accordance with the manufacturer's instructions, whichever results in the highest currents, temperatures, and pressures. See 3.5, 4.3, and 4.4.

36.5 The test room(s) is to be maintained at conditions which will provide inlet air to the unit at temperatures specified in Table 36.1. Air temperatures are to be the average of three measurements at points selected to give representative inlet air conditions. Water and steam temperature measurements are to be made as nearly adjacent to the inlet and outlet connections as is practicable.

Table 36.1
Temperature conditions for input test and temperature and pressure test

		Temperature[a]			
		Input test, Degrees		Temperature and pressure test, Degrees	
		F	(C)	F	(C)
1.	Cooling				
	Air cooled unit				
	Indoor air, DB/WB	80/67	(26.7/19.4)	104/80	(40/26.7)
	Outdoor air, DB/WB	95/75	(35/23.9)	104/80	(40/26.7)
	Water cooled unit				
	Indoor air, DB/WB	80/67	(26.7/19.4)	104/80	(40/26.7)
	Condensed water, In/Out	75/95	(23.9/35)	80/100	(26.7/37.8)
2.	Reverse cycle heating				
	Air cooled unit				
	Indoor air, DB/WB	–	–	70/58.5	(21.1/14.7)
	Outdoor air, DB/WB	–	–	70/58.5	(21.1/14.7)
	Water cooled unit				
	Indoor air, DB	70	(21.1)	70	(21.1)
	Condensed water, In/Out	60/45	(15.6/7.2)	70/55	(21.1/12.8)
3.	Resistance heat (only)	Approximately 77	(25)	Approximately 77	(25)
4.	Combination reverse cycle-resistance heat				
	Air cooled unit				
	Indoor air, DB/WB	70/58.5	(21.1/14.7)	70/58.5	(21.1/14.7)
	Outdoor air, DB/WB	70/58.5	(21.1/14.7)[b]	70/58.5	(21.1/14.7)[b]
5.	Steam or hot water heat	–	–	Approximately 77	(25)

[a] Temperature tolerance: ±2°F (±1°C) dry bulb; ±1°F (±0.5°C) wet bulb except for resistance heat or steam/hot water heat.

[b] Or design temperature, for example, outdoor temperature at which all electric heaters which may operate concurrently with compressor are energized, see 37.5.2.

36.6 The test unit is to be operated continuously at the voltage(s) specified in Table 33.1.

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37 Input Test

37.1 General

37.1.1 The room air conditioner is to be operated under the input test conditions specified in Section 36 for the various performance modes. The stabilized input current value is to be used in judging compliance with 37.2.1 – 37.5.2.

37.2 Cooling load

37.2.1 The measured ampere input to a cord-connected room air conditioner operating in the cooling mode, shall not exceed the total cooling-load amperes marked on the nameplate by more than 10 percent.

37.2.2 The measured ampere input to a permanently-connected room air conditioner operating in the cooling mode, shall not exceed the individual rating of each cooling load or group of cooling loads or the total rating marked on the nameplate by more than 10 percent.

37.2.3 The pressures developed in the room air conditioner shall be used in establishing the minimum high- and low-side design pressures appearing on the unit nameplate. See 79.7. Gaugeline valves are to be opened and pressures recorded after the input current has stabilized.

37.3 Heating load (reverse cycle heat only)

37.3.1 The measured ampere input to a water-cooled room air conditioner, operating in the reverse cycle heating mode, shall not exceed the individual rating of each load or group of loads or the total marked rating for reverse cycle heating by more than 10 percent.

37.4 Heating load (resistance heat only)

37.4.1 The measured ampere (or wattage) input to a cord-connected room air conditioner employing resistance heat and operating in that mode, shall not exceed the total heating ampere or wattage marked on the room air conditioner nameplate by more than 5 percent.

37.4.2 The measured input to a permanently-connected room air conditioner employing resistance heat and operating in that mode, shall not exceed the individual rating of each load or group of loads or the total marked rating for this function by more than 5 percent.

37.5 Heating load (combination reverse cycle and resistance heat)

37.5.1 The measured ampere input to a room air conditioner designed for combination reverse cycle and resistance heating shall not exceed the individual rating of each load or group of loads, or the total marked rating for this function by more than the following:

a) Ten percent when the compressor motor, fan motor(s), and all resistance heating loads operate concurrently; and

b) Five percent when the fan motor(s) and resistance heating loads do not operate concurrently with the compressor motor.

37.5.2 Compliance with 37.5.1 (a), is determined by using the indoor and outdoor ambient air temperatures of 70°F (21.1°C) dry bulb, 58.5°F (14.7°C) wet bulb as specified in Table 36.1. If all resistance heating loads which may operate concurrently with the compressor motor are not energized at these temperatures, the outdoor air temperature is to be decreased until such operation occurs. See footnote [b] in Table 36.1.

37.5.3 Compliance with 37.5.1 (b), is to be determined by energizing all loads which do not operate concurrently with the compressor as described under Heating Load (Resistance Heat Only), 37.4.1 and 37.4.2.

38 Temperature and Pressure Test

38.1 In addition to operating in the cooling mode, this test also applies to room air conditioners which incorporate reverse cycle heating or combination reverse cycle and resistance heating.

38.2 The unit is to be operated under the temperature and pressure test conditions specified in Section 36. Operation is to continue until input current, temperatures, and high- and low-side pressures have stabilized.

38.3 Temperature rises of electrical components, wiring, enclosure surfaces, and the like, shall not exceed those specified in Table 38.1.

Table 38.1
Maximum temperature rises

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

Table 38.1 Continued on Next Page

Table 38.1 Continued

Device or material	Degrees C	Degrees (F)
B. Components		
1. Capacitors		
Electrolytic type[c]	40	(72)
Other types[d]	65	(117)
2. Field wiring[e]	35	(63)
3. Fuse bodies[f]	65	(117)
4. Hermetic motor-compressor enclosure[g]	150	(302)
5. Relay solenoid, and other coils with		
a. Class 105 insulated winding –		
Thermocouple method	65	(117)
Resistance method	85	(153)
b. Class 130 insulation –		
Thermocouple method	85	(153)
Resistance method	105	(189)
6. Solid contacts	65	(117)
7. Transformer enclosures with		
a. Class 2 transformers	60	(108)
b. Power transformers	65	(117)
8. Transformer windings:		
a. Class 105 insulated winding –		
Thermocouple method	65	(117)
Resistance method	85	(153)
b. Class 130 insulation –		
Thermocouple method	85	(153)
Resistance method	105	(189)
c. Class 155 insulation;		
Class 2 transformers		
Thermocouple method	95	(171)
Resistance method	115	(207)
Power transformers		
Thermocouple method	110	(198)
Resistance method	115	(207)
d. Class 180 insulation;		
Class 2 transformers		
Thermocouple method	115	(207)
Resistance method	135	(243)
Power transformers		
Thermocouple method	125	(225)
Resistance method	135	(243)
9. Wood or other combustible material	65	(117)

Table 38.1 Continued on Next Page

Table 38.1 Continued

Device or material		Degrees C	Degrees (F)
C. Insulated conductors			
1. Flexible cords and wires with rubber, thermoplastic, or neoprene insulation unless recognized as having a special heat-resistant properties as follows:			
Temperature rating –			
Degrees C	**Degrees F**		
60	140	35	(63)
75	167	50	(90)
90	194	65	(117)
105	221	80	(144)
D. Electrical insulation – general			
1. Fiber used as electrical insulation or cord bushings		65	(117)
2. Phenolic composition used as electrical insulation or as parts where failure will result in a hazardous condition		125	(225)
3. Thermoplastic material Rise based on temperature limits of material			
E. Surfaces			
1. Surfaces of room air conditioner at points of zero clearance to test enclosure		65	(117)
2. Surfaces of test enclosure where clearance to combustible material is specified		65	(117)
3. Surfaces of room air conditioner contacted by the persons operating it (control knobs, pushbuttons, levers, and the like)			
	Metal	35	(62)
	Nonmetallic	60	(108)
4. Surfaces of room air conditioner subjected to casual contact by persons (enclosure, grille, and the like)			
	Metal[h]	45	(81)
	Nonmetallic	65	(117)

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

[b] Thermocouple applied as in footnote[a] or applied to conventional coil wrap.

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

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

[e] A temperature rise of no more than 50°C (90°F) is acceptable in the terminal box or wiring compartment of a unit that requires supply conductors with an ampacity of more than 100 amperes.

[f] Includes both casing and ferrule. However, a temperature not more than 20°C (36°F) higher than the value indicated in the table is acceptable on the casing (not ferrule) of a Class CC, G, J, L, or T fuse.

[g] Maximum – not rise.

[h] 65°C (117°F) rise permitted on air discharge grilles used on units provided with means for heating.

38.4 The maximum pressures developed in the room air conditioner shall be used in applying strength test requirements, Section 62.

38.5 Motor-compressors shall be capable of operation continuously under the conditions of this test with any protective device in the circuit.

Exception: An automatic-reset protective device may cycle during the starting period. A manual-reset protective device shall not trip during the starting or operating period.

38.6 The room air conditioner shall comply with the requirements of the Dielectric Voltage Withstand Test, Section 40, following the above tests.

39 Starting Test

39.1 A room air conditioner shall start, run, and restart without opening the branch circuit fuses for which it is designed, marked, or both, to be used.

Exception: If a permanently-connected unit is intended to be connected to a branch circuit protected by an overcurrent device sized in accordance with 52.1.4, a starting test is not required.

39.2 For cord-connected units, the fuse rating mentioned in 39.2 is determined by the rating of the attachment plug. If a permanently-connected unit is intended to be connected to a circuit protected by an overcurrent device sized in accordance with 52.1.5, the fuse rating is to be as marked on the nameplate.

39.3 The unit and four fuses are to be connected in series. The unit is to be operated in a room maintained at 104°F (40°C) dry bulb and 80°F (26.7°C) wet bulb. The test voltage is to be maintained as indicated in Table 33.1. The unit is to be operated for 1/2 hour and then turned off. If a cord-connected unit has a permanent and legible marking near the control knob which specifies a minimum restart time, it is to be restarted by the control switch after the time lapse indicated but not more than 3 minutes. Otherwise, the unit is to be started immediately after the fans stop.

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

39.5 If it is determined that time-delay fuses are required for starting, the unit shall be marked in accordance with 79.13.

39.6 If an automatic reset thermal protective device interrupts the current flow one or more times during the 1/2 hour operating period described in 39.3, the room air conditioner shall restart and run after each interruption and shall comply with the fusing requirements of 39.4 and 39.5.

40 Dielectric Voltage-Withstand Test

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

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

Exception No. 2: If the steady-state voltage developed in a motor circuit through the use of capacitors exceeds 500 volts, as measured in the Temperature and Pressure Test, Section 38, the test potential for the parts affected shall be 1000 volts plus twice the developed capacitor voltage.

40.1 revised May 2, 1996

40.2 A room air conditioner employing a low-voltage circuit shall withstand, without breakdown, a test potential of 500 volts applied for 1 minute between low-voltage live parts and dead metal parts. The test potential shall be at any frequency between 40 and 70 hertz. If protective devices of the type indicated in 25.3 are employed in the low-voltage circuit, the test shall also be conducted between live parts of opposite polarity.

40.2 revised May 2, 1996

40.3 With reference to 40.2, the test between low-voltage parts of opposite polarity is to be conducted on magnet coil windings of the transformer after breaking the inner coil lead where it enters the layer. This opposite polarity test may be waived on the complete assembly provided that the components have been separately subjected to this test.

40.3 revised May 2, 1996

40.4 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 maintains the specified high potential voltage at the equipment during the duration of the test.

40.4 revised May 2, 1996

40.5 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 capacitors and capacitor-type filters may be tested as described in 40.6.

40.5 added May 2, 1996

40.6 The capacitors and capacitor-type filters mentioned in 40.5 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.

40.6 added May 2, 1996

40.7 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.

40.7 added May 2, 1996

41 Condenser Fan Motor Failure Test

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

a) The maximum high- and low-side pressure shall not exceed one-third of the ultimate strength of high- and low-side parts, respectively, as determined by Strength Tests – Pressure Containing Components, Section 60. A room air conditioner employing a pressure limiting device complying with 30.2 or 30.3, as applicable, is considered to comply with the high pressure requirement.

b) The temperature of the compressor motor enclosure, of the fan motor winding (open type) or of the fan motor enclosure (enclosed type) shall not exceed 302°F (150°C). Compressors and condenser fan motors equipped with a thermal protective device(s) as specified in Motors and Motor Overload Protection, Section 20, are considered to comply with this requirement.

41.1 revised June 24, 1997

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

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

b) After shutdown of the compressor.

The compressor motor overload device and/or the fan motor overload device may operate during this test. The ambient air temperature is approximately 77°F (25°C). The test voltage is to be maintained as indicated in Table 33.1.

41.3 If the room air conditioner incorporates a reverse cycle heating feature, the test in 41.2 is to be repeated with the controls set for maximum heating.

42 Condenser Water Failure Test

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

a) The maximum high-side pressure shall not exceed one-fifth of the ultimate strength of high-side parts, and the maximum low-side pressure shall not exceed one-third of the ultimate strength of low-side parts, as determined by Strength Tests – Pressure Containing Components, Section 60.

b) The temperature of the compressor motor enclosure shall not exceed 302°F (150°C). Compressors equipped with a thermal protective device(s) as specified in Motors and Motor Overload Protection, Section 20, are considered to comply with this requirement.

Exception: The test need not be conducted if a pressure-limiting device is provided. The maximum cutout pressure to which the pressure-limiting device may be readily adjusted by the adjusting means provided is to be employed in determining compliance with 42.1. See 60.1.

42.1 revised June 24, 1997

42.2 The unit, fitted with pressure gauges on the high- and low-pressure sides of the refrigeration system and provided with thermocouples on the compressor motor enclosure, is to be operated with the condensing water shut off and also with the condensing water restricted until maximum stabilized temperatures and pressures are reached or until representative maximum temperatures and pressures are attained under cycling load. The low-side pressure is to be recorded while the compressor is operating and after shutdown. If the room air conditioner is provided with means to relieve discharge pressure into the low-side of the system, the low-side pressure is to be recorded:

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

b) After shutdown of the compressor.

The ambient air temperature is to be approximately 77°F (25°C). The test voltage is to be maintained as indicated in Table 33.1.

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43 Temperature Test – Steam Or Hot Water Heat

43.1 When operating in the heating mode, temperature rises of electrical components, wiring, enclosure surfaces, and the like, of a room air conditioner equipped with a steam or hot water heating coil shall not exceed those specified in Table 38.1.

43.2 The room air conditioner is to be installed in accordance with the manufacturer's instructions. Dampers, louvers, and switches, are to be set to produce maximum heating. If a unit is intended for built-in installation, it is to be enclosed in accordance with the instructions. The test enclosure is to be made of 1 inch (25.4 mm) nominal thickness wood boards or 3/4 inch (19 mm) plywood with inside surfaces painted flat black and with all joints sealed. It is to be in direct contact with heated surfaces of the room air conditioner except where a clearance to flammable material is specified by the manufacturer. If clearances are specified, the wood enclosure is to be spaced from the heated surfaces accordingly. Temperatures are to be measured on the unit surfaces if no clearance is specified. Temperatures are to be measured on the inside surfaces of the wood enclosure if clearances are specified. An insulating blanket made of 1 inch (25.4 mm) thick glass fiber or equivalent, snugly wrapped around the plenum and other heated surfaces, may be used as an alternative to the wood enclosure if agreeable to those concerned.

43.3 The room air conditioner is to be connected to a source of steam or hot water, depending on the type of unit. For a unit employing a steam coil, the pressure of the entering steam is to be the maximum steam pressure marked on the unit but not less than 2 psig (13.8 kPa). See 80.23. For a unit employing a hot water coil, the temperature of the entering water is to be the maximum inlet temperature marked on the unit. See 80.24. The water flow rate is to be adjusted so that the temperature of the water at the outlet is 20°F (11.1°C) lower than that of the entering water, except that a smaller temperature differential may be employed if recommended by the manufacturer. The selector switch is to be placed in the heating position to energize the blower motor(s) and to open any valves which may be used in the heating system. The test voltage is to be maintained as indicated in Table 33.1. The ambient air temperature is to be approximately 77°F (25°C). The unit is to be operated until stabilized temperatures are attained.

43.4 If the design of the room air conditioner permits operation of the steam or hot water coil while the blower motor is de-energized, the test in 43.3 is to be repeated under these conditions.

43.5 The room air conditioner shall comply with the requirements of the Dielectric Voltage-Withstand Test, Section 40, following the tests in 43.3 and 43.4.

44 Temperature Test – Resistance Heat

44.1 When operating in the heating mode, temperature rises of electrical components, wiring, enclosure surfaces, and the like, of a room air conditioner equipped with an electric air heater(s) shall not exceed those specified in Table 38.1.

44.2 The unit is to be installed as described in 43.2. Unit switches are to be set so that all heaters which may operate concurrently are energized during the test. The ambient air temperature is to be approximately 77°F (25°C). The test voltage is to be maintained as indicated in Table 33.1.

44.3 The room air conditioner shall comply with the requirements of the Dielectric Voltage-Withstand Test, Section 40, following the test in 44.2.

45 Abnormal Tests – Resistance Heat

45.1 General

45.1.1 If a room air conditioner employs an electric air heater, there shall be no emission of flame, burning particles, or molten metal from the enclosure, or glowing or flaming of flammable material inside the room air conditioner when the unit is subjected to blocked outlet, restricted inlet, and fan failure tests as described below. The unit shall have an insulation resistance of not less than 50,000 ohms following the tests.

45.1.2 Prior to each abnormal test, the unit is to be operated in the normal heating mode for approximately 1/2 – 1 hour to bring components up to operating temperature.

45.2 Blocked outlet

45.2.1 A blocked outlet test is to be conducted only on vertical air-discharge units.

45.2.2 The test voltage and unit arrangement is to be as described in the Temperature Test – Resistance Heat, Section 44. Adjustable louvers are to be set at a position that will result in maximum temperatures during the test. The air-outlet opening is to be covered successively for 25, 50, 75, and 100 percent of its area with a 1 inch (25.4 mm) thick felt pad covered by a layer of cheesecloth.

45.2.3 The felt is to be 100 percent standard weight animal-hair, punched felt with center reinforcement consisting of burlap having a mass of 5 ounces per square yard (0.170 kg/m^2). Felt 1 inch (25.4 mm) thick has a mass of 105 $\pm$ 15 ounces per square yard (3.56 $\pm$ 0.51 kg/m^2).

45.2.4 The cloth is to be bleached cheesecloth 36 inches (914 mm) wide, running 14 – 15 yards per pound-mass (approximately 28 – 30 m/kg), and having what is known in the trade as a ″count of 32 $\times$ 38,″ that is, for any 1 by 1 inch (25.4 by 25.4 mm) square, 32 threads in one direction and 38 threads in the other direction.

45.2.5 In addition to the requirements of 45.1.1, there shall be no flaming or glowing of the cheesecloth and felt.

45.3 Restricted inlet

45.3.1 The test voltage and unit arrangement is to be as described in the Temperature Test – Resistance Heat, Section 44. With the unit operating, the air-inlet opening is to be gradually and uniformly restricted until the opening is completely blocked at the end of 30 minutes or until a temperature-limiting control opens the circuit, whichever occurs first. Operation is to continue until temperatures of electrical components, wiring, enclosure surface, and the like, have stabilized.

45.3.2 The unit shall comply with the requirements of 45.1.1.

45.4 Fan Failure

45.4.1 The test voltage and unit arrangement is to be as described in the Temperature Test – Resistance Heat, Section 44, except that the fan motor is to be locked and a double layer of cheesecloth is to be placed around the room side of the unit so that it adheres closely to the enclosure near all openings. The cheesecloth is to be as described in 45.2.4.

45.4.2 If a manual- or automatic-reset temperature-limiting control does not comply with the endurance test requirement of 50.1.2, it is to be shunted out of the circuit. If an automatic-reset temperature-limiting control complies with the endurance test requirement, the test is to terminate when the temperatures of components and materials as indicated in 44.1 have stabilized. If a manual-reset temperature-limiting control complies with the endurance test requirement, the test is to terminate when the device opens the heater circuit.

45.4.3 If a replaceable thermal cutoff is employed, the test is to be conducted five times, using different samples of the thermal cutoff in each test. The thermal cutoff shall open the circuit in the intended manner without causing the short circuiting of live parts and without causing live parts to become grounded. During the test, the enclosure is to be connected through a 3-ampere fuse to ground and any thermally-operated control devices in the heater circuit other than the thermal cutoff are to be shunted out of the circuit. The 3-ampere fuse shall not open during the test.

45.4.4 In addition to the requirements of 45.1.1, there shall be no glowing or flaming of the cheesecloth.

46 Static Loading Test

46.1 A window-type room air conditioner shall withstand the test described in 46.2 – 46.4 without collapse of the cabinet, base, or the supporting means, and shall not fall out of the window.

46.2 The unit is to be installed in a simulated window frame in accordance with the manufacturer's instructions and with the mounting hardware supplied by the manufacturer. A load of 400 pounds-mass (181 kg) acting vertically downward shall be applied along the edge parallel with and farthest from the plane of the window.

46.3 The window is to be a conventional double-hung type, each sash measuring 32 inches (813 mm) wide by 28 inches (711 mm) high by 1-3/8 inch (35 mm) thick. The window frame is to be 62 inches (1.57 m) high by 36 inches (0.914 m) wide, and is to be provided with a 1-1/2 by 5-1/2 inch (38 by 140 mm) sill, a 3/4 by 3-1/2 inch (19 by 89 mm) stool, and 1/2 by 1-3/8 inch (12.7 by 35 mm) stops. The material used for the frame, sash, sill, stool, and stops is to be No. 1 clear ponderosa pine.

46.4 In this test, a 5 inch (127 mm) wide channel or equivalent is to be placed flat across the top of the outer enclosure of the unit with one edge of the channel flush with the outer edge of the enclosure. Equal weights are to be suspended on wire ropes attached to the center of the channel on either side of the unit. The total load of 400 pounds-mass (181 kg) includes weights, channel, and ropes.

47 Stability Test

47.1 A window-type room air conditioner which relies on a window sash for retention shall not fall out of the window when the sash is raised.

47.2 The unit is to be installed in a simulated window in accordance with the manufacturer's instructions and with the mounting hardware supplied by the manufacturer. The window described in 46.3 is to be used. After installation, sash locks or similar means which normally prevent the sash from being raised are to be removed. Other parts of the mounting hardware, such as leveling bolts, support brackets, and the like, which do not have to be removed to raise the sash, are to remain in place. The window sash is to be raised and a horizontal force of 25 pounds (111.2 N) applied against the top edge at the center of the indoor side of the cabinet.

48 Overflow Test

48.1 A room air conditioner in which water may accumulate or in which overflow may result from a blocked drain shall not allow the water to wet uninsulated live parts or film-coated wire when the unit is tilted 1/4 inch (6.4 mm) in any direction from its normal installation position.

48.2 Compliance with 48.1 may be determined by such means as visual examination, the Dielectric Voltage-Withstand Test, Section 40, or the Insulation Resistance Test, Section 55.

49 Spillage Test

49.1 With reference to 6.5 and 6.6, a room air conditioner shall have an insulation resistance of not less than 50,000 ohms when tested as described in 49.2.

49.2 The room air conditioner is to be installed in accordance with the manufacturer's instructions but not operated. Covers, such as hinged or sliding panels, which provide access for manual operation of electrical controls, are to be in the open position unless such covers are of the self-closing type. A solution of 8 fluid ounces (0.24 liter) of water containing 0.035 ounce-mass (0.25 gram) of ordinary table salt is to be poured onto the unit in a manner most likely to cause entrance of water into or on electrical controls, uninsulated live parts, and film-coated wire. After spillage is completed, insulation resistance is to be monitored continuously for 5 minutes.

49.3 Following measurement of insulation resistance, the unit shall comply with the Dielectric Voltage-Withstand Test, Section 40. The unit is then to be energized at rated voltage and shall be capable of operating in all intended modes.

50 Heater Temperature-Limiting Control Tests

50.1 Endurance test

50.1.1 If a room air conditioner must be equipped with a temperature-limiting control in order to comply with the requirements of Abnormal Tests – Resistance Heat, Section 42, the control shall withstand an endurance test under the load which it controls for the number of cycles indicated in 50.1.2.

50.1.2 The number of cycles for the test shall be as follows:

a) An automatic-reset temperature-limiting control shall withstand 100,000 cycles of operation under load.

b) A manual-reset temperature-limiting control shall withstand 1000 cycles of operation under load plus an additional 5000 cycles without load.

50.1.3 The test is to be conducted with the control connected either to the heater element load or to an equivalent noninductive load. The frame of the control is to be connected through a 3-ampere fuse to ground or to the grounded conductor of the supply circuit. The fuse shall not open during the test.

50.2 Calibration test

50.2.1 A temperature-limiting control shall comply with the requirements in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873, pertaining to the calibration of temperature-limiting controls.

51 Maximum Continuous Current Test – Motor-Compressor Protection Devices

51.1.1 The tests in this section are applicable to a room air conditioner which employs a motor-compressor equipped with a thermal protective device or system and which exceeds the rating limitations of 20.5.

51.1.2 To determine if a thermal protector complies with the requirement of 20.3 (b) (2) or if a protective system complies with the requirement of 20.3 (d) (2), the room air conditioner is to be tested in accordance with 51.1.4 – 51.1.6.

Exception: The motor-compressor may be separately tested as described in 51.1.7.

51.1.3 As used in 51.1.5 and 51.1.6, stable operation is considered to be obtained when two consecutive measurements, 15 minutes apart, of the temperature on top of the motor-compressor enclosure do not vary by more than 1°F (0.6°C).

51.1.4 The voltage reduction mentioned in 51.1.5 and 51.1.6 may be applied to the motor-compressor only, with other components in the room air conditioner operated at rated (or higher) voltage. For dual-voltage rated units, the rated voltage referred to in 51.1.5 and 51.1.6 is to be the higher of the two ratings.

51.1.5 The room air conditioner is to be connected to a circuit of rated voltage and operated under the conditions described in Table 51.1 for at least 1 hour or until stable conditions have been reached, whichever is longer. The voltage is then to be reduced in steps of 2 percent of rated voltage (to the nearest integral volt). Operation is to be allowed to become stable after each reduction in voltage before the next reduction is made, and measurements of current input to the motor-compressor are to be noted after stable operation is obtained subsequent to each voltage reduction. If the room air conditioner will operate at 90 percent of rated voltage without tripping the motor protective device, the first step in voltage reduction may be to 90 percent of rated voltage followed by alternate stabilization periods and 2 percent steps in voltage reduction as described above. This procedure is to be continued until the protective device opens the circuit. The motor-compressor current input at the lowest voltage step during which continuous operation occurs (the lowest voltage preceding the voltage at which the protective device opens the circuit) is to be used as the basis for judging compliance with the requirement of 20.3 (b)(2) or (d)(2) or 20.3.

51.1.6 As an alternate to the stepped voltage reduction described in 51.1.5, initial operation of the room air conditioner may be at such voltage that the current input under stable conditions is 156 percent of the rated-load current as defined in 20.4. The voltage is then to be reduced by 2 percent of rated voltage (to the nearest integral volt) to establish that the protective device opens.

51.1.7 The motor-compressor with its protective system may be separately tested as described in 51.1.5 or 51.1.6 under the conditions specified in Table 51.2. This separate test may be used as a basis for judging compliance with the requirements of (b)(2) or (d)(2) of 20.3. The air in the test chamber without the compressor installed shall have a horizontal velocity of 400 feet per minute (2.03 m/s). The actual velocity across the compressor may be different from this value, depending on the shape of the compressor and its effect on the air-flow pattern. A higher velocity may be employed if the results of the test with the higher air velocity indicate compliance with (b)(2) or (d)(2) of 20.3.

Table 51.1
Test conditions for calibration of thermal protectors and protective systems in room air conditioners

Type and operation	Temperature °F	Temperature (°C)
Air temperature		
surrounding unit, DB/WB	104/80	(40/26.7)
Air-cooled units		
Air to indoor coil, DB/WB	104/80	(40/26.7)
Air to outdoor coil, DB/WB	104/80	(40/26.7)
Water-cooled units		
Air to indoor coil, DB/WB	104/80	(40/26.7)
Condenser water, In/Out	80/100	(26.7/37.8)

Table 51.2
Test condition for calibration of thermal protectors and protective systems separately from a room air conditioner

Location	Temperature °F	Temperature (°C)
Return gas		
Saturated vapor temperature	53.5	(11.9)
Superheat	26.5	(minus 3)
Discharge gas		
Saturated vapor temperature	154	(67.8)
Ambient air	115	(46.1)

52 Limited Short-Circuit Test

52.1 General

52.1.1 The following components shall withstand short-circuiting when protected by a branch-circuit overcurrent device of the size required by the room air conditioner:

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

b) Motor circuit conductors and connections in accordance with 12.5.1.

c) Bonding conductors and connections as required by 14.9 and 14.13.

52.1.2 For a cord-connected unit, the protection specified in 52.1.1 is to be provided by a fuse having a rating not less than the rating of the unit's attachment plug. The minimum fuse size for cord-connected room air conditioners is to be 20 amperes for units rated 125 volts or less and 15 amperes for units rated 126 – 250 volts.

52.1.3 For a permanently-connected unit, the protection specified in 52.1.1 is to be provided by either:

a) A device that is recognized for branch-circuit protection and located in the unit or

b) A branch-circuit protective device of the type and maximum rating specified on the product nameplate.

See 52.1.4 and 52.1.5.

52.1.4 A permanently-connected room air conditioner having more than one motor wired for connection to one supply line shall withstand short-circuiting when protected by a branch-circuit overcurrent device rated at 225 percent of the rated-load current or branch circuit selection current, whichever is larger, of the largest hermetic motor of the group plus an amount equal to the sum of any additional loads supplied. If a hermetic motor is not supplied, the branch-circuit overcurrent protective device is to be rated at 400 percent of the full-load current of the largest motor of the group plus an amount equal to the sum of any additional loads supplied. The nearest standard size of branch-circuit overcurrent device, but rated not less than 15 amperes, is to be employed for the test.

Exception: If the unit incorporates a branch-circuit overcurrent device as described in 52.1.3(a), the tests are to be conducted with that device.

52.1.5 For a permanently-connected room air conditioner, the test may be conducted with a branch-circuit overcurrent device having a lower rating than calculated in 52.1.4 (but not less than 15 amperes) provided that the room air conditioner will start and operate without opening a fuse having this lower rating. See Starting Test, Section 39, and 80.7.

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

52.1.7 The component is to be connected in a test circuit having a capacity based on the rated-load current and voltage rating of the room air conditioner. See Table 52.1. When the rated-load current lies between two values in the table, the larger value is to be used in determining the circuit capacity. If the room air conditioner nameplate shows individual loads, the rated-load current is the total of all individual loads which may occur simultaneously. If more than one simultaneous load condition is possible, the condition resulting in the maximum total current is used as a basis for determining the capacity of the test circuit. The voltage for the test circuit is to be an alternating current supply, and the circuit capacity is to be measured without the component in the circuit. The power factor of the test circuit is to be 0.9 – 1.0 unless a lower power factor is agreeable to those concerned.

52.1.8 Three samples of each component or conductor under test are to be subjected to each test condition and a new fuse or a new circuit breaker, whichever is applicable, is to be used for each test. Consideration is to be given to both short-circuit and ground-fault conditions.

52.2 Motor overload protective devices

52.2.1 There shall be no ignition of cheesecloth surrounding the enclosure of the protective device when samples are subjected to this test.

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

Table 52.1
Short–circuit test currents

Room air conditioner rated-load current, amperes				Circuit capacity amperes
	Single phase			
110–120 V	200–208 V	220–240 V	254–277 V	
9.8 or less	5.4 or less	4.9 or less	–	200
9.9 – 16.0	5.5 – 8.8	5.0 – 8.0	6.65 or less	1000
16.1 – 34.0	8.9 – 18.6	8.1 – 17.0	–	2000
34.1 – 80.0	18.7 – 44.0	17.1 – 40.0	–	3500
Over 80.0	Over 44.0	Over 40.0	Over 6.65	5000
	3 Phase			
200–208 V	220–240 V	440–480 V	550–600 V	Circuit capacity amperes
2.12 or less	2.0 or less	–	–	200
2.13 – 3.7	2.1 – 3.5	1.8 or less	1.4 or less	1000
3.8 – 9.5	3.6 – 9.0	–	–	2000
9.6 – 23.3	9.1 – 22.0	–	–	3500
Over 23.3	Over 22.0	Over 1.8	Over 1.4	5000

52.3 Bonding conductors and connections

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

52.4 Motor circuit conductors and connections

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

53 Current Overload Test – Bonding Conductors and Connections

53.1 If required by 14.9 or 14.13, bonding conductors and connections shall not open when carrying a current equal to twice the rating of the branch-circuit overcurrent protective device for the interval indicated in Table 53.1.

Table 53.1
Current overload test

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

54 Overvoltage and Undervoltage Tests

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

54.2 If a relay or other control is used in combination with a motor controller to prevent automatic recycling of the motor-compressor due to the operation of a protective device, the components involved shall comply with 54.1 under any condition which might result from operation of the protective device and de-energization of the circuit.

54.3 Relays and solenoids are to be connected to a supply source maintained at the overvoltage condition until the coils of the relays and solenoids reach constant temperature. The potential is then to be reduced to rated voltage and each relay and solenoid is to operate at this voltage. The potential is to be maintained at rated voltage until the coils reach constant temperatures. The potential is then to be reduced to the undervoltage condition, and each relay and solenoid is to operate at this voltage. A relay or solenoid which will not be subject to continuous operation is to be energized at the overvoltage condition and at rated voltage for the maximum time permitted by its duty cycle or until constant temperature is reached, whichever occurs first.

55 Insulation Resistance Test

55.1 Sheath-type heaters

55.1.1 Terminal seals of a sheath-type heating element which are exposed to moisture shall maintain an insulation resistance of not less than 50,000 ohms when cycles in the presence of moisture and shall comply with the Dielectric Voltage-Withstand Test, Section 40, following exposure.

55.1.2 The heater assembly is to be operated for 1000 cycles in a test chamber maintained at 98 percent relative humidity. The on and off times of each cycle are to be approximately 1-1/2 and 13-1/2 minutes, respectively.

55.2 Thermal and Acoustical Insulation Material

55.2.1 A room air conditioner employing insulating material likely to be affected adversely by moisture under conditions of use shall have an insulation resistance of not less than 50,000 ohms between live parts and interconnected dead metal parts after exposure for 24 hours to air having a relative humidity of 85±5 percent at a temperature of 90 ±4°F (32.0 ±2°C).

56 Accelerated Aging Test – Electric Heaters

56.1 Rubber, neoprene, or thermoplastic compounds used as a terminal seal on metal-sheathed heating elements shall withstand accelerated aging as indicated in Table 56.1 for the maximum temperature rise measured on the seal during the Temperature Test – Resistance Heat, Section 44, without deteriorating to a degree which will affect its use.

57 Reliability Test – Heater Terminations

57.1 Electric heaters employing integrally-molded leads or molded terminal assemblies shall withstand a load of 20 pounds-mass (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 shall not result in displacement of insulation or separation of the connection between the lead and heater.

58 Accelerated Aging Tests On Gaskets Sealing Compounds, And Adhesives

58.1 58.2 – 58.7 apply to gaskets and sealing compounds required for electrical enclosures as determined during the Rain Test, Section 35. 58.8 applies to adhesives required to secure such gaskets to enclosures or covers.

Table 56.1
Accelerated aging test criteria electric heaters

Table 56.1 revised August 6, 1996

Measured temperature rise		Material	Test program
°C	(°F)		
35	(63)	Rubber or neoprene	Air oven aging for 70 hours at 100 ±2°C (212 ±3.6°F)
35	(63)	Thermoplastic	Aged in full-draft, air-circulating oven for 168 hours at 100±1.0°C (212.0±1.8°F)
50	(90)	Rubber or neoprene	Air oven aging for 168 hours at 100 ±2°C (212 ±3.6°F)
50	(90)	Thermoplastic	Aged in full-draft, air-circulating oven for 240 hours at 100.0±1.0°C (212.0±1.8°F)
55	(99)	Rubber, neoprene or thermoplastic	Aged in full-draft, air-circulating oven for 168 hours at 113.0±1.0°C (235.4±1.8°F)
65	(117)	Rubber or neoprene	Aged in full-draft, air-circulating oven for 240 hours at 121.0±1.0°C (249.8±1.8°F)
65	(117)	Thermoplastic	Aged in full-draft, air-circulating oven for 168 hours at 121±1.0°C (249.8±1.8°F) or 1440 hours at 97.0±1.0°C (206.6±1.8°F)
80	(144)	Rubber, neoprene or thermoplastic	Aged in full-draft, air-circulating oven for 168 hours at 136.0±1.0°C (276.8±1.8°F)
100	(180)	Rubber, neoprene or thermoplastic	Aged in full-draft, air-circulating oven for 1440 hours at 136.0±1.0°C (276.8±1.8°F)
125	(225)	Rubber, neoprene or thermoplastic	Aged in full-draft, air-circulating oven for 1440 hours at 158±1.0°C (316.4±1.8°F)
175	(315)	Rubber, neoprene or thermoplastic	Aged in full-draft, air-circulating oven for 1440 hours at 210°C (410°F)

58.2 Neoprene or rubber compounds, except foamed materials, shall have physical properties as indicated in Table 58.1 before and after accelerated aging under the conditions indicated in Table 58.2 correspond to the maximum temperature rise measured on the gasket during the Temperature and Pressure Test, Section 38.

Table 58.1
Physical properties for gaskets

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

58.3 Foamed neoprene or rubber compounds are to be subjected to accelerated aging under the conditions indicated in Table 58.2. The compounds shall not harden or otherwise deteriorate to a degree which will affect their sealing properties.

58.4 Thermoplastic materials shall be subjected to accelerated aging under the conditions indicated in Table 58.2. Thermoplastic material shall not deform, or melt, or otherwise deteriorate to a degree which will affect its sealing properties. Solid polyvinyl-chloride gasket material shall have physical properties as indicated in Table 58.1 before and after the accelerated aging.

58.5 Tensile strength and elongation are to be determined using the test methods and apparatus described in Tests for Rubber Properties in Tension, ASTM D412-87.

58.6 Gaskets of materials other than those mentioned in 58.2 – 58.4 shall be nonabsorptive and shall provide equivalent resistance to aging and temperatures.

58.7 Sealing compounds shall be applied to the surface they are intended to seal. A representative sample of the surface with the sealing compound applied shall be subjected to accelerated aging under the conditions indicated in Table 58.2 for air-circulating oven exposure. The sealing compound shall not melt, become brittle, or otherwise deteriorate to a degree which will affect its sealing properties as determined by comparing an aged specimen to an unaged specimen.

58.8 If gaskets are secured by adhesives, specimens of the gasket, adhesive, and mounting surface shall be subjected to:

a) Accelerated aging under the conditions indicated in Table 58.2 for air-circulating oven exposure and

b) Immersion in distilled water for 3 days.

The force required to peel the gasket from its mounting surface after exposure shall be not less than 50 percent of the value determined on ″as-received″ specimens and in no case less than 2 pounds per inch (0.17 N/mm) of gasket width.

Table 58.2
Accelerated aging test conditions (Gaskets, sealing compounds, adhesives)

Table 58.2 revised August 6, 1996

Measured temperature rise °C	(°F)	Material	Test program
35	(63)	Rubber or neoprene	Air oven aging for 70 hours at 100 ±2°C (212 ±3.6°F)
35	(63)	Thermoplastic	Aged in full-draft, air-circulating oven for 168 hours at 87±1.0°C (188.6±1.8°F)
50	(90)	Rubber or neoprene	Air oven aging for 168 hours at 100 ±2°C (212 ±3.6°F)
50	(90)	Thermoplastic	Aged in full-draft, air-circulating oven for 240 hours at 100.0±1.0°C (212.0±1.8°F)
55	(99)	Rubber, neoprene or thermoplastic	Aged in full-draft, air-circulating oven for 168 hours at 113.0±1.0°C (235.4±1.8°F)
65	(117)	Rubber or neoprene	Aged in full-draft, air circulating oven for 240 hours at 121.0±1.0°C (249.8±1.8°F)
65	(117)	Thermoplastic	Aged in full-draft, air circulating oven for 168 hours at 121±1.0°C (249.8±1.8°F) or 1440 hours at 97.0±1.0°C (206.6±1.8°F)
80	(144)	Rubber, neoprene or thermoplastic	Aged in full-draft, air-circulating oven for 168 hours at 136.0±1.0°C (276.8±1.8°F)

59 Metallic Coating Thickness Test

59.1 The solution to be used for this test is to be made from distilled water and is to contain 200 grams per liter of reagent grade chromic acid, CrO^3 and 50 grams per liter of reagent grade concentrated sulphuric acid, H_2SO_4. The latter is equivalent to 27 milliliters per liter of reagent grade concentrated sulphuric acid, specific gravity 1.84, containing 96 percent of H_2SO_4.

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

59.3 The specimen and the test solution shall be kept in the test room long enough to acquire the room temperature, which shall be noted and recorded. The test is to be conducted at a room temperature of 70 to 90°F (21.1 to 32.2°C).

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

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

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

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

59.8 To calculate the thickness of the coating being tested, the thickness factor appropriate for the temperature at which the test was conducted is to be selected from Table 59.1 and multiplied by the time, in seconds, required to expose base metal as determined in 59.6.

60 Strength Tests – Pressure Containing Components

60.1 High-side parts of the refrigeration system shall have an ultimate strength equal to the highest of the following:

a) Five times marked high-side design pressure. See 79.7.

b) Five times the maximum pressure developed in the Temperature and Pressure Test, Section 38.

c) Five times the start-to-discharge pressure of a pressure relief valve or five times the set-pressure of a rupture member.

d) For units containing more than 22 pounds-mass (10 kg) of refrigerant, three times the maximum adjustable setting of the pressure-limiting device.

*e) *Deleted June 24, 1997**

f) For a unit equipped with a fusible plug, 2-1/2 times the vapor pressure of the refrigerant at the relief temperature of the fusible plug or 2-1/2 times the critical pressure of the refrigerant, whichever is smaller.

g) For an air-cooled unit, three times the maximum high-side pressure developed in the Condenser Fan Motor Failure Test, Section 41.

h) For water-cooled units, five times the pressure developed in the Condenser Water Failure Test, Section 42.

i) One and one-half times the vapor pressure of the refrigerant at 140°F (60°C).

Table 59.1
Thickness of coating factors

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

60.2 Low-side parts of the refrigeration system shall have an ultimate strength equal to the highest of the following:

a) Three times the marked low-side design pressure. See 79.7.

b) Three times the maximum low-side pressure developed in the Temperature and Pressure Test, Section 38.

c) For an air-cooled unit, three times the maximum low-side pressure developed in the Condenser Fan Motor Failure Test, Section 41, including discharge pressure relieved to the low-side and equalization pressure developed after compressor shut-down.

d) For a water-cooled unit, three times the maximum low-side pressure developed in the Condenser Water Failure Test, Section 42, including discharge pressure relieved to the low-side and equalization pressure developed after compressor shut-down.

e) One and one-half times the vapor pressure of the refrigerant at 140°F (60°C).

Exception No. 1: Low-side parts exposed to high-side pressure under reverse-cycle heating shall comply with the requirements in 60.1.

Exception No. 2: Low-side pressure vessels shall have an ultimate strength of not less than five times the highest of the following:

a) Low-side design pressure,

b) Maximum pressure developed in the Temperature and Pressure Test, Section 38

c) Start-to-discharge pressure of a pressure-relief valve, or

d) The set-pressure of the rupture member. See also 31.3.2 and 31.4.3.

Exception No. 3: Low-side pressure vessels protected by a fusible plug shall have an ultimate strength equal to 2-1/2 times the vapor pressure of the refrigerant at the relief temperature of the fusible plug or 2-1/2 times the critical pressure of the refrigerant, whichever is smaller.

60.3 With reference to 60.1 (i) and 60.2 (e), vapor pressures of R12, R22, R134a, and R500 at 140°F (60°C) are 207, 337, 229, and 248 psig (1427, 2323, 1579, and 1710 kPa), respectively.

60.3 revised June 24, 1997

60.4 A refrigerant-containing components having a marked working pressure shall have an ultimate strength equal to five times the marked working pressure.

60.5 Pressure vessels bearing the ASME Code ″U″ symbol and having a working pressure not less than required by 60.1 or 60.2, as applicable without test.

60.6 Pressure-actuated refrigeration controllers rated for the application are exempt from strength test requirements for pressure containing components.

60.7 With reference to 60.1 and 60.2, sections of the refrigeration system constructed of continuous tubing or of lengths of tubing connected by hard-soldered, brazed or welded joints are considered as complying with the above requirements, provided the tubing employed in the assembly complies with the requirement in 28.1.

60.8 Two samples of each refrigerant-containing part are to be tested to determine compliance with these requirements. The test medium is to be any nonhazardous liquid, such as water. The test samples are to be filled with the test medium to exclude air and are to be connected in a hydraulic pump system. The pressure is to be raised gradually until the required pressure is reached. This pressure is to be maintained for 1 minute, during which time the samples shall not burst or leak. Leakage is to be determined visually; for example, by examination of the sample for release of the test medium or as evidenced by a decreasing hydrostatic gauge pressure.

Exception: Where gaskets are employed in components of refrigeration systems employing Refrigerant 12, 22, 134a or 500, leakage at gaskets is acceptable if such leakage occurs at a pressure greater than 40 percent of the required pressure. The component is to be capable of withstanding the required test pressure even though leakage occurs at the gaskets or seals.

60.8 revised June 24, 1997

60.9 Steam and hot-water heating coils shall have an ultimate strength equal to five times the marked maximum operating pressure, but not less than 150 psig (1034 kPa), when tested as described in 60.8.

POLYMERIC MATERIALS – PERFORMANCE

61 Vertical Burning Test – 5V Materials

61.1 This test is to be conducted for the purpose of classifying polymeric materials as 5V. The test apparatus and test method are to be those used in Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, for 5V materials. Samples of the complete finished part or sections obtained from the finished part are to be tested with the flame applied to areas of the part judged to be most critical with respect to ignition.

61.1 revised October 28, 1998

61.2 Two sets of at least three specimens each are to be provided for the test. One set is tested in the as-received condition, and the other set tested after aging:

a) In accordance with Table 67.1 if the polymeric material is used as an enclosure or a structural part or

b) At 194°F (90°C) for 168 hours if the material is used as thermal or acoustical insulation or as a functional part.

If a polymeric material is used as indicated in both (1) and (2) above, it is to be aged at the more severe set of conditions.

61.3 Two of the three specimens from each set shall show acceptable performance as follows. Specimens shall not continue to flame or exhibit consuming combustion for more than 1 minute after the fifth application of the test flame. Particles shall not drip from the specimen at any time during the test. Performance is not acceptable if the material is destroyed in the area of the test flame to such an extent as to produce a condition that would increase the risk of fire, electric shock, or injury to persons.

62 Vertical Burning Test – V-0, V-1, Or V-2 Solid Polymeric Materials

62.1 This test is to be conducted for the purpose of classifying polymeric materials as V-0, V-1, or V-2. The test apparatus and test method are to be those used in Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, for V-0, V-1, and V-2 materials. Test samples are to be obtained from the finished part and are to be 5 inches (127 mm) long, 1/2 inch (12.7 mm) wide, and in the minimum and maximum thicknesses used in the part. Two sets of five samples each are required for test.

62.1 revised October 28, 1998

63 Horizontal Burning Test – HBF, HF-1, Or HF-2 Foamed Materials

63.1 General

63.1.1 This test is to be conducted for the purpose of classifying foamed polymeric materials as HBF, HF-1, or HF-2.

63.1.1 revised October 28, 1998

63.2 Test specimens and conditioning

63.2.1 Test specimens are to be 6 inches (152 mm) long, 2 inches (50.8 mm) wide, and 1/2 inch (12.7 mm) thick. Edges are to be smooth and the radius on the corners is not to exceed 0.05 inch (1.27 mm). Any loose particles are to be removed from the specimen surfaces.

63.2.2 Two sets of specimens are to be tested after conditioning as indicated below:

a) One set of five specimens is to be conditioned for at least 48 hours at a temperature of 73±3.6°F (23±2°C) and a relative humidity of 50±5 percent prior to testing.

b) One set of five specimens is to be conditioned in a circulating air-oven for 168 hours at 158±1.8°F (70±1°C) and then cooled in a desiccator, over anhydrous calcium chloride, for at least 4 hours at room temperature prior to testing.

63.3 Apparatus

63.3.1 The test apparatus is to consist of the following:

a) Draft-free test chamber, enclosure, or laboratory hood.

b) Laboratory Burner – A Bunsen or Tirrill burner, having a tube with a length of 4.0 inch (101.1 mm) and an inside diameter of 3/8 inch (9.5 mm), provided with a wing tip [dimensions of slit approximately 1-7/8 by 0.05 inch (47.6 by 1.27 mm)].

c) Ring Stands – Two laboratory ring stands with clamps adjustable to the desired angles and heights, or equivalent equipment.

d) Gas Supply – A supply of technical grade methane gas with suitable regulator and meter for uniform gas flow. Natural gas having a heat content of approximately 1000 Btu per cubic feet (37 MJ/m^3) has been found to provide similar results.

e) Wire Cloth (Plain Weave, Low Carbon, Plain Steel) – Four mesh (four openings per 25.4 mm), 0.035±0.002 inch (0.89±0.05 mm) diameter steel wire. An 8.5 by 3.0 inch (216 by 76 mm) piece of wire cloth is to be formed to provide a 90 degree upward bend, 0.5 inch (13 mm) high, at one end. The cloth mesh and wire diameter is to be determined as described in the Specifications for Industrial Wire Cloth and Screens (Square Opening Series), ASTM E437-85(1990), Appendix A3. The wire diameter is to be measured perpendicular to its corrugations using a micrometer or caliper that reads to the nearest 0.001 inch (0.03 mm).

f) Stopwatch or other acceptable timing device.

g) A supply of dry absorbent surgical cotton.

h) A desiccator containing anhydrous calcium chloride.

i) Conditioning room or chamber capable of being maintained at 73±3.6°F (23±2°C) and a relative humidity of 50±5 percent.

j) Conditioning Oven – A full draft circulating air-oven capable of being maintained at 158±1.8°F (70±1°C).

63.4 Test method

63.4.1 The burning test is to be conducted in a chamber, enclosure, or laboratory hood that is free from drafts. An enclosed laboratory hood with a heat resistant glass window and an exhaust fan for removing products of combustion after the test is recommended.

63.4.2 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.

63.4.3 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 a 6 by 2 inch (152 by 50.8 mm) surface of the specimen horizontal. The end of the specimen closest to the 1 inch (25.4 mm) 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 facing downward. Specimens with adhesive on one side are to be tested with the adhesive side facing upward.

63.4.4 In tests for classifying HF-1 and HF-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.

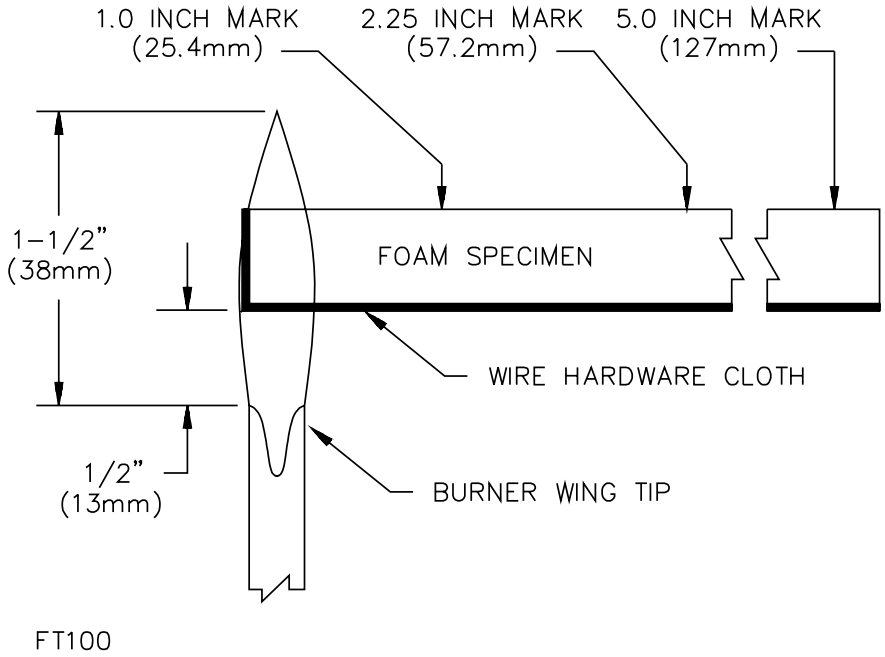
63.4.4 revised October 28, 1998

63.4.5 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.

63.4.6 The burner, with wing tip, 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 (38 mm) 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. It is to be placed 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 63.1. The center of the width of the wing tip is to be in line with the longitudinal axis of the specimen.

Figure 63.1
Horizontal burning test for HBF, HF-1, OR HF-2 classification

Figure 63.1 revised October 28, 1998



63.4.7 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.

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63.5 Material classification

63.5.1 Materials classified HBF shall either:

a) Not have any specimens with a burning rate exceeding 1.5 inch (38.1 mm) per minute, measured between the 1 inch (25.4 mm) and 5 inch (127 mm) reference marks, or

b) Have each specimen cease to burn before the flaming or glowing reaches the 5 inch (127 mm) reference mark.

Exception: If only one specimen from a set of five specimens does not comply with the requirements in either (a) or (b), another set of five specimens, subjected to the same conditioning (see 63.2.2), shall be tested. All specimens from this second set shall comply with the requirements in either (a) or (b).

63.5.1 revised October 28, 1998

63.5.2 Materials classified as HF-1 or HF-2 shall:

a) Not continue to flame for more than 2 seconds after the test flame is removed.

Exception: One specimen in each set of five may continue to flame for more than 2 seconds but not more than 10 seconds.

b) Not have any specimens affected for a distance greater than 2.25 inches (57 mm) from the end exposed to the test flame.

c) Not have any specimens with glowing combustion which:

1) Continues for more than 30 seconds after removal of the test flame and

2) Travels past the 2.25 inch reference mark.

d) For HF-1 material, not have any specimens drip flaming particles which ignite the layer of cotton located below the specimen.

Exception: If, for any one of the following 5 reasons, a set of specimens does not comply with (a) – (d), another set of five specimens, subjected to the same conditioning (see 63.2.2) is to be tested. All specimens in this second set shall comply with (a) – (d).

1) A single specimen in the set flames for more than 10 seconds,

2) Two specimens in the set flame for more than 2 seconds but less than 10 seconds,

3) One specimen in the set flames for more than 2 seconds but less than 10 seconds; and a second specimen flames for more than 10 seconds,

4) One specimen in the set does not comply with (b) or (c), or

5) For HF-1 material, one specimen in the set does not comply with (d).

63.5.2 revised October 28, 1998

64 Horizontal Burning Test – HB Polymeric Material

64.1 This test is to be conducted for the purpose of classifying polymeric materials as HB. The test apparatus and test method are to be those used in Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, for HB materials.

64.1 revised October 28, 1998

64.2 Test specimens are to be obtained from the finished part and are to be 5 inches (127 mm) long, 1/2 inch (12.7 mm) wide and in the minimum and maximum thicknesses used in the part. The edges of the test specimen are to be smooth.

64.3 Where specimens of HB materials undergo significant longitudinal shrinkage during the burning test, due to relief of strains or molecular orientation by heat from the burning portion, as may be the case with specimens taken from finished parts, the dimensional change may be taken into account in determining the rate of burning. Measurements may be made of the changes in dimensions of representative specimens of the material after annealing between glass plates at an appropriate temperature and a correction for such dimensional changes applied to the observed rate of burning, or the burning tests may be conducted on specimens which have been annealed.

64.3 revised October 28, 1998

65 Heat Deflection Test

65.1 The heat deflection temperature of a polymeric material used as an enclosure or as a structural part shall not be less than 18°F (10°C) higher than the maximum temperature measured during the Temperature and Pressure Test, Section 38; Temperature Test – Steam or Hot Water Heat, Section 43; or Temperature Test – Resistance Heat, Section 44; but not less than 158°F (70°C) in any case.

65.2 The deflection temperature is to be determined at a loading of 66 psi fiber stress in accordance with the procedure employed in short term evaluation of polymeric materials, UL 746A.

66 Water Absorption Test

66.1 If a polymeric material is used as an enclosure or structural part, the percentage of water absorption by weight shall not exceed 1.5 percent.

Exception: If dimensional changes in any measurable direction on the specimen tested do not exceed 0.1 percent, the moisture absorption may be not more than 2 percent by weight.

66.2 Three specimens, approximately 1 by 2 inches (25.4 by 50.8 mm) and in the thickness obtained from the finished part, are to be used. Each specimen is to be dried in a calcium chloride desiccator for 24 hours, then weighed, and immersed in distilled water at 68 to 86°F (20 to 30°C) for 24 hours. The specimens are to be removed from the water, wiped free of surface water, and reweighed immediately. The percentage increase in weight is to be calculated.

67 Environmental Exposure

67.1 Air oven aging

67.1.1 Specimens of a polymeric material used as an enclosure or as a structural part are to be aged in a full-draft circulating air oven at the aging temperature and time determined by the intended use of the finished part in accordance with Table 67.1.

67.1.2 Following the air oven aging, the specimens are to be subjected to the burning test required for the material application (see Sections 61 – 64) and individually to the:

a) Tensile Strength Test, Section 68;

b) Flexural Strength Test, Section 69; and

c) Izod Impact Test, Section 70, or Tensile Impact Test, Section 73.

67.2 Ultraviolet light and water exposure

67.2.1 Polymeric materials which are used for enclosures or for structural parts and which are affected by sunlight are to be exposed to ultraviolet light and water for periods of 360 and 720 hours. The apparatus and method of exposure is to be in accordance with the procedure employed in evaluation of polymeric materials for use in electrical equipment, UL 746C.

67.2.2 Following exposures, the specimens are to be subjected to the burning test required for the material application (see Sections 61 – 64) and individually to the:

a) Tensile Strength Test, Section 68;

b) Flexural Strength Test, Section 69; and

c) Izod Impact Test, Section 70, or Tensile Impact Test, Section 73.

67.3 Water immersion

67.3.1 Specimens of a polymeric part made of 5V material are to be immersed in distilled water at:

a) 180°F (82°C) for periods of 7 and 14 days or

b) 140°F (60°C) for periods of 30 and 60 days with a complete change of water on each of the first 5 days.

After the immersions, the specimens are to conditioned in air at 73.4±3.6°F (23±2°C) and 50±5 percent relative humidity for 14 days.

67.3.1 revised October 28, 1998

Table 67.1
Aging conditions

Intended Use[a]	Operating Temperature[b] °C	Operating Temperature[b] (°F)	Aging Temperature °C	Aging Temperature (°F)	Aging Time, Hours
Enclosure (Indoor only)	65	(149)	90	(194)	168
Enclosure	75	(167)	90	(194)	1440
Enclosure	85	(185)	95	(203)	1440
Enclosure	95	(203)	105	(221)	1440
Enclosure	100	(212)	121	(250)	1440
Structural	50	(122)	75	(167)	1440
Structural	75	(167)	100	(212)	1440
Structural	100	(212)	121	(250)	1440

[a] A structural part is assumed to be protected from sunlight. If a material is used as both an enclosure and a structural part, it is to be subjected to the aging condition shown for structural parts. Where such material is exposed to sunlight, a minimum operating temperature of 75°C (167°F) will be assumed.

[b] The operating temperature is to be the maximum value measured during the Temperature and Pressure Test, Section 38; Temperature Test–Steam or Hot Water Heat, Section 43; or Temperature Test – Resistance Heat, Section 44. If the operating temperature is between two values shown in the Table, the higher of these two values is used in determining the aging conditions.

67.3.2 Following immersion and humidity conditioning, the specimens are to be subjected to the burning test described in Section 61. Also, following immersion, specimens are to be removed from the water and placed in distilled water maintained at room temperature for 1/2 hour before being subjected individually to the:

a) Tensile Strength Test, Section 68;

b) Flexural Strength Test, Section 69; and

c) Izod Impact Test, Section 70, or Tensile Impact Test, Section 73.

67.3.3 Specimens of materials being investigated in accordance with the requirements for V-0, V-1, V-2, or HB materials are to be immersed in distilled water at 158°F (70°C) for 7 and 14 days, with a complete change of water on each of the first 5 days. Following immersion, the specimens are to be removed from the water and placed in distilled water maintained at room temperature for 1/2 hour before being subjected to the applicable burning test as described in Sections 62 and 64 and individually to the:

a) Tensile Strength Test, Section 68;

b) Flexural Strength Test, Section 69; and

c) Izod Impact Test, Section 70, or Tensile Impact Test, Section 73.

67.3.3 revised October 28, 1998

68 Tensile Strength Test

68.1 The tensile strength of a polymeric material used as an enclosure or as a structural part shall:

a) Not decrease more than 50 percent and

b) Be essentially stabilized and no longer significantly changing with exposure time.

68.2 The tensile strength is to be determined in accordance with the procedures specified in the Tests for Tensile Properties of Plastics, ASTM D638-91, on specimens obtained from the finished part, in the as-received condition and after the Environmental Exposure, Section 67.

69 Flexural Strength Test

69.1 The flexural strength of a polymeric material used as an enclosure or as a structural part shall:

a) Not decrease more than 50 percent and

b) Be essentially stabilized and no longer significantly changing with exposure time.

69.2 The flexural strength is to be determined in accordance with the Tests for Flexural Properties of Plastics and Electrical Insulating Materials, ASTM D790-91, on specimens obtained from the finished part, in the as-received condition and after Environmental Exposure, Section 67.

70 Izod Impact Test

70.1 The Izod impact strength of a polymeric material used as an enclosure or as a structural part shall:

a) Not decrease more than 50 percent and

b) Be essentially stabilized and no longer significantly changing with exposure time.

Exception: In place of the Izod Impact Test, the Tensile Impact Test, Section 73, is generally conducted on materials less than 1/8 inch (3.2 mm) thick and on materials which tend to flex (twist) in the test.

70.2 The Izod impact strength is to be determined in accordance with the procedures specified in Tests for Impact Resistance of Plastics and Electrical Insulating Materials, ASTM D256-90b, on specimens obtained from the finished part, in the as-received condition and after Environmental Exposure, Section 67.

71 Burnout Test – High-Voltage Transformers

71.1 There shall be no emission of flame or molten metal from the unit enclosure when a high-voltage transformer is operated under the conditions described in 71.2 and 71.3.

Exception: This test does not apply to a high-voltage transformer that is provided with thermal overload protection of other than the nonrenewable thermal cutoff type (see 22.1.2.1) or that is protected by an overcurrent device(s) in accordance with the requirements in 22.1.3.1.

71.2 Three samples of the transformer are to be operated continuously at the normal test voltage indicated in Table 33.1 and rated frequency with the enclosure grounded. The test ambient temperature is to be approximately 77°F (25°C) and operation is to be continued until constant temperature is indicated by a thermocouple on the enclosure or until burnout occurs. The circuit on which the transformer is tested is to be protected by fuses rated not less than that required for the unit.

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

a) A resistance load to provide a current equal to three times the full rated transformer secondary current, or

b) If the transformer supplies a motor with or without additional loads, a resistance load to provide a current equal to the motor locked-rotor current plus any additional loads, or

c) If the transformer supplies an inductive load (other than a motor), such as the coils of relays, solenoids, and the like, a resistance load to provide a current equal to the sum of such loads with the armature of the largest blocked open.

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

72 Overload Test – High-Voltage Transformers

72.1 This test applies to a high-voltage transformer provided with thermal protection of other than the nonrenewable thermal cutoff type. See 22.1.2.1.

72.2 Temperatures of a thermally protected high-voltage transformer, measured on the surface of the windings, shall not exceed the insulation temperature rating when the transformer is tested as indicated in 72.3 and 72.4. Insulation temperature rating is defined as the rating for the class of insulation; such as, 105°C for Class 105 insulation, 130°C for Class 130 insulation, and the like.

72.3 A variable resistance load is to be connected to the output terminals and the transformer operated continuously at the normal test voltage indicated in Table 33.1. If the protective device controls a switching device that, in turn, interrupts primary current to the transformer, the switching device is to be in the circuit. The test ambient temperature is to be approximately 77°F (25°C). The resistance load is to be adjusted so that the transformer winding is brought to a stabilized temperature of approximately 18°F (10°C) below its insulation rating. The load is then to be gradually increased until operation of the protector occurs.

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

72.5 The transformer shall comply with the Dielectric Voltage-Withstand Test, Section 40, following the test specified in 72.3 and 72.4.

73 Tensile Impact Test

73.1 If conducted in place of the Izod Impact Test, Section 70, the tensile impact strength of a polymeric material used as an enclosure or as a structural part shall:

a) Not decrease more than 50 percent and

b) Be essentially stabilized and no longer significantly changing with exposure time.

73.2 The tensile impact strength is to be determined in accordance with the procedures specified in the Test for Tensile-Impact Energy to Break Plastics and Electrical Insulating Material, ASTM D1822-89, on specimens obtained from the finished part, in the as-received condition and after Environmental Exposure, Section 67.

74 Impact Test

74.1 When subjected to impact, a polymeric material used as an enclosure or as a structural part shall not break or crack to the extent that:

a) Electrical spacings are less than those specified in Sections 24 and 25.

b) Moving parts or uninsulated high-voltage live parts are exposed when judged by the requirements for Assembly, Section 6.

Exception: A part which does not serve to enclose uninsulated live parts or to protect against a risk of injury to persons need not comply with this requirement.

74.2 An outer enclosure, including a unit base pan, shall withstand an impact of 5 foot-pounds (6.8 J). An internal structural part or an internal enclosure intended to protect against contact with uninsulated high-voltage live parts shall withstand an impact of 1.5 foot-pounds (2 J).

Exception: Outer enclosures located on the indoor section of the unit and intended to guard moving parts shall withstand an impact of 1.5 foot-pounds.

74.3 The complete part is to be employed in the test. The impact is to be obtained using a steel sphere, 2 inches (50.8 mm) in diameter and weighing 1.18 pounds-mass (0.54 kg). The sphere is to be suspended by a cord and swung as a pendulum or allowed to fall freely to produce the required impact. The vertical distance of travel is to be 50.8 inches (1291 mm) to produce a 5 foot-pound (6.8 J) impact and 15.25 inches (387 mm) to produce a 1.5 foot-pound (2 J) impact. The test is to be repeated on enclosures exposed to weather after conditioning for 24 hours at minus 40°F (minus 40°C).

75 Volume Resistivity Test

75.1 If electrical spacings between uninsulated live parts and a polymeric material are less than specified in Sections 24 and 25, the volume resistivity of the polymeric material shall be not less than 50 megohms-cm in the as-received condition and not less than 10 megohms-cm after exposure to moist air having a relative humidity of 85 ±5 percent at a temperature of 89.6 ±5.4°F (32 ±3°C) for 96 hours.

75.2 The volume resistivity is to be determined in accordance with requirements for short term property evaluations of polymeric materials, UL 746A.

MANUFACTURING AND PRODUCTION TESTS

76 Pressure Tests

76.1 Each room air conditioner shall be tested and proved tight at not less than the design pressure(s) marked on the appliance. See 79.7.

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

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

76.3 At least once each year, a strength test shall be conducted on refrigerant-containing components of the shell-type which have an inside diameter greater than 3 inches (76.2 mm) including motor-compressor enclosures. The test shall be conducted on at least one sample of each size and type. The part shall comply with requirements of Strength Tests – Pressure Containing Components, Section 62. Such tests may be conducted either by the room air conditioner manufacturer or by the manufacturer of the component.

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

77 Production Line Dielectric Voltage-Withstand Test

77.1 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.

77.1 revised May 2, 1996

77.1.1 The production-line test shall be conducted in the time and at the potential specified in either Condition A or Condition B of Table 77.1.

77.1.1 added May 2, 1996

Table 77.1
Production-line test conditions

Table 77.1 added May 2, 1996

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

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

[b] Maximum marked voltage.

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

77.2 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.

77.2 revised May 2, 1996

77.2.1 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.

77.2.1 added May 2, 1996

77.3 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).

77.3 revised May 2, 1996

77.4 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.

77.4 revised May 2, 1996

77.5 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.

77.5 revised May 2, 1996

77.6 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.

77.6 added May 2, 1996

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

77.7 added May 2, 1996

77.8 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 with a single-pole primary switch, if used, in the off position, or 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.

77.8 added May 2, 1996

78 Production Line Grounding Continuity Test

78.1 The manufacturer shall test each room air conditioner which has a power supply cord to determine that electrical continuity exists between the grounding blade of the attachment plug and the frame or enclosure of the appliance.

78.2 This test is also required for permanently-connected units, including accessories for such units, that derive power means of internal cord and plug connection.

78.3 An indicating device, such as an ohmmeter, low-voltage battery- and buzzer-combination, or the like, may be employed in the test mentioned in 78.1.

MARKING

79 General

79.1 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 requirements for marking and labeling systems, UL 969.

79.2 Each room air conditioner 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 79.4, 80.1 – 80.4, and 81.1.

d) The kind and amount of refrigerant in pounds, ounces, or both. See 79.3, 79.5, and 79.6.

e) The high- and low-side design pressures. See 79.3 and 79.7.

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.

79.3 With reference to 79.2 (d) and (e), room air conditioners may be marked with equivalent SI units in addition to the USA customary units of measure.

79.4 Room air conditioners shall be marked with the operating voltage, the frequency, and the total or individual loads as indicated in 80.2 and 81.1. Permanently-connected room air conditioners shall also be marked with the number of phases.

79.5 The kind of refrigerant shall be designated by number. The number shall be prefixed or suffixed with the word ″Refrigerant″ or it shall be prefixed with the letter ″R″ or the trade name of the refrigerant. Combinations of these marks are acceptable, except that employing the letter ″R″ and the word ″Refrigerant″ in the same marking group is not appropriate.

79.5 revised May 2, 1996

79.6 Examples for refrigerant marking are as follows: R12, Refrigerant 12, or 12 Refrigerant; (Trade Name) 12, (Trade Name) R 12, or (Trade Name) 12 Refrigerant as shown in the Number Designation and Safety Classification of Refrigerants, ANSI/ASHRAE 34-1992.

79.6 revised May 2, 1996

79.7 The high- and low-side design pressures marked on the room air conditioner shall not be less than the maximum values recorded during the Input Test (cooling mode), Section 37, nor less than the values in Table 79.1.

79.7 revised May 2, 1996

Table 79.1
Minimum design pressure

Table 79.1 added May 2, 1996

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)

For other refrigerants, the minimum design pressure shall be not less than the values recorded during the Input Test (cooling mode), Section 37, nor less than the saturation pressure of the refrigerant at the following temperatures:

80°F (26.5°C) for low-sides

105°F (40.5°C) for water-cooled high-sides

125°F (51.7°C) for air cooled-high-sides

79.8 The information specified in 79.2 shall be on a nameplate(s), located so as to be visible after installation of the room air conditioner. The nameplate need not be located on the outside of the unit provided it is readily visible by opening a door or removing a cover after installation.

79.9 A room air conditioner that incorporates a hermetic refrigerant motor-compressor, with a thermal protector that provides protection in accordance with 20.3 (b), shall be permanently marked ″Motor-Compressor Thermally Protected″ or with an equivalent statement unless the motor-compressor(s) is so marked.

79.10 A room air conditioner that incorporates a protective system that provides motor-compressor protection in accordance with in 20.3 (d), shall be permanently marked ″Motor-Compressor Thermally Protected System″ or with an equivalent statement.

79.11 If parts or sections of a room air conditioner are separately shipped from the factory, the primary nameplate for the room air conditioner shall comply with the requirements in 79.8, 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 private labeler's name or identifying symbol and a distinctive model or type designation.

79.12 The requirements of 79.11 apply to any essential element such as outside louver assemblies, wall sleeves; cooling, heating, blower, or control sections; indoor cabinets, decorative fronts, air discharge adapters, and the like, which are not packaged with the section bearing the primary nameplate for the unit.

79.13 If, as determined by the Starting Test, Section 39, a unit will not start, run, and restart when connected to a circuit protected by ordinary (not time-delay) fuses, the unit shall be permanently marked as shown in Table 79.1 with an equivalent wording. The marking shall be located so as to be visible after installation of the room air conditioner. The marking need not be located on the outside of the unit provided it is readily visible by opening a door or removing a cover, panel or the like after installation.

Table 79.1
Fuse markings

Type of unit	Marking
Permanently-connected	Use time-delay fuse.[a]
Cord-connected	If connected to a circuit protected by a fuse, use time-delay fuse.[b]

[a] If the unit is acceptable for connection to a circuit protected by a circuit breaker (see 80.7 – 80.10), the marking specified for cord-connected units may be used.

[b] The marking ″Use a circuit breaker or time-delay fuse″ is considered equivalent.

79.14 If the design of the room air handling section of a room air conditioner necessitates disassembly for the purpose of cleaning or similar servicing by the user and if such disassembly involves the exposure of persons to unintentional contact with any normally enclosed or protected moving part or hot part, the room conditioner shall be permanently marked with the word ″CAUTION″ and the following or equivalent statement(s), as applicable:

a) Moving Parts. Do Not Operate Unit With [a] Removed.

b) Hot Parts. Do Not Operate Unit With [a] Removed.

[a]Specify appropriate part.

When applying this requirement it will be assumed that parts, such as decorative fronts, air intake and discharge grilles, filters, and the like, will be periodically removed.

79.15 If the design of a room air conditioner necessitates the use of tools for removal of panels, covers, and the like, for the purpose of servicing by the user as indicated in 6.7 and if such disassembly involves the exposure of persons to unintentional contact with any normally enclosed or protected uninsulated live part, the room air conditioner shall be permanently marked with the word ″CAUTION″ and the following or equivalent statement:

Risk of Electric Shock. Disconnect Power Before Servicing Unit.

79.16 The warning markings indicated in 79.14 and 79.15 shall be in letters no less than 1/8 inch (3.2 mm) high and shall be located so as to be visible before or immediately upon removal of a cover, panel, or the like, which encloses or protects the moving part, hot part, or uninsulated live part. The marking shall not be on the back of a removable cover or panel.

79.17 With respect to 79.16, if the marking is located on a removable panel or cover, the design of the panel or cover or its means of attachment shall be such that the panel cannot be reversed or inverted when it is replaced so as to obscure the warning.

79.18 If a window-type room air conditioner is shipped from the factory without mounting hardware, the following markings shall be provided:

a) The package containing the mounting hardware and installation instructions shall be identified by the manufacturer's or private labeler's name or identifying symbol and a distinctive model or type designation.

b) The room air conditioner or its shipping carton shall be marked to:

1) Indicate that mounting hardware is not included and

2) Specify the model or type designation of the mounting hardware which is intended for use with the unit.

79.19 If a window-type room air conditioner is shipped from the factory with mounting hardware but can be used with other types of mounting hardware which are shipped separately, the following marking shall be provided:

a) The package containing the separately-shipped mounting hardware and installation instructions shall be identified by the manufacturer's or private labeler's name or identifying symbol and a distinctive model or type designation.

b) The installation instructions included with the room air conditioner shall specify the model or type designations of the alternate mounting hardware intended for use with the unit.

79.20 If replaceable fuses are provided for overcurrent protection of a transformer or control circuit conductor (see 22.2.3 and 23.4.2), the unit shall be marked with the maximum current rating of fuse. This marking, that may be a paper sticker or decal, shall appear adjacent to the fuseholder.

Exception: If supplementary fuses are used in accordance with the exception to 22.2.3 and 23.4.2, the marking shall also include the fuse manufacturer's or private labeler's name, catalog designation, and fuse voltage rating.

79.21 An electrical accessory intended for field installation in or on a room air conditioner shall be permanently marked with the name or identifying symbol of the manufacturer or private labeler, with a catalog number or equivalent designation, and with the type of equipment with which it is intended to be used. The associated room air conditioner shall be marked to indicate the catalog number or equivalent designation of such an accessory and the name of the manufacturer or private labeler of the accessory.

79.22 With regard to 78.2, instructions for installing the accessory shall be provided on or with the accessory. A statement shall be included in the instructions warning the user that the room air conditioner must be disconnected from the source of electrical supply before attempting the installation and that the accessory is intended for use only with the room air conditioner that is marked to indicate such use.

Exception: If the accessory is designed to be installed by means of receptacles and plug-in connectors which have been investigated to make and break circuits under load, and if such connection or disconnection does not result in exposure of uninsulated live parts, the statement that the room air conditioner must be disconnected from the source of electrical supply need not be employed.

79.22 revised September 3, 2002

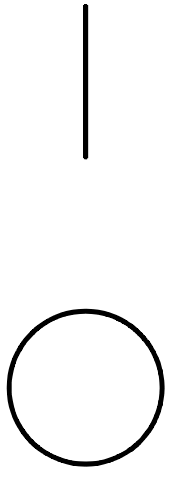
79.23 If a manufacturer produces room air conditioners at more than one factory, each unit shall have a permanent distinctive marking to identify it as the product of a particular factory.

79.24 Where symbols are used, on or near controls, for example switches, push buttons, and similar controls, to indicate ″ON″ and ″OFF″ conditions, they may be identified by the symbols illustrated in Figure 79.1.

79.24 added September 3, 2002

Figure 79.1
On and off symbols

Figure 79.1 added September 3, 2002



S3486

IEC Publication 417, Symbols 5007 and 5008

80 Permanently-Connected Units

80.1 A permanently-connected room air conditioner shall be marked with the individual electrical loads. The marking shall clearly indicate which loads operate concurrently unless it is obvious that the total load is the sum of the individual loads.

80.2 The individual loads shall be indicated as follows:

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

1) Full-load amperes.

2) Horsepower.

Exception: Motors rated less than 1/8 horsepower (93.2 W output) may be marked in watts.

b) For a hermetic refrigerant motor-compressor,

1) Rated-load amperes.

2) Locked-rotor amperes (see 80.4).

3) The branch-circuit selection current in amperes, if required in accordance with 80.12.

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

Exception: A heater load of less than 1 ampere and pilot duty loads need not be marked.

No Text on This Page

80.3 The nameplate ampere rating for a single-phase room air conditioner intended for permanent connection to a single branch circuit may be a single ampere value rather than individual ratings for individual loads, under the following conditions:

a) The single load rating (amperes), voltage, rating, and the marked maximum rating of supply circuit protective device, do not exceed the following values:

Maximum ampere rating	Maximum voltage rating	Maximum rating of overcurrent protective device, amperes
12	120	15
16	120	20
12	208 or 240	15

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

80.4 Except where a single ampere rating is permitted by 80.3, a permanently-connected room air conditioner shall be marked with the locked-rotor current of single-phase compressors having rated-load currents of more than 9 amperes at 115 volts and more than 4.5 amperes at 230 volts; and with the locked-rotor current of compressors rated above 230 volts or if polyphase.

80.5 Unless marked as a single load in accordance with 80.3, a permanently-connected room air conditioner employing:

a) More than one motor or

b) A motor and other loads, which are operated from a single supply line shall be permanently marked on the nameplate with the minimum circuit ampacity required for the supply circuit conductors.

If more than one such power supply is to be connected to the room air conditioner, the ampacity shall be marked for each circuit.

80.6 The minimum ampacity required in accordance with 80.5 shall be at least equal to:

a) 125 percent of the rated-load current or branch circuit selection current, whichever is greater, of the motor-compressor, plus

b) 125 percent of the current rating of space (comfort) heaters, plus

c) The rated current of other motors and loads supplied.

The marked rated-load current or branch-circuit selection current, whichever is greater, of a hermetic refrigerant motor-compressor is to be used in the calculations and the full-load current equivalent to the rated horsepower, as determined from the National Electrical Code, ANSI/NFPA 70-1990, is to be used for conventional (nonhermetic) motors. The largest motor is to be determined by its rated current. The ampacity marked on the nameplate is to be the highest of those calculated for each concurrent load condition.

80.7 Except as indicated in 80.8 – 80.10, a permanently-connected room air conditioner employing:

a) More than one motor or

b) A motor and other loads which are operated from a single supply line,

shall be permanently marked on the nameplate with the maximum current rating of the supply circuit fuses. If more than one such power supply is to be connected to the room air conditioner, the fuse size shall be marked for each circuit.

Exception: The marking may additionally specify a maximum size of HACR type circuit breaker if required short circuit tests (see Section 52) have been conducted using HACR Type circuit breakers.

80.8 Both fuses and circuit breakers may be specified for protection of the supply circuit provided that:

a) The branch circuit is protected at no more than 20 amperes at 125 volts or less, or 15 amperes at more than 125 volts but less than 600 volts, and

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

80.9 The marking indicated in 80.7 may specify both a maximum fuse and circuit breaker size, or may refer to the maximum rating of overcurrent protective device without referring to fuses or circuit breakers if the internal motor circuit involved is protected by:

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

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

See Limited Short Circuit Test, Section 52.

80.10 The marking indicated in 80.7 may specify both a maximum fuse and circuit breaker size, or may refer to the maximum rating of overcurrent protective device without referring to fuses or circuit breakers, if the unit complies with (a) – (c), inclusive, as specified below:

a) Each motor overload protective device may be considered to comply with the requirements of the Limited Short Circuit Test, Section 52. Compliance may be established by one of the following means:

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

2) A short circuit test on the motor overload protective device is not required (for example, if the motor overload protective device is located at the center point of a wye-connected, 3-phase motor, or is located inside a hermetic motor-compressor enclosure), or

3) The motor overload protective device has been subjected to the Limited Short Circuit Test, Section 52, using a fuse of such rating that the circuit impedance during the test is the same or less than could be anticipated using a circuit breaker rated not more than the marked maximum rating of the overcurrent device; and:

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

ii) The fuse does not open during the test.

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

c) The marked maximum rating of the overcurrent protective device does not exceed 180 percent of the ampacity of motor-circuit conductors protected by that overcurrent protective device except as indicated in the exception to 12.5.1 (c) and (d). Ampacities of conductors are to be determined from the ampacity tables in the National Electrical Code, ANSI/NFPA 70-1990, for the type of wire or cord employed or the wire or cord equivalent to appliance wiring material.

80.11 The maximum current rating of the supply circuit overcurrent protective device shall not exceed 225 percent of the rated-load current or branch-circuit selection current, whichever is greater, of the largest hermetic motor plus an amount equal to the sum of any additional concurrent loads. For circuits involving other than hermetic motors, the protective device shall not exceed 400 percent of the full-load current of the largest motor plus an amount equal to the sum of any additional concurrent loads. In no case shall the rating of the protective device exceed the rating of the overcurrent protective device employed in Limited Short Circuit Tests, Section 52.

80.12 If a thermal protector or protective system for a hermetic refrigerant motor-compressor permits a continuous current of more than 156 percent of the rated-load current of the motor-compressor as marked on the room air conditioner nameplate and if the room air conditioner is intended for use on a circuit which exceeds the limitation mentioned in 20.5, the unit shall be permanently marked with a branch-circuit selection current rating, in amperes. The marked value of this rating shall be at least 64.1 percent of the maximum continuous current determined in accordance with Maximum Continuous Current Test – Motor-Compressor Protection Devices, Section 51.

80.13 If other than three overcurrent units are employed for protection of a 3-phase motor, a marking shall appear on the room air conditioner 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.

80.14 Unless correct field-wiring connections are evident, a wiring diagram shall be attached to each permanently-connected room air conditioner to show the intended method of making field-wiring connections. A paper sticker, cemented to an accessible cover, is acceptable.

80.15 A room air conditioner with field wiring terminals shall be marked:

a) ″Use Copper Conductors Only″ if the room air conditioner is not intended for field connection with aluminum wire, or

b) ″Use Copper or Aluminum Conductors,″ ″Use Copper or Copper-Clad Aluminum Conductors,″ or ″Use Copper, Copper-Clad Aluminum, or Aluminum Conductors″ if the room air conditioner is intended for field connection with either copper or aluminum wire.

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

80.16 A room air conditioner intended for permanent connection to a wiring system other than metal-clad cable or metal conduit shall be marked to indicate the system or systems for which it is designed. The marking shall be located so that it will be visible when making or inspecting the connections.

80.17 The following information shall appear on the room air conditioner or attached wiring diagram:

a) If a room air conditioner is controlled by a specific-use controller which is not installed on the assembly, the marking on the room air conditioner or wiring diagram shall show the identifying designation of the controller. The rating of the proper overcurrent (heater) element to be used shall be shown when a thermal overload relay is part of the controller.

b) If a room air conditioner 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 overload protective 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.

2) A designation on the overload protective 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.

c) If a room air conditioner 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.

80.18 If the rating of a field-installed disconnect switch is shown on the wiring diagram, the indicated rating shall be not less than required in accordance with the National Electrical Code, ANSI/NFPA 70-1990.

80.19 If a low-voltage device or part of a device is intended to be wired in the field to become only part of:

a) A Class 1 circuit or

b) A Class 2 circuit wired as a Class 1 circuit,

the terminals of the device or part of the device shall be marked accordingly. A low-voltage switching or power-consuming device or part of a device which is intended to be wired in the field to become part of a Class 2 circuit only shall be marked accordingly.

Exception No. 1: A low-voltage power supply device which includes a transformer is not required to be marked to indicate that it is acceptable for use only in a Class 2 circuit.

Exception No. 2: A low-voltage device or part of a device which is designed for connection to either a Class 1 or a Class 2 circuit is not required to be so marked.

80.20 If more than one disconnect switch is used to disconnect all power within a control panel or compartment of a permanently-connected room air conditioner, the panel or compartment shall be marked with the word ″CAUTION″ and with one of the following or equivalent statements, as applicable:

a) For room air conditioners which may be provided with two or more disconnect switches:

Risk of Electric Shock. Disconnect All Power. May Have More Than One Disconnect Switch.

b) For room air conditioners which require two or more disconnect switches:

Risk of Electric Shock. Disconnect All Power. [a] Disconnect Switches Provided.

The marking shall be permanent, shall be in letters not less than 1/8 inch (3.2 mm) high, and shall be located so as to be visible before or immediately upon removal of the cover over the panel or compartment. The marking shall not be on the back of a removable cover.

[a]The number of disconnect switches required for the room air conditioners is to be specified by the manufacturer in the blank space in Part B.

80.21 If a section, such as a wall sleeve or subbase, of a room air conditioner is shipped separately from the factory and if such section is provided with a terminal box or compartment intended for field connection of the power supply to the unit, the section shall be permanently marked with:

a) Minimum circuit ampacity,

b) Maximum rating of the branch circuit overcurrent protective device,

c) Voltage,

d) Number of phases,

e) Manufacturer’s or private labeler’s name or identifying symbol, and

f) Distinctive model or type designation.

Also see 80.11.

80.22 As an alternate to the marking specified in 80.21 (a) – (f), the section may be marked with a tabulation of all room air conditioner models which may be used with the section if the:

a) Minimum circuit ampacity,

b) Maximum rating of the branch circuit protective device,

c) Voltage, and

d) The number of phases for each unit or group of units,

is shown. In addition, each section shall include the following or equivalent statement, preceded by the word ″CAUTION,″ in letters not less than 1/8 inch (3.2 mm) high:

This section is intended for use with one of the room air conditioner units tabulated below. For proper electrical connection, the unit to be used with this section must be known to determine the minimum circuit ampacity, maximum rating of branch circuit overcurrent protective device, voltage, and phases of the branch circuit supplying this wall sleeve or subbase.

The above statement shall be followed by a tabulation of model numbers for the related room air conditioners.

80.23 A room air conditioner equipped for steam heat shall be permanently marked with the maximum steam pressure.

80.24 A room air conditioner equipped for hot water heat shall be permanently marked with the maximum supply temperature and pressure of the water.

80.25 If a unit employs a direct-connected high-voltage control circuit (see 23.2.1), it shall be marked with the maximum size of overcurrent device(s) for the control circuit. The rating of overcurrent device shall be based on the ampacity of the control circuit conductors, as determined from the ampacity tables contained in the National Electrical Code, ANSI/NFPA 70-1990 for No. 14 AWG or larger conductors and shall not exceed 7 amperes for No. 18 AWG conductors or 10 amperes for No. 16 AWG conductors. The marking shall appear on the wiring diagram, adjacent to the field wiring terminals or on the unit nameplate. See 80.26.

80.26 With reference to 80.25, the type of overcurrent protective device shall also be specified in the marking if required in order to comply with the requirements in 80.7.

81 Cord-Connected Units

81.1 A cord-connected room air conditioner for cooling only or for cooling and reverse cycle heating only shall be marked with the total load in amperes. A cord-connected room air conditioner which incorporates an electric heater shall be marked with the total cooling load and with the total heating load in amperes. The marked ampere rating shall include all individual loads which may operate concurrently.

81.2 On cord-connected room air conditioners, the nameplate and marking referred to in 79.2 and 79.13 shall additionally be located so as to be visible from the room side.

81.3 A marking on, or in addition to, the nameplate shall be provided on a cord-connected room air conditioner as follows: If a unit with a power supply cord has a marked ampere rating which exceeds 50 percent of the rating of the branch circuit to which it may be connected in accordance with the National Electrical Code, ANSI/NFPA 70-1990, it shall have a permanent marking in letters not less than 3/16 inch (4.8 mm) high located adjacent to the cord entrance on the exterior of the room side enclosure. This marking shall read: ″Use on Single Outlet Circuit Only.″

Exception: The marking on a unit with a 15 ampere attachment plug may read: ″Use on Single Outlet Circuit or 20 Ampere circuit,″ if the marked rating of the unit does not exceed 10 amperes.

81.4 A cord-connected room air conditioner shall be marked to indicate that a damaged power supply cord must be replaced with a new power supply cord obtained from the product manufacturer and not repaired.

Added 81.4 effective August 1, 2004

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APPENDIX A

Standards for Components

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

Title of Standard − UL Standard Designation

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

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CANADIAN REQUIREMENTS COMPARISON GUIDE CRG 484

UL AND CANADIAN STANDARDS FOR ROOM AIR CONDITIONERS

c UL Underwriters Laboratories Inc.®

Product Category: Room Air Conditioners
UL Category Control Number: ACKZ, ACKZ2, ACOT, ADAU, ACVS

UL Standard:

Standard for Room Air Conditioners
UL 484
Seventh Edition

Canadian Standard:

Room Air Conditioners
CAN/CSA-C22.2 No. 117
Second Edition

This Canadian Requirement Comparison Guide is only intended to identify Canadian requirements that must be applied in addition to the requirements in the UL Standard to obtain a C-UL Mark. The guide is not intended to replace a thorough review and comparison of the requirements applicable to the product category as contained in the applicable UL and Canadian Standards. Where requirements are not specifically addressed, compliance with the requirements in the UL Standard satisfy the requirements in the Canadian Standard.

The actual requirements applied for a C-UL product investigation may differ from those identified in this guide based on the specific features, characteristics, components, materials, or systems used in the product.

CRG: 484
Issue No.: 1
Issue Date: February 5, 1998

Revisions of this guide will be made by issuing revised or additional pages bearing their date of issue. A Canadian Requirement Comparison Guide is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revision pages for the Guide.

The following outlines the requirements contained in CSA C22.2 No. 117 that are in addition to the requirements in UL 484 that must be met in order for a product to bear the appropriate UL Marking. UL provides a certification program for products that meet the Canadian requirements. The C-UL Mark is the manufacturer's assurance that products as evaluated by UL, continue to comply with the appropriate Canadian requirements.

Requirements Topics	CSA Clause	Comparison
Scope	Section 1	The standard does not cover permanently connected or water-cooled units. See ″General Components″ for discussion.
General Comments		As indicated in the scope of the Standard, only cord-connected room air conditioners are covered by C22.2 No. 117. Permanently connected and water-cooled units, including Packaged Terminal Air Conditioners are evaluated to the bi-national Standard for Heating and Cooling Equipment, CAN/CSA C22.2 No. 236/UL 1995. *Units employing electric heat are evaluated by the requirements covering electric heat contained in CSA No 236/UL 1995*. In general, the requirements for the binational Standard are similar to the requirements in UL 484, except for the heating tests, which are slightly different. Italized text was added by UL
Construction	Clause 4.1.2	Components shall comply with the appropriate Canadian Standards and be suitable for the intended application.
Performance	Section 6.7	During the condenser fan failure test, the temperature of a compressor shell must be obtained, no exceptions. Maximum temperature to be 150°C.
	Section 6.15	Rain Test – The rain test itself is the same as in UL 484; however, after the test the unit is examined to determine if water is in contact with live parts. In addition, the CSA minimum insulation resistance is 50,000 ohms.
	6.16.2	Low side refrigerant containing parts are to be pressure tested at five times maximum normal working pressure. There is no leakage current test referenced in the CSA Standard. As a rule, UL conducts a leakage current test at 85 percent relative humidity, which coincides with other CSA Standards.
Marking	5.2	Markings shall comply with the requirements of CSA Standard C22.2 No. 0.
Code Difference		Per the CEC, the attachment plug of a unit rated greater than 125 V shall not be the unit disconnect. A switch must be provided.

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Subject 484, (474, 1699)
(In reply, refer to Subject 484)

333 Pfingsten Road
Northbrook, IL 60062
August 26, 2002

TO: **Standards Technical Panel (STP) for Dehumidifiers and Room Air Conditioners, STP 474;**
Subscribers to UL's Standards Service for
Room Air Conditioners;
Arc-Fault Circuit-Interrupters;
Other Interested Parties

SUBJECT: Change in effective date and date of revisions for UL 484, Room Air Conditioners

UL announces that revisions to UL 484, Room Air Conditoners, dated June 19, 2002, have been superseded by revisions dated September 3, 2002 with a corresponding change of the effective date to August 1, 2004.

DISCUSSION

UL had originally set a date of June 19, 2002 for publishing revisions to UL 484 with a corresponding effective date of December 19, 2003. The requirements were originally proposed in the Subject 484 bulletin dated Novermber 9, 2001. Prior to the mailing of the revision pages dated June 19, 2002, numerous and varied comments were received regarding the effective date of proposed AFCI and LCDI requirements. These comments were considered substantial enough to warrant an in-depth review of the effective date. After further investigation, it was decided that the effective date would be changed to August 1, 2004. This review has also caused a change in the publication date of the revisions, which will now be September 3, 2002.

It is possible that due to UL's electronic publishing system, people may have received an electronic copy of the revisions dated June 19, 2002. Please disregard those revisions as September 3, 2002 is the correct date for these revisions. The requirements in both revisions are identical, only the publication and effective dates have changed.

This bulletin should be kept with your copy of the standard.

Questions regarding interpretation of requirements should be directed to the responsible UL Staff. Please see Appendix A of this bulletin regarding designated responsibility for the subject product category.

UNDERWRITERS LABORATORIES INC.

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APPENDIX A

DESIGNATED RESPONSIBILITY FOR UL PRODUCT CATEGORIES

AAIZ, EQUIPMENT FOR USE IN AND RELATING TO CLASS I, II AND III, DIVISION 1 AND 2 HAZARDOUS LOCATIONS
AAIZ7, EQUIPMENT FOR USE IN AND RELATING TO CLASS I, II AND III, DIVISION 1 AND 2 HAZARDOUS LOCATIONS CERTIFIED FOR CANADA
ACKZ, AIR CONDITIONERS, PACKAGED TERMINAL
ACKZ2, AIR CONDITIONERS, PACKAGED TERMINAL – COMPONENT
ACKZ7, AIR CONDITIONERS, PACKAGED TERMINAL CERTIFIED FOR CANADA
ACOT, AIR CONDITIONERS, ROOM
ACOT2, AIR CONDITIONERS, ROOM – COMPONENT
ACOT3, AIR CONDITIONERS, ROOM – UNLISTED COMPONENT
ACOT7, AIR CONDITIONERS, ROOM CERTIFIED FOR CANADA
ACVS, AIR CONDITIONERS, SPECIAL PURPOSE
ACVS2, AIR CONDITIONERS, SPECIAL PURPOSE – COMPONENT
ACVS3, AIR CONDITIONERS, SPECIAL PURPOSE – UNLISTED COMPONENT
ACVS7, AIR CONDITIONERS, SPECIAL PURPOSE CERTIFIED FOR CANADA
ACVS8, AIR CONDITIONERS, SPECIAL PURPOSE CERTIFIED FOR CANADA – COMPONENT
ACVS9, AIR CONDITIONERS, SPECIAL PURPOSE CERTIFIED FOR CANADA – UNLISTED COMPONENT
ADAU, REPLACEMENT AIR CONDITIONERS, PACKAGED TERMINAL
ADAU7, REPLACEMENT AIR CONDITIONERS, PACKAGED TERMINAL CERTIFIED FOR CANADA
AHSY, AIR CONDITIONING EQUIPMENT FOR USE IN HAZARDOUS LOCATIONS
AHSY7, AIR CONDITIONING EQUIPMENT FOR USE IN HAZARDOUS LOCATIONS CERTIFIED FOR CANADA
AVYI, ARC-FAULT CIRCUIT-INTERRUPTERS
AVZQ, ARC-FAULT CIRCUIT-INTERRUPTERS, BRANCH/FEEDER TYPE
AWAH, ARC-FAULT CIRCUIT-INTERRUPTERS, COMBINATION TYPE
AWAY, ARC-FAULT CIRCUIT-INTERRUPTERS, CORD TYPE
AWBZ, ARC-FAULT CIRCUIT-INTERRUPTERS, OUTLET BRANCH CIRCUIT TYPE
AWCG, ARC-FAULT CIRCUIT-INTERRUPTERS, OUTLET CIRCUIT TYPE
AWDO, ARC-FAULT CIRCUIT-INTERRUPTERS, PORTABLE TYPE
ELGN, CORD SETS W/ LEAKAGE-CURRENT DETECTOR-INTERRUPTER
ELGN2, CORD SETS W/ LEAKAGE-CURRENT DETECTOR-INTERRUPTER – COMPONENT

The individuals shown in the following tables are involved with the investigation of products covered under the subject categories. The Primary Designated Engineer (**shown in UPPERCASE letters**) coordinates the establishment and uniform interpretation of UL requirements applicable to the product categories. The Designated Engineers (**shown in lowercase letters**) work with the Primary Designated Engineer to interpret requirements and maintain standards.

Should you have questions regarding the interpretation of the requirements proposed in this bulletin or any adopted requirements that affect your product, you are encouraged to contact the individual at the office to which you normally submit your products.

The STP Chair for subject categories ACKZ, ACKZ2, ACKZ7, ACOT, ACOT2, ACOT3, ACOT7, ACVS, ACVS2, ACVS3, ACVS7, ACVS8, ACVS9, ADAU, and ADAU7 is Raymond Burg at UL's Northbrook Office. The Responsible Department Manager for subject categories AAIZ, AAIZ7, AHSY, and AHSY7 is Gerald Kopstein at UL's Northbrook Office. The Responsible Department Manager for subject categories AVYI, AVZQ, AWAH, AWAY, AWBZ, AWCG, AWDO, ELGN and ELGN2 is John Smith at UL's Melville Office. The STP Chair/Responsible Department Manager oversees the significant

interpretations made by the Primary Designated Engineer and arbitrates any differences regarding interpretation of UL requirements.

CCN	Office/Subsidiary	Responsible Engineer	Extension
AAIZ, AAIZ7	Northbrook	EDWARD BRIESCH	43174

CCN	Office/Subsidiary	Responsible Engineer	Extension
ACKZ, ACKZ2, ACKZ7	Camas	Karl Keip	70330
	Melville	Nicholas DiFiore	22441
	Northbrook	ANDREW HAULOTTE	42428
	RTP	Eric Haddon	11679
	Santa Clara	Dean Klubnik	32343
	Asia Region	M. Kang	82-2-767-0531
	Seoul, Korea	M. Kang	82-2-767-0531

CCN	Office/Subsidiary	Responsible Engineer	Extension
ACOT, ACOT2, ACOT3, ACOT7	Camas	Karl Keip	70330
	Melville	Nicholas DiFiore	22441
	Northbrook	ANDREW HAULOTTE	42428
	RTP	Eric Haddon	11679
	Santa Clara	Dean Klubnik	32343
	Europe Region	Aksel Madsen	45-44-85-6565
	Frankfurt, Germany	Robert Brown Jr.	49-6102-369-207
	Herlev, Denmark	Aksel Madsen	45-44-85-6565
	Seoul, Korea	M. Kang	82-2-767-0531
	Shanghai, China	M. Yao	86-21-6288-2990
	Toronto, Canada	A. Saunders	61508

CCN	Office/Subsidiary	Responsible Engineer	Extension
ACVS, ACVS2, ACVS3, ACVS7, ACVS8, ACVS9	Camas	Karl Keip	70330
	Melville	Nicholas DiFiore	22441
	Northbrook	THOMAS WHEATLEY	42644
	RTP	Robert Roberson	11677
	Santa Clara	Barry Karnes	32433

CCN	Office/Subsidiary	Responsible Engineer	Extension
ADAU, ADAU7	Camas	Karl Keip	70330
	Melville	Nicholas DiFiore	22441
	Northbrook	RANDALL HASEMAN	43076
	RTP	Eric Haddon	11679
	Santa Clara	Dean Klubnik	32343

CCN	Office/Subsidiary	Responsible Engineer	Extension
AHSY, AHSY7	Northbrook	FRANCIS MAH	42842

CCN	Office/Subsidiary	Responsible Engineer	Extension
AVYI, AVZQ, AWAH,	Melville	PAUL NOTARIAN	22590
AWAY, AWCG, AWDO, AWBZ	Northbrook	Antonio Romanacce	41784

CCN	Office/Subsidiary	Responsible Engineer	Extension
ELGN, ELGN2	Melville	JOHN KONZ	22250

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