

# UL 507

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## Electric Fans



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UL Standard for Safety for Electric Fans, UL 507

Ninth Edition, Dated December 13, 1999

Revisions: This Standard contains revisions through and including December 23, 2003.

### **Summary of Topics**

**These revisions to ANSI/UL 507 are being issued to incorporate the following changes to the Standard:**

- 1) Additional Requirements to More Fully Address Retrofit Pumps**
- 2) Clarification of UV Requirements for Stationary Evaporative Coolers Intended for Use and Provided with Polymeric Enclosures**
- 3) Clarification of Requirements to Evaluate Evaporative Coolers for Wetting of Live Parts**
- 4) Addition of Window Mount Test Requirements for Window Mounted Evaporative Coolers**
- 5) Marking of HP Ratings for Appliances having Multiple Motors and/or Combination Loads**
- 6) Fluorescent Light Kits**
- 7) Live Parts Accessibility**
- 8) Cords For Portable Products and Oscillating Fans**
- 9) Installation Instructions**
- 10) Grounding Through Brushes**
- 11) Static Load and Mounting Hardware**
- 12) Positioning Requirement in Water Spray Test**
- 13) Deletion of Resistivity Requirement in Water Spray Test**
- 14) Duct or Plenum Mount Testing**
- 15) Lights Employed in Cooking Area Appliances**
- 16) Solid State Speed Control Testing**
- 17) Drop Test Clarification**
- 18) Guarding of Moving Parts and Mounting Height Exceptions**

- 19) Class E Insulation Systems**
- 20) Plastic Requirements**
- 21) Capacitor Recognition**
- 22) Running Heating Test**
- 23) Motor Standard Changes**
- 24) Supplement SA Revisions**
- 25) Open Frame Motors**
- 26) Markings for Wall and Ceiling Insert Fan Polymeric Enclosures**
- 27) Fan Flame Spread Requirements**
- 28) Cold Temperature Impact Requirement**
- 29) Quick Connect Ground Terminations and Interconnections**
- 30) Ceiling Fan Blade Brackets and Mounting Means**
- 31) Mix and Match Ceiling Fan Assemblies**
- 32) Miscellaneous Revisions**

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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.

A change in an effective date is indicated by a note following the affected item, and giving both the previous effective date and the new date the requirement becomes effective.

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

Future Effective Dates	References
September 24, 2003	Paragraphs 16.19, 22.11, 28.1.10 – 28.1.12, 42.1.1, 66.3, 93.6, 93A.5, and Table 42.1
June 1, 2004	Paragraphs 6.2.1 and 6.2.2
February 21, 2005	Paragraphs 16.20, 6.3.3, 46.1, 64.11, 71.2A.1 – 71.2A.6, 72.6.1, 91.3.5, 91.3.5A, 92.1A.1 – 92.1A.5, 93.7, 93.8, 93A.0, 129.2.2, 129.2.3, 136.3.1, 139.1, 141.2, Sections 96A – 96E, 166 – 169, and Table 13.2
June 23, 2005	Paragraphs 6.3.3, 6.4.2, 19.6, 62.5.8, and 62.5.9
December 23, 2005	Paragraphs 6.3.1, 7.1, 8.3.1, 8.3.3, 9.3.1, 9.3.2, 9.4.1, 9.4.3, 23.0, 46.2, 46.3, 61.4, 62.1.10, 62.5.3, 63.6, 130.8, 159.2, and 159.3.1, Table 9.1 and Figure 9.1

The revised requirements are substantially in accordance with UL's Bulletin(s) on this subject dated April 14, 2003, June 16, 2003, and October 24, 2003. The bulletin(s) is now obsolete and may be discarded.

The revisions dated December 23, 2003 include a reprinted title page (page1) for this Standard.

The revisions dated June 5, 2003 were issued to correct an effective date for Table 13.2. The effective date was changed from February 21, 2004 to February 21, 2005.

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

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

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## **UL 507**

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### **Ninth Edition**

**December 13, 1999**

The most recent designation of ANSI/UL 507 as an American National Standard (ANSI) occurred on December 2, 2003.

This ANSI/UL Standard for Safety, which consists of the Ninth edition with revisions through December 23, 2003, is under continuous maintenance, whereby each revision is ANSI approved upon publication. Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Written comments are to be sent to UL-RTP Standards Department, 12 Laboratory Dr., PO Box 13995, Research Triangle Park, NC 27709-3995.

The Department of Defense (DoD) has adopted UL 507 on February 5, 1993 . The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest 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.

## PART 1 – ALL FANS

### INTRODUCTION

#### 1 Scope

1.1 These requirements cover:

- a) Fans and blowers that circulate air, such as desk, ceiling-suspended, and hassock fans;
- b) Fans and blowers that ventilate air, such as attic, wall-insert, ceiling-insert, household hood- and canopy-types, and window fans;
- c) Dryer type fans used for drying carpets or floors;
- d) Household and commercial blower inflator type fans;
- e) Evaporative coolers;
- f) Evaporative cooler pumps, including retrofit pumps;
- g) Air-filtering appliances;
- h) Fan-type deodorizers and air fresheners;
- i) Component fans; and
- j) Low voltage component fans.

These products are rated 600 volts or less and are intended to be employed in accordance with the National Electrical Code, ANSI/NFPA 70.

1.1 revised December 23, 2003

1.2 These requirements do not cover air heaters incorporating fans, heating-ventilating units, or blowers comprising components of such equipment as furnaces, mechanical-refrigeration equipment, or air conditioners.

1.3 These requirements do not cover fusible links, and the like, provided to disconnect a fan or close shutters in the event of fire.

1.4 These requirements do not cover fans for use in cooking areas when the fan is intended for other than household use.

1.5 These requirements do not cover fans intended to be:

- a) Used in hazardous locations as defined in the National Electrical Code, ANSI/NFPA 70;
- b) Installed over solvents or chemically flammable liquids or vapors; or
- c) Located in chemically corrosive environments.

1.6 These requirements do not cover humidifiers.

1.7 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

## 2 Glossary

### 2.1 General

2.1.1 For the purpose of this standard the following definitions apply. The types of appliances are arranged in alphabetical order under the heading Product Terms. Other terms not related to the types of products are defined in alphabetical order under the heading Additional Terms. Also, see appropriate sections of the Standard for specific fan types not defined in this section.

### 2.2 Product terms

2.2.1 AIR-FILTERING APPLIANCE – An appliance consisting of an air-circulating fan and a mechanical filter.

2.2.2 AIR DEODORIZER – An appliance that has a fan and is intended to treat the air in a relatively small area by the dispersal of chemicals. A mechanical filter may be employed.

2.2.3 AIR FRESHENER – An appliance that has a fan and is intended to scent the air in a relatively small area by the dispersal of chemicals. A mechanical filter may be employed.

2.2.3.1 ATTIC FAN – A fan mounted on a building's roof or gable used to vent air out from the attic to the exterior of the building. Exhaust of the fan is typically capped with a dome lid or behind louvres to prevent exposure to weather.

2.2.3.1 added February 21, 2003

2.2.4 BLADE – A component of an impeller or an individual "paddle" of a ceiling-suspended fan.

2.2.5 BOX FAN – A portable fan sometimes referred to as a "suitcase" fan.

2.2.6 CEILING INSERT FAN/LIGHT COMBINATION – An appliance consisting of a fan and a light which is installed through a hole in the ceiling surface.

2.2.7 CEILING-SUSPENDED FAN – A fan intended to be mounted to a ceiling outlet box or ceiling building structure, and has blades which rotate below the ceiling. Popularly called a "paddle" fan.

2.2.8 DESK FAN – A fan intended for use on a desk or table. Some desk fans are provided with keyhole slots for wall mounting.

2.2.9 DOWN-DRAFT FAN – A fan intended for installation adjacent to a grill or stove top, and that draws smoke down into an exhaust duct.

2.2.9.1 DRAIN PUMP – A pump provided in an evaporative cooler, in addition to the recirculating pump(s), intended to periodically purge the reservoir of mineral laden water.

2.2.9.1 added December 23, 2003

2.2.10 EVAPORATIVE COOLER – An appliance that introduces moisture into the air. This appliance incorporates a fan, filter, or heater, or all of these components. Some evaporative coolers have provision for connection to a duct.

2.2.11 FLOOR INSERT FAN – An intake or exhaust fan installed in a raised floor.

2.2.12 HASSOCK FAN – A floor support fan resembling a foot rest.

2.2.12.1 HOUSEHOLD AND COMMERCIAL BLOWER INFLATOR TYPE FAN – used for inflating low-pressure products such as bouncers, commercial rooftop balloon displays, and miscellaneous low-pressure inflatable products. These fans do not contain any type of pressurized-vessel .

2.2.12.1 added February 21, 2003

2.2.13 IMPELLER – An assembly of blades about an integral hub.

2.2.14 THROUGH-WALL FAN – A fan installed in a sleeve through the wall or other structure and intended to draw air from the outside or exhaust air from the inside. The fan assembly, which does not include the sleeve, is not permanently attached to the building structure.

2.2.14 revised December 23, 2003

2.2.15 LOW VOLTAGE COMPONENT FAN – A component fan intended to be used in isolated secondary circuits and rated a maximum of 30 V rms (42.2 V peak) or 60 V dc.

2.2.16 PORTABLE APPLIANCE – A cord-connected appliance capable of being easily moved by hand from place to place (in normal use).

2.2.17 ROOM-TO-ROOM FAN – An appliance that is to be installed in a sleeve through an interior wall, and is intended to direct air from one room to another. The fan assembly, which does not include the sleeve, is not permanently attached to the building structure.

2.2.18 SECONDARY PROTECTION – A thermal cutoff or manual reset thermal protector provided with a motor that does not operate during the Locked Rotor Test of Section 40. Also referred to as "back-up" protection.

2.2.19 STATIONARY APPLIANCE – A cord-connected appliance that is intended to be fastened in place or located in a dedicated place.

2.2.20 VENTILATING-HOOD-FAN SHELF – A hood fan incorporating a shelf or a compartment to accommodate a microwave oven.

2.2.21 WALL-INSERT FAN – An intake or exhaust fan permanently attached in a wall without a sleeve.

2.2.21.1 WHOLE HOUSE FAN – A fan mounted on the attic-side of a ceiling, typically centrally located in a hallway. The fan is usually concealed behind a ceiling grill that opens and closes automatically. The fan is used to cool an entire house by drawing cooler outside air through open windows in the house and exhausting the hot room air through the attic to the building exterior.

2.2.21.1 added February 21, 2003

2.2.22 WINDOW-MOUNTED FAN – A window fan or a box fan intended for installation in a window.

### 2.3 Additional terms

2.3.0 AIR DISTRIBUTION SYSTEM – For the purpose of determining smoke developed requirements for non-metallic enclosures and other parts of appliances covered by this Standard, an air distribution system is defined as a continuous passageway for the transmission of air that does not vent directly to the outdoors. For example, a building having several fans inter-connected with air ducts before venting to the outdoors.

2.3.0 added September 24, 2001

2.3.0.1 APPLIANCE COUPLER – A single-outlet, female contact device that is attached to a flexible cord as part of a detachable power supply cord to be connected to an inlet.

2.3.0.1 added September 24, 2001

2.3.1 ASKAREL – A generic term for a group of nonflammable synthetic chlorinated hydrocarbons used as electrical insulating media. Askarels of various compositional types are used. Under arcing conditions the gases produced, while consisting predominantly of noncombustible hydrogen chloride, can include varying amounts of combustible gases depending upon the askarel type.

2.3.1.1 BRANCH CIRCUIT, INDIVIDUAL – A branch circuit that supplies only one utilization equipment.

2.3.1.1 added September 24, 2001

2.3.1.2 CABINET – That part of a unit that encloses insulated wiring, electrical enclosures, moving parts, motors, or enclosed electrical parts.

2.3.1.2 added February 21, 2003

2.3.2 COOKING AREA – An area in close proximity (as defined in Figure 62.1) to a stove, range, or oven, where fumes, grease laden air, or the like may be present.

2.3.3 ENCLOSURE – That part of the product that:

- a) Renders inaccessible all or any parts of the fan that present a risk of electric shock or injury to persons due to total or partial collapse with a resulting reduction of spacings, loosening or displacement of parts, or other serious defects; or
- b) Retards propagation of flame initiated by electrical disturbances occurring within.

2.3.3.1 INLET – A male contact device that is mounted on a fan to provide an integral blade configuration for the connection of an appliance coupler.

2.3.3.1 added September 24, 2001

2.3.4 MOUNTING MEANS – Hardware to mount the fan to the building structure or to an outlet box.

2.3.4.1 OTHER SPACE USED FOR ENVIRONMENTAL AIR – Space used for environmental air-handling purposes other than ducts and plenums. It does not include habitable rooms or areas of buildings, the prime purpose of which is not air handling. The space over a hung ceiling used for environmental air handling purposes is an example of the type of other space to which this section applies.

2.3.4.1 added February 21, 2003



2.3.5 OUTLET BOX – As used in this standard, the term "outlet box" includes an outlet box or any other supporting system, usually field supplied, intended to enclose splices and wiring devices or to support a fan.

2.3.6 RISK OF ELECTRIC SHOCK – A risk of electric shock exists at any part when:

- a) The potential between the part and earth ground or any other accessible part is more than 30 V rms (42.4 V peak); and
- b) The continuous current flow through a 1500 ohm resistor connected across the potential exceeds 0.5 mA.

2.3.7 SINGLE-OPERATION DEVICE – A device that incorporates a bimetal that is calibrated to open the motor circuit upon reaching a certain temperature and is resettable only by cooling to minus 35°C (minus 31°F), or lower.

2.3.8 TOTALLY ENCLOSED MOTOR – A motor that is enclosed to prevent the free exchange of air between the inside and outside of the enclosure for windings but not sufficiently enclosed to be airtight. Drainholes are acceptable.

2.3.9 TYPE F MOTOR – A thermally protected or impedance protected shaded pole motor employing class A insulation and marked "ZPF" or "Impedance Protected F", or "TPF" or "Thermally Protected F", where "F" stands for "Fan". These markings require compliance with requirements for Type F motors in this Standard.

2.3.10 USER SERVICING – Any form of servicing, such as routine cleaning and replacement of a fuse or a lamp, that is performed by personnel other than those trained to maintain the appliance.

2.3.11 VENTURI – A constricting throat in the air passage of an appliance which causes a pressure differential.

### 3 Components

3.1 Except as indicated in 3.2, a component of a product covered by this Standard shall comply with the requirements for that component.

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

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

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

3.4 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.

#### 4 Units of Measurement

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

4.2 Unless indicated otherwise, all voltage and current values mentioned in this standard are root mean square (rms).

#### 5 Application of Requirements

5.1 This standard is comprised of two parts. Part 1 consists of requirements that are to be applied to all products covered by UL 507 unless otherwise specified. Part 2 consists of requirements for specific product types. These requirements supplement or modify the requirements in Part 1. For each product type, the requirements unique to that construction are presented in the same format as Part 1 (with headings for construction, performance, marking, and the like). A product's construction and intended use may result in the application of more than one set of requirements in Part 2. (For example: a ceiling-suspended fan intended for use in an agricultural environment shall comply with the requirements in Part 1, the requirements for ceiling-suspended fans in Part 2, and the requirements for fans used in agricultural buildings in Part 2.)

5.2 With respect to the text in this Standard, a requirement that applies only to a specific type of appliance, such as an evaporative cooler or an air-filtering appliance, is so identified by a specific reference in that requirement to the type involved. Absence of such specific reference, or use of the term "appliance" or "fan", indicates that the requirement applies to all appliances covered by this Standard unless the context indicates otherwise.

5.3 A household canopy- or hood-type unit, the electrical components of which are complete except for a fan or blower, may be investigated under the applicable requirements in this standard to determine whether the unit is acceptable for use with cooking equipment. A household wall- or ceiling-insert fan that is intended for use with such a separate hood may also be investigated to determine whether it is acceptable for use with cooking equipment. See 62.5.1 and 90.1.

5.4 A combination fan and light combination or a ceiling-suspended fan light kit shall comply with the applicable requirements of this standard and with the applicable requirements in the Standard for Luminaires, UL 1598.

5.4 revised February 21, 2003

5.5 An evaporative cooler that incorporates a heating element is investigated in accordance with the applicable requirements of this standard and with the applicable requirements for electric space-heating equipment.

## CONSTRUCTION

### 6 Frame and Enclosures

#### 6.1 General

6.1.1 An appliance shall be formed and assembled so that it has the strength and rigidity necessary to resist the abuses to which it is subjected, without causing a risk of fire, electrical shock, or injury to persons due to total or partial collapse with a resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

6.1.2 A cast- or sheet-metal section of the enclosure shall not be thinner than the applicable value specified in Table 6.1.

*Exception No. 1: A small area or surface that is curved or otherwise reinforced to provide equivalent mechanical strength is not required to comply with the specifications in the first column of thicknesses in Table 6.1.*

*Exception No. 2: A section of the enclosure made of uncoated or galvanized sheet steel or cast malleable iron shall not be thinner than the specifications in the first column of thicknesses in Table 6.1 unless such factors as the following are determined to be acceptable:*

- a) Mechanical strength and impact resistance with regard to intended use and location of the appliance;
- b) Resistance to corrosion;
- c) Size and shape; and
- d) Location on the appliance.

6.1.3 A fan having features intended to be attractive to children or to have play value or an appearance of play value shall:

- a) Be provided with a marking that warns against use as a toy as described in 63.9; and
- b) Not have any portion of the fan intended to be removed and utilized as an item with play value.

*Exception: This requirement does not apply to a fan that complies with the Standard for Electric Toys, UL 696.*

**Table 6.1**  
**Minimum thicknesses of enclosure metal**

Metal	At small, flat, unreinforced surfaces and at surfaces of a shape or size to provide adequate mechanical strength		At surfaces to which a wiring system is to be connected in the field		At large, unreinforced, flat surfaces	
	mm	(inch)	mm	(inch) <sup>a</sup>	mm	(inch)
Die-cast metal	1.19	(3/64)		–	1.98	(5/64)
Cast malleable iron	1.59	(1/16)		–	2.38	(3/32)
Other cast metal	2.38	(3/32)		–	3.18	(1/8)
Uncoated sheet steel	0.66	(0.026)	0.81	(0.032)	0.66	(0.026)
Galvanized sheet steel	0.74	(0.029)	0.86	(0.034)	0.74	(0.029)
Nonferrous sheet metal	0.91	(0.036)	1.14	(0.045)	0.91	(0.036)

<sup>a</sup> A sheet-steel wall of thickness less than that specified shall not be used unless the area surrounding the knockout has a minimum thickness of 0.81 mm (0.032 inch).

6.1.4 The enclosure of an appliance shall prevent molten metal, burning insulation, flaming particles, and other ignited material from falling onto flammable materials, including the surface upon which the appliance is supported when the appliance is:

- a) Installed in a remote location such as the location of an attic ventilator or a whole house ventilator; or
- b) Thermostatically controlled.

*Exception: This requirement does not apply to a thermostatically controlled fan intended for use in cooking areas and mounted directly above the cooking surface.*

6.1.5 The requirements in 6.1.4 necessitate the use of a metal barrier or a non-metallic barrier of a material having a zero flame spread rating when tested as described in the Standard for Tests for Surface Burning Characteristics of Building Materials, UL 723:

a) Under a motor unless:

- 1) The structural parts of the motor or of the appliance provide the equivalent of such a barrier (such as the use of metal louvers as bottom barriers);
- 2) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the appliance or into the wiring compartment when the motor is energized under each of the following fault conditions:
  - i) Open main winding;
  - ii) Open auxiliary winding;
  - iii) Starting switch short-circuited; and
  - iv) Capacitor of a permanent-split capacitor motor short-circuited and the rotor locked – the short circuit is to be applied before the motor is energized; or
- 3) The motor is provided with a thermal motor protector that prevents the temperature of the motor windings from exceeding 125°C (257°F) under the maximum load under which the motor runs without causing the protector to cycle and from exceeding 150°C (302°F) with the rotor of the motor locked; or

*Exception: A direct drive fan motor is required to only be subjected to the locked rotor test.*

- 4) The motor complies with the requirements for impedance-protected motors in UL 2111, the Standard for Overheating Protection for Motors, and the temperature of the motor winding does not exceed 150°C (302°F) during the first 72 hours of operation with the rotor of the motor locked.

b) Under wire, unless the wire:

- 1) Is thermoplastic wire which complies with the requirements of the Vertical Wires test in UL 1581, the Standard for Electrical Wires, Cables, and Flexible Cords, and is marked VW-1; or
- 2) Has at least equivalent characteristics as determined in the flame tests specified in the Standard for Thermoplastic-Insulated Wires and Cables, UL 83.

c) Under a switch, relay, solenoid, or similar component unless:

- 1) A short circuit or overload in the component does not result in a risk of fire; or
- 2) There are no openings in the enclosure through which molten metal, burning insulation, flaming particles, or other ignited material can fall.

*Exception: A terminal is not required to have a barrier.*

6.1.5 revised February 21, 2003

6.1.6 The barrier mentioned in 6.1.5 shall be horizontal, shall be located as illustrated in Figure 6.1, and shall have an area in accordance with the illustration. Openings for drainage, ventilation, and the like, shall not be employed in the barrier unless such openings do not permit molten metal, burning insulation, or similar material, to fall onto flammable material.

6.1.7 A ventilating opening provided in the enclosure of an appliance or an externally mounted component of an appliance where the appliance is intended to be recessed into a wall or false ceiling shall not vent into a concealed space where the spread of a fire occurs undetected.

## 6.2 Wood enclosure parts

6.2.1 Wood shall not be employed as an appliance enclosure unless:

- a) The enclosure is not intended for use in a cooking area, a bathroom, a damp location, or outdoors; and
- b) The enclosure is in accordance with the Temperature Test requirements in Table 36.1, as applicable to wood.

Revised 6.2.1 effective June 1, 2004

6.2.2 A wood enclosure serving as an enclosure of uninsulated live parts shall be subjected to flammability testing and resistance to impact testing (5 ft-lbs) in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Revised 6.2.2 effective June 1, 2004

## 6.3 Non-metallic enclosures

6.3.1 A non-metallic enclosure shall comply with the applicable mechanical and electrical property considerations, flammability, and thermal requirements as specified in UL 746C, the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations. A 6.8 J (5 ft-lbf) impact value shall apply to all appliances when determining the impact resistance of polymeric enclosures. This impact value shall also be used for cold impact testing of appliances intended to be used or stored in cold environments, such as fans mounted in the crawl space or attic and outdoor use products.

*Exception No. 1: A polymeric grille used in a ceiling or wall insert fan is not required to comply with the flammability requirements of UL 746C when:*

- a) *The material has a minimum flame class rating of HB;*
- b) *All live parts within the enclosure are insulated and the insulation thickness is 0.71 mm (0.028 inch) or greater; and*
- c) *The grille is completely external when installed as intended.*

*Exception No. 2: A polymeric grille used in a fan intended to be mounted at least 2.1 m (7 feet) above the floor is not required to comply with the Resistance to Impact Test of UL 746C.*

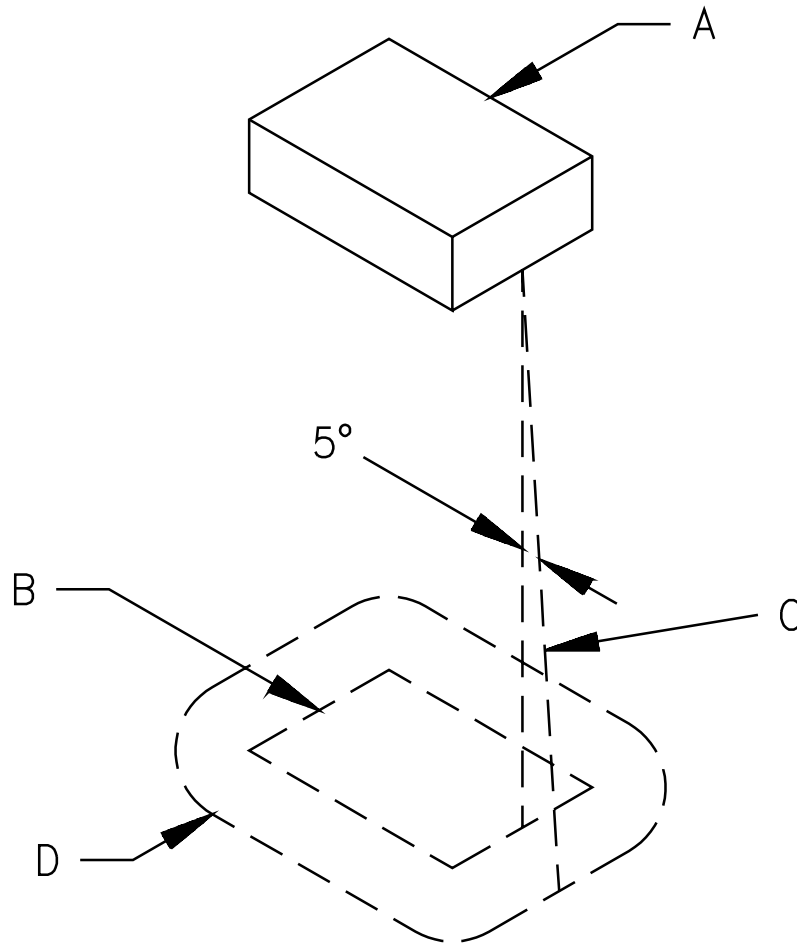
Revised 6.3.1 effective December 23, 2005

6.3.2 Among the factors to be considered when judging a non-metallic enclosure, other than of polymeric material, or a magnesium enclosure shall be:

- a) Mechanical strength;
- b) Resistance to impact;
- c) Moisture-absorptive properties;
- d) Combustibility;
- e) Resistance to arcing; and
- f) Resistance to distortion at temperatures to which the enclosure is subjected under conditions of normal or abnormal use.

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**Figure 6.1**  
**Barrier**



EB120A

A – Region to be shielded by barrier. This will consist of the entire component if it is not otherwise shielded and will consist of the unshielded portions of a component that is partially shielded by the component enclosure or equivalent.

B – Projection of outline of component on horizontal plane.

C – Inclined line that traces out minimum area of barrier. The line is always:

- 1) Tangent to the component,
- 2) 5 degrees from the vertical, and
- 3) So oriented that the area traced out on a horizontal plane is maximum.

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



6.3.3 A non-metallic enclosure of a fan employing a fluorescent light shall comply with the requirements of Section 136.3.

*Exception: A polymeric enclosure that complies with the Ultraviolet Light Exposure Test in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, does not need to comply with the requirements of Section 136.3.*

Added 6.3.3 effective February 21, 2005

6.3.4 A wall or ceiling insert fan or ceiling insert fan/light combination that is provided with a polymeric housing shall be marked not for use in fire rated installations and for use in one- and two-family dwellings only, in accordance with 62.5.8 and 62.5.9.

Added 6.3.4 effective June 23, 2005

## 6.4 Non-metallic parts other than enclosures

6.4.1 Polymeric material used to enclose a metal housing that encloses insulated or uninsulated live parts, or used as a decorative part, shall be classed either 5VA, 5VB, V-0, V-1, V-2, or HB by the burning tests described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

*Exception No. 1: Decorative parts are not required to be made of a material classed 5VA, 5VB, V-0, V-1, V-2, or HB when the part does not occupy a volume greater than 2 cubic centimeters (0.122 cubic inch), does not have any dimension greater than 3 cm (1.18 inch), and is located so it does not propagate flame from one area to another or bridge between a possible source of ignition and other ignitable parts.*

*Exception No. 2: A material is determined to be equivalent when it complies with the 12-mm (0.47 inch) flame test, the 19-mm (0.75-inch) flame test, or 127-mm (5-inch) flame test of UL 746C, the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, when flame tested as used in the equipment. The use of a flame-retardant coating applied to the inside of a polymeric enclosure is not acceptable unless the coating/material interface is found to be acceptable by separate investigation.*

6.4.2 An impeller of polymeric material outside a motor shall not be located within 25.4 mm (1 inch) of an opening in the motor housing.

*Exception No. 1: For all motor types except skeleton or open frame, an impeller is not prohibited from being within 25.4 mm of an opening in the motor housing when:*

*a) The material is classed as V-2, V-1, V-0, or 5V in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94. The coil wrap that complies with the 127 mm (5 inches) end product flame test as described in UL 746C, the Standard for Polymeric Materials – Use in Electric Equipment Evaluations, does not need to possess a 5VA flame rating;*

*b) The material complies with the requirements for enclosure flammability using a 19-mm (3/4-inch) flame, in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C; or*

*c) No motor opening within 25.4 mm of the blade has a dimension more than 6.75 mm (17/64 inch) or an area more than 35.48 mm<sup>2</sup> (0.055 square inch), and no more than six such openings are provided;*

*d) Deleted*

- e) *The material has a hot wire ignition rating of at least 7 seconds as described in the Standard Test Method for Ignition of Materials by Hot Wire Sources, ASTM D3874-1990a;*
- f) *The fan employs a thermally protected motor to drive the impeller and complies with the test requirements in Section 50, Impeller Ignition Test; or*
- g) *The fan complies with the requirements for unattended areas as specified in Sections 139 and 140.*

*Exception No. 2: For bobbin-wound skeleton motors employed in a product other than ceiling-insert, wall-insert fans, or rangehoods, an impeller is not prohibited from being within 25.4 mm of the motor windings when:*

- a) *The impeller is of material classed HB or less flammable in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94;*
- b) *The coil is completely covered with insulation at least 0.8 mm (1/32 inch) thick; and*
- c) *The space between the coil covering and bobbin does not exceed 0.48 mm total.*

*Exception No. 3: For bobbin-wound skeleton motors employed in a ceiling-insert fan, wall-insert fan, or rangehood, an impeller is not prohibited from being within 25.4 mm of the motor windings when the motor complies with the requirements of 19.6.*

Revised 6.4.2 effective June 23, 2005

6.4.3 A polymeric impeller for a fan intended to be installed in an area exposed to temperatures higher than 40°C (104°F), such as an attic fan or a fan intended for use in cooking areas, shall be molded from polymeric material having:

- a) A heat deflection temperature under a minimum 455.07 kPa (66 psi) load of at least 75°C (167°F), determined as specified in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A; and
- b) A relative mechanical temperature index without impact of at least 60°C (140°F) determined as specified in the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B.

6.4.4 Foamed thermoplastic shall be classed HF-2 or HF-1.

6.4.5 A thermoplastic damper shall be classed HB, V-2, V-1, V-0, or 5V.

6.4.6 A thermoplastic part that is not decorative and that does not serve as an enclosure shall be classed HB, V-2, V-1, V-0, or 5V.

## 7 Flame Spread and Smoke Developed Requirements for Non-Metallic Enclosures and Other Parts of Permanently Connected Equipment

7.1 A non-metallic enclosure or part that provides a barrier between a building cavity and internal parts of a fan that is intended to be permanently connected electrically, shall have a flame spread rating of zero in accordance with UL 723, the Standard for Test for Surface Burning Characteristics of Building Materials.

*Exception No. 1: A fan grille, duct adapter, or other part that is installed exterior to the enclosure or part described in 7.1 is not required to comply with the flame spread requirements.*

*Exception No. 2: A material having a flame-spread rating of 25 or less, as determined by the Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source, ASTM E162, is an alternative.*

*Exception No. 3: Deleted*

*Exception No. 4: This requirement does not apply to sound deadening material inside a fan enclosure that is rated HB or HF-2.*

*Exception No. 5: Deleted*

Revised 7.1 effective December 23, 2005

*7.2 Deleted February 21, 2003*

7.3 Compliance with the Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces, UL 2043, is considered to meet the flame spread requirement of 7.1.

7.3 added February 21, 2003

## 8 Accessibility of Moving Parts

### 8.1 General

*8.1.1 Deleted February 21, 2003*

8.1.2 The rotor of a motor, a pulley, a belt, a gear, an impeller, or other moving parts shall be enclosed, guarded, or installed at a sufficient height per Section 8.2 or Section 8.3, as applicable, to reduce the risk of injury to persons.

*Exception No. 1: This requirement does not apply to a part or portion of a part that is exposed to enable an appliance to perform its intended function.*

*Exception No. 2: This requirement does not apply to large commercial-industrial evaporative coolers intended for use in warehouses and similar spaces.*

8.1.2 revised February 21, 2003

8.1.3 An impeller shall be constructed of a material and in such a manner to reduce the risk of its breakage or its release of parts that could cause a risk of injury to persons.

8.1.3 revised February 21, 2003

8.1.4 Polymeric guards which are used for protecting the impeller, and also function as an electrical enclosure, shall be subjected to the following tests as applicable:

a) For a guard of un-insulated live parts, the guard shall comply with the Resistance to Impact Test of UL 746C, the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations. The impact used is to be 6.8 J (5 ft·lbf).

b) For a guard of insulated live parts which have an insulation thickness of 0.71 mm (0.028 inch) or greater, the guard shall comply with Section 47, Impact Test on Guards and Section 48, Static Force Test on Guards.

8.2.12 revised and relocated as 8.1.4 February 21, 2003

8.1.5 An impeller shall be secured to the shaft, with consideration given to such factors as the size and weight of the impeller, motor power, mounted position, thrust direction, and the risk of injury to persons if breakage occurs. A reversible fan shall not rely solely on friction between the impeller and a nut turned onto a threaded shaft.

49.2 relocated as 8.1.5 February 21, 2003

## 8.2 Portable fans and window fans

8.2.1 Other than as described in 8.2.2, a moving part that causes a risk of injury to persons shall be guarded or enclosed.

8.2.2 A moving part such as a rotating grille, rotating air deflector driven by an airstream, or an impeller is not required to be guarded when the moving part complies with all of the following applicable requirements:

a) When motor driven, the impeller:

- 1) Does not weigh more than 45 g (0.1 pound);
- 2) Is not more than 203.20 mm (8 inches) in diameter; and
- 3) Is not more than 3.2 mm (1/8 inch) thick and has no reinforcement beyond the nose cone.

b) When driven by an airstream, the moving part:

- 1) Does not weigh more than 454 g (1 pound);
- 2) Does not have a diameter that exceeds 508 mm (20 inches); and
- 3) Complies with Section 52, Drop Test, without breakage of the blades.

c) The moving part:

- 1) Does not rotate faster than 2000 revolutions per minute; and

- 2) Complies with the requirements specified in Section 43, Unguarded Impeller Tests, Section 47, Impact Test on Guards, and Section 52, Drop Test, without breakage of the blades.
- d) The output power of the motor driving the part is not more than 35 watts (0.047 horsepower).
- e) The "K" factor of the moving part determined as specified in 8.2.5 is less than 732.
- f) A blade:
  - 1) Employs a rounded leading edge with a diameter of at least 3.2 mm (1/8 inch); and
  - 2) Is composed of material having:
    - i) A tensile strength of at least 6.895 MPa (1000 psi), in accordance with ASTM D638; and
    - ii) Elongation of not more than 206.85 MPa (30,000 psi), in accordance with ASTM D790.
- g) An air deflector driven by the airstream has no leading edge and all exposed surfaces are smooth and well rounded.

*Exception No. 1: An unguarded impeller is not required to comply with the requirements of 8.2.2(a)(1), (a)(2), (d), and (e) when the fan complies with 8.2.3.*

*Exception No. 2: An unguarded impeller is not required to comply with the requirements of 8.2.2(f)(2)(i), (f)(2)(ii), 8.2.2(b)(3), and 8.2.2(c)(2) if the impeller is molded of a component foam material rated a minimum HF-2.*

8.2.2 revised December 23, 2003

8.2.3 An unguarded impeller that complies with the Exception to 8.2.2 shall produce an impact force of 175 N (39.34 pounds) or less.

8.2.4 Factors to be considered when judging whether a moving part or a portion of a part is likely to cause a risk of injury to persons shall include, but are not limited to:

- a) The portion of the blade being contacted – trailing edge, leading edge, or periphery;
- b) The blade material and angle, and type and sharpness of exposed edge; and
- c) The energy available.

8.2.5 Conventional designs of impellers meet the requirement of being guarded when:

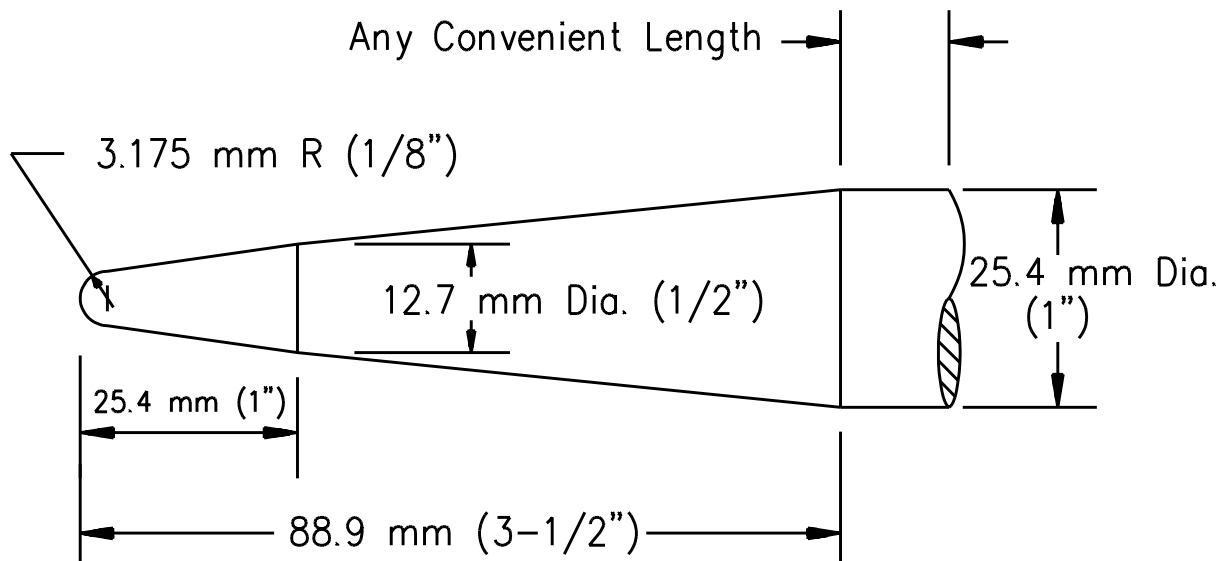
a) The relationship between mass ( $W$ ) in kg, radius ( $r$ ) in mm, and speed ( $N$ ) in revolutions per minute is such that  $K$  in the following equation is less than 29264:

$$K = 6 \times 10^{-7} (Wr^2N^2)$$

b) The guarding is such that the probe illustrated in Figure 8.1 cannot touch the leading edge of the blade and hub when inserted as described in 8.2.6. For a reversible fan, both edges of the blade are considered leading edges. When  $K$  is greater than 29264, the probe shall not touch any part of the impeller.

8.2.6 The portion of an impeller that entails a risk of injury to persons shall be guarded so that the probe illustrated in Figure 8.1 does not touch the part when inserted with a force of 4.45 N (1 pound) for a maximum of 5 seconds through any opening in the guard.

**Figure 8.1**  
**Probe for impellers of portable appliances**



PA160B

8.2.7 During an examination to determine whether an appliance complies with the requirements specified in 8.2.6, the guards and impellers of desk and stand fans are not to be removed before examination.

8.2.8 When a part used to comply with the requirement in 8.2.6 is made of a polymeric material, a sample is to be exposed for 7 hours to air at 70°C (158°F). While in the oven, the part is to be assembled to the fan and the fan is to be in its intended operating position. After the sample has cooled to room temperature, the probe illustrated in Figure 8.1 is to be inserted through each opening in the guard. The probe shall not be able to touch any portion of an impeller that can cause a risk of injury to persons.

8.2.9 A guard employed to comply with the requirement in 8.2.6 shall be attached to the fan in any of the following ways:

- a) Permanently;
- b) By means requiring the use of a tool or tools for removal; or
- c) By means not requiring the use of a tool or tools for removal provided that the securing means remain attached to the front or rear guard; and
  - 1) Two separate motions, for example push and turn, are required to disengage the securing means; or
  - 2) A force of 22.24 N (5 pounds) is required to disengage the securing means.

8.2.10 The removal force specified in 8.2.9(c)(2) is to be measured after conditioning the holding means by removing and replacing the guard ten times in the intended manner.

8.2.11 An enclosure, a frame, a guard, a handle, or other part of the fan that is exposed to contact during intended operation shall not be sufficiently sharp to constitute a risk of injury to persons.

*8.2.12 Revised and relocated as 8.1.4 February 21, 2003*

8.2.13 Non-metallic impellers on portable fans and window fans shall comply with Section 49, Impeller Test for Free Standing Fans and Window Fans.

8.2.13 added February 21, 2003

### **8.3 Stationary fans and permanently connected fans**

8.3.0 In accordance with 8.1.2, the design and intended use of a stationary fan or of a fan intended to be permanently connected electrically is to be considered when evaluating an enclosure or guard.

8.3.0 added February 21, 2003

8.3.1 The impeller of a stationary or permanently connected fan shall be constructed so that it cannot be contacted by the probe illustrated in Figure 8.2.

*Exception No. 1: An impeller of an in-wall fan, or a plenum-mounted fan with the grille flush with the ceiling, is not required to be guarded when it is mounted at least 2.1 m (7 feet) above the floor and marked as specified in 63.4.*

*Exception No. 1A: An impeller of a wall- or ceiling- insert fan shall comply with 8.3.3 – 8.3.4.*

*Exception No. 2: An impeller of a stationary or permanently connected nonresidential fan is not required to be guarded when it is mounted at least 2.1 m (7 feet) above the floor and marked as specified in 63.4 and either 62.1.10 or 111.1.*

*Exception No. 3: Residential attic fans and whole house fans shall comply with 8.3.5 and 8.3.6.*

*Exception No. 4: Ceiling-suspended fans shall comply with Section 70.2 and 72.1.*

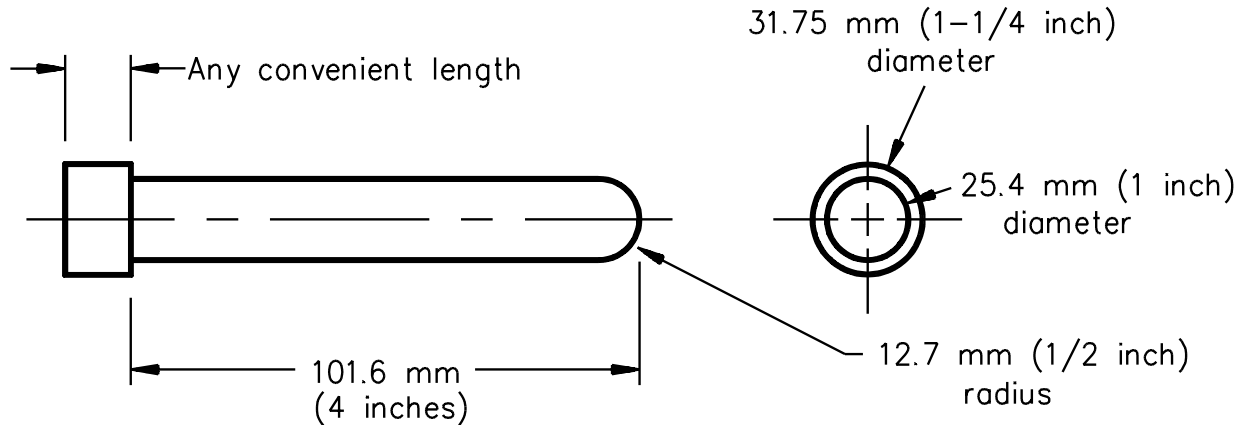
*Exception No. 5: Fans for use in cooking areas shall comply with 91.3.1 – 91.3.3.*

*Exception No. 6: The discharge side of duct connected fans as described in 8.3.7 need not comply with this requirement.*

8.3.1 revised December 23, 2005

8.3.2 A stationary or permanently connected fan shall be constructed so that any moving parts, other than the impeller, that cause a risk of injury to persons cannot be contacted by the probe illustrated in Figure 8.2.

**Figure 8.2**  
**Probe for fan impellers and other moving parts of stationary fans and fans intended to be permanently connected electrically**



S2140A

8.3.3 The 25.4-mm (1-inch) diameter probe as illustrated in Figure 8.2, when inserted through an opening on the air-inlet side of a wall- or ceiling-insert fan, shall not contact a moving part that presents a risk of injury to a person.

*Exception No. 1: This requirement does not apply to a wall- or ceiling-insert fan provided with a reusable metal filter or marked to be mounted at least 2.1 m (7 feet) above floor level. See 63.4.*

*Exception No. 2: This requirement does not apply to a wall- or ceiling-insert fan having an impeller diameter of 254 mm (10 inches) or less, when:*

- a) The wall- or ceiling-insert fan is marked as specified in 62.5.7; and*
- b) The installation instructions specified in 64A.6 are provided.*

*Exception No. 3: This requirement does not apply to a wall- or ceiling-insert fan having an impeller 152.4 mm (6 inches) or less in diameter.*

Revised 8.3.3 effective December 23, 2005



8.3.4 The unobstructed distance of an opening on the exhaust side of a wall-insert fan to a moving part capable of causing injury to persons shall be not less than 25.4 mm (1 inch) for an opening on the exhaust side of a wall- insert fan. When the unobstructed distance to such a part is 25.4 mm or more, the requirements of Table 8.1 apply.

*Exception No. 1: A part less than 25.4 mm from the opening meets the intent of this requirement only when it cannot be contacted by the probe illustrated in Figure 8.2.*

*Exception No. 2: A wall-insert fan is not required to comply with these requirements when it is marked as specified in 63.4.*

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**Table 8.1**  
**Distance from opening to part capable of causing injury to persons**

Diameter of opening		Minimum acceptable distance to moving part	
mm	(inches)	mm	(inches)
Less than 38.10	(1-1/2)	25.40	(1)
38.10 to 76.20	(1-1/2 to 3)	101.60	(4)
Greater than 76.20 but Less than 101.60	(3) (4)	152.40	(6)

8.3.5 A guard is not required on the side of an attic-mounted or roof-mounted fan intended to face an unoccupied space only when the installation instructions or a marking on the fan indicate that the fan is intended for use facing an unoccupied space only. See 62.6.1.

8.3.6 A guard is not required on the inlet side of a power attic or whole house ventilator when:

- a) Louvers or a grill is provided in the box with the product; or
- b) The installation instructions or marking on the attic-mounted or roof-mounted fan indicate that louvers or grilles are to be attached when the fan is installed as intended. See 62.6.2.

8.3.7 A guard is not required to be provided on the discharge side of a duct connected fan intended for connection to an exhaust duct.

## **9 Accessibility of Live Parts**

### **9.1 General**

9.1.1 To reduce the risk of unintentional contact that involves a risk of electric shock from uninsulated live parts and film-coated wire, an opening in an enclosure of an appliance or in a motor shall comply with 9.3.1 – 9.4.1 and Table 9.1.

### **9.2 Directly- and indirectly-accessible motor**

9.2.1 A directly accessible motor is a motor:

- a) That can be contacted without removing any part; or
- b) That is located to be accessible to contact.

### 9.3 Application of probes

9.3.1 The probe illustrated in Figure 9.2 shall be applied to any depth that the opening permits and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to try to contact an uninsulated live part including film-coated wire. If necessary, the configuration shall be changed after insertion through the opening. Configuration refers to positioning of the jointed portions of the probes.

Revised 9.3.1 effective December 23, 2005

**Table 9.1**  
**Accessibility of live parts**

Revised Table 9.1 effective December 23, 2005

Fan type	Figure reference of probe for judging accessibility	
	Uninsulated live parts other than film-coated wire	Film-coated wire
Ceiling-suspended, roof-mounted and attic fans	Figure 9.2 (Probe)	No requirement
Ceiling-insert, wall-insert, and rangehoods	Figure 9.2 (Probe)	Figure 9.2 (Probe)
All other fans	Figure 9.2 (Probe)	—

**Figure 9.1**  
**Probe for film-coated wire**

Figure 9.1 deleted effective December 23, 2005

9.3.2 The probe illustrated in Figure 9.2 shall be used as measuring instruments to judge the accessibility to uninsulated live parts and film-coated wire provided by openings and not as instruments to judge the strength of a material. Force is not to be applied to the probe when judging accessibility.

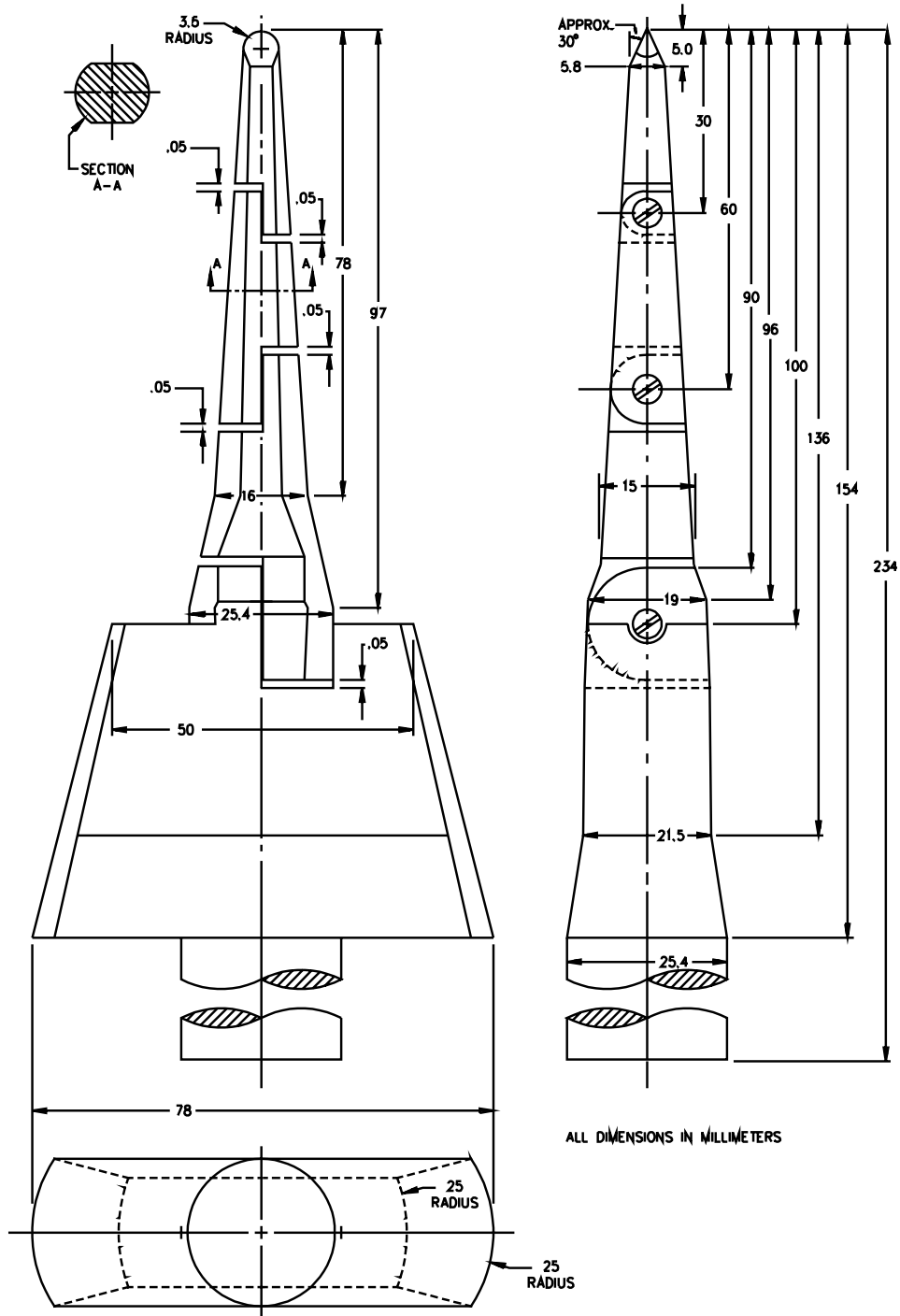
Revised 9.3.2 effective December 23, 2005

### 9.4 Removal of parts

9.4.1 During an examination to determine whether an appliance complies with the requirements specified in 9.1.1, 9.3.1, and 9.3.2 and Table 9.1, a part intended to be removed by the user without the use of a tool, including the grille of a ceiling-insert or wall-insert fan and the filter of a rangehood, is to be removed before the examination.

Revised 9.4.1 effective December 23, 2005

Figure 9.2  
Articulate probe with web stop



PA100A

9.4.2 With reference to 9.4.1, the filter or filters of an air-filtering appliance are to be removed, even if it is necessary to use tools to do so, when the appliance is being examined with reference to exposure of uninsulated live parts.

9.4.3 With reference to the requirements specified in 9.1.1, 9.3.1, and 9.3.2, insulated brush caps are not required to be additionally enclosed.

Revised 9.4.3 effective December 23, 2005

## 9.5 Disconnection Means

9.5.1 A means of disconnection – such as a cord connector in conductors between the motor and the base of an oscillating fan – shall be such that live parts are not exposed under intended conditions.

## 10 Mechanical Assembly

10.1 An appliance shall be assembled so as not to increase the risk of injury to persons. Brush caps shall be tightly threaded or otherwise constructed to prevent loosening.

10.2 A switch, a lampholder, an attachment-plug receptacle, a motor-attachment plug, or similar component shall be mounted securely, and shall be prevented from turning or shifting. See 10.3.

*Exception No. 1: A switch is not required to be prevented from turning when the following conditions are met:*

- a) The switch is a plunger or other type that does not tend to rotate when operated – a toggle switch is considered to be subjected to such forces;*
- b) The means for mounting the switch makes it unlikely that operation of the switch will loosen it (such as straight pull);*
- c) Spacings are not reduced below the minimum acceptable values when the switch is rotated; and*
- d) Normal operation of the switch is by mechanical means rather than by direct contact by persons.*

*Exception No. 2: A lampholder of the type in which the lamp cannot be replaced, such as a neon pilot or indicator lamp in which the lamp is sealed in by a nonremovable jewel, is not required to be prevented from turning when rotation does not reduce spacings below the minimum acceptable values.*

10.3 The means for preventing turning, as required by 10.2, shall consist of more than friction between surfaces. For example, a toothed lock washer that provides spring take-up, applied as intended, is an acceptable means for preventing a small stem-mounted switch or other device having a single-hole mounting means from turning.

10.4 A fan in which internal wiring or a part of the power-supply cord is enclosed in an adjustable column shall be constructed so that adjustment of the height of the column does not damage the wiring or the cord. When the wiring or cord is secured to two parts of the fan that can be rotated readily with respect to each other, means shall be provided to prevent a relative rotation of more than 360 degrees between such parts. See 10.5.

10.5 With reference to 10.4, it shall be assumed that two parts of a fan are able to be rotated readily with respect to each other when they are secured together by thumbscrews, wing nuts, or the like, or are otherwise readily adjustable by hand.

10.6 An appliance shall be completely assembled when it is shipped from the factory, except when the appliance is partially disassembled to facilitate packaging or installation, and the assembly of the appliance is readily accomplished without causing a risk of fire, electric shock, or injury to persons. When mismatching of components of an appliance shipped disassembled results in a risk of fire, electric shock, or injury to persons, the parts shall be marked as specified in 62.4.1. The installation instructions shall include statements as specified in 64A.9.

10.7 Internal connections that must be made in the field in a cord-connected appliance that is shipped partially disassembled shall be made by plug and receptacle connections. Internal connections that must be made in the field in an appliance intended for permanent connection to the power supply and shipped partially disassembled shall be made with means that comply with requirements for field wiring in accordance with 13.3.5 or by plug and receptacle connection.

10.8 Unless the intended method of assembly is obvious, an appliance that is shipped from the factory partially disassembled shall be provided with clear and detailed assembly instructions.

10.9 An appliance that is shipped from the factory partially disassembled and is not marked in accordance with 62.4.1 shall be shipped in a single shipping container.

10.10 Uninsulated live parts of a thermostat provided with a welded stop shall not contact a dead metal part or parts of opposite polarity when breakage of the welded stop permits the thermostat to rotate.

## 11 Mounting Means

### 11.1 General

11.1.1 An appliance, other than as noted in 11.2.1 – 11.2.3, is to be mounted in accordance with the mounting requirements specified in the appropriate section of this Standard.

### 11.2 Cord-connected wall-mounted appliances

11.2.1 Mounting brackets and any necessary hardware required to install a cord-connected, wall surface-mounted appliance shall be provided with the appliance or shall be available from the appliance manufacturer.

*Exception: Small parts commonly available for the mounting of the appliance are not required to be provided when the mounting instructions that refer to such parts are furnished in accordance with the requirements in Section 64, Important Safety Instructions, and Section 64A, Installation Instructions.*

11.2.2 With reference to 11.2.1, means shall be provided to reduce the likelihood that an appliance is dislodged from the wall. When the construction of the appliance or the mounting means permits the bottom of the appliance to swing or move, and such movement results in dislodging the appliance, means shall be provided to secure the bottom edge of the appliance to the wall.

11.2.3 An opening provided for hanging or mounting an appliance shall be located or guarded so that a nail, hook, or the like does not displace a part that creates a risk of fire, electric shock, or injury to persons and does not contact one of the following:

- a) An uninsulated live part;

- b) Film-coated wire;
- c) Internal wiring; or
- d) Moving parts.

## 12 Protection Against Corrosion

12.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or an equivalent means.

*Exception No. 1: This requirement does not apply to a part in which corrosion does not result in a risk of fire, electric shock, or injury to persons.*

*Exception No. 2: This requirement does not apply to the surfaces of sheet-steel and cast-iron parts within an enclosure, when corrosion of the parts due to exposure of the metal to air and moisture is not appreciable – thickness of metal and temperature also being factors.*

*Exception No. 3: This requirement does not apply to bearings, laminations, or minor parts of iron or steel such as washers, screws, and the like.*

## 13 Power Supply Connections – Permanently-Connected Appliances

### 13.1 General

13.1.1 An appliance intended for permanent connection to the power supply shall be constructed so that it may be permanently connected electrically to one of the wiring systems that is acceptable for the appliance in accordance with the National Electrical Code, ANSI/NFPA 70-1999.

13.1.2 With reference to the requirement specified in 13.1.1, the following types of appliances shall be provided with means for permanent electrical connection to the power supply:

- a) An attic fan;
- b) An appliance intended for permanent attachment to a building structure;
- c) A duct-connected appliance; or
- d) A range hood.

*Exception No. 1: A through-wall or in-glass fan not intended to be used in a cooking area is not required to be provided with a means for permanent electrical connection when it is provided with a power-supply cord that:*

- a) Is at least 0.46 m (18 inches) and not more than 3.05 m (10 feet) long;*
- b) Has three conductors, one being the equipment grounding conductor;*
- c) Is Type S, SJ, SJO, SJT, SJTO, SO, SP-3, SPT-3, ST, or STO;*
- d) Is permanently attached to the fan; and*
- e) Complies with the requirements in 14.1.2 and 14.2.1 – 14.2.5.*



*Exception No. 2: A portable fan with provision for temporary mounting, such as keyhole slots, is not required to be provided with means for permanent electrical connection when it is provided with a power-supply cord that is permanently attached to the fan and complies with the requirements of 14.1.2, 14.2.1 – 14.2.5, and Table 14.2.*

*Exception No. 3: A wall-mounted, ceiling-mounted, I-beam mounted, or suspension-bracket-mounted fan marked for commercial, industrial, or agricultural use is not required to have provision for permanent electrical connection when provided with a power-supply cord that:*

- a) Has three conductors;*
- b) Is Type SJ or heavier terminating in an acceptable grounding type attachment plug;*
- c) Has a length of 0.30 – 3.7 m (1 – 12 feet);*
- d) Is permanently attached to the fan;*
- e) Complies with the requirements of 14.1.2 and 14.2.1 – 14.2.5; and*
- f) Is marked in accordance with 62.1.10 or 111.1.*

*Exception No. 4: A down-draft fan is not required to be provided with a means for permanent electrical connection when it is provided with a power supply cord that:*

- a) Is at least 457.2 mm (18 inches) but not more than 762 mm (30 inches) long;*
- b) Has three conductors, one being the equipment grounding conductor;*
- c) Is Type S, SJ, SJO, SJT, SJTO, SO, ST, or STO;*
- d) Is permanently attached to the fan at a location intended to be below the surface of the cooking area; and*
- e) Complies with the requirements in 14.1.2 and 14.2.1 – 14.2.5.*

*Exception No. 5: A rangehood is not required to be provided with a means for permanent electrical connection when it complies with the requirements in sub-section 91.6, Cord-connected rangehoods; sub-section 91.7, Rangehood cord-connection kits; sub-section 92.5, Tests for cord-connected rangehoods; sub-section 92.6, Tests for rangehood cord-connection kits; Section 92A, Rating for Cord-Connected Rangehoods; Section 93A, Installation Instructions for Rangehoods and Cord-Connection Kits, and 93.3 – 93.5.*

*Exception No. 6: An in-line duct fan is not required to be provided with a means for permanent electrical connection when it is provided with the marking defined in item (f) and it is provided with a supply cord that:*

- a) Is not longer than 1.82 m (6 feet) measured from the point at which the cord emerges from the unit to the face of the attachment plug;*
- b) Is Type SJ or equivalent;*
- c) Is permanently attached to the fan;*

- d) Has three conductors, one being the equipment grounding conductor;
- e) Complies with the requirements of 14.1.2, 14.1.5, 14.1.6, and 14.2.1 – 14.2.5; and
- f) Is marked in accordance with 62.1.12.

13.1.2 revised December 23, 2003

## 13.2 Knockouts and openings

13.2.1 A knockout in a sheet-metal enclosure provided for connection of the appliance to a wiring system installed in accordance with the National Electrical Code, ANSI/NFPA 70-1999, shall be securely attached and removable without deformation that would impair the intended performance of the enclosure. The thickness of the knockout shall be in accordance with the thicknesses specified in Table 6.1.

13.2.2 There shall be a flat surface surrounding a knockout or opening of sufficient area to permit the attachment of a length of standard rigid metallic conduit of a size corresponding to the size of the knockout or opening. The flat area shall have a minimum diameter in accordance with Table 13.1.

13.2.3 A knockout or opening shall be surrounded on both the inside and outside surfaces by a flat surface to permit proper installation of a locknut. The flat surface shall extend in all directions beyond the edge of the knockout for a distance not less than that specified in Table 13.1.

**Table 13.1**  
**Dimensions associated with openings for conduit**

Trade size of conduit		Unthreaded openings			
		Nominal knockout diameter <sup>a</sup>		Minimum diameter of flat surface at knockout	
mm	(inches)	mm	(inches)	mm	(inches)
12.70	(1/2)	22.22	(0.875)	29.26	(1.152)
19.05	(3/4)	27.78	(1.109)	36.83	(1.450)
25.40	(1)	34.53	(1.375)	45.82	(1.804)

<sup>a</sup> A plus tolerance of 0.79 mm (0.031 inch) and a minus tolerance of 0.38 mm (0.015 inch) applies to the knockout opening diameter. Knockout diameters are to be measured other than at points where a tab remains after removal of the knockout.

### 13.3 Field-wiring compartments

13.3.1 A field-wiring compartment in which power-supply connections are made shall be located so that the connections are able to be readily inspected after the appliance is installed as intended.

*Exception: This requirement does not apply to a field-wiring compartment in a hood-type fan that, in accordance with the manufacturer's instructions, is installed behind a hinged or sliding cabinet door or the like.*

13.3.2 Accessibility of field-installed wiring and inspection of splices is to be judged by:

- a) A trial installation following any instructions provided by the manufacturer; or
- b) Using any wiring system permitted by the National Electrical Code, ANSI/NFPA 70-1999, if no instructions are provided.

13.3.3 The minimum usable volume of an outlet box or terminal compartment in which field-installed wiring connections to the power supply are to be made shall be as specified in Table 13.2.

13.3.3 effective December 3, 2000

**Table 13.2**  
**Minimum usable volume of terminal compartment**

Effective date for Table 13.2 changed from February 21, 2004 to February 21, 2005

Size of conductors		Volume for each conductor that originates outside the compartment and terminates or is spliced within the compartment, and each conductor that passes through the compartment without splice or termination, including a grounding conductor.	
AWG	(mm <sup>2</sup> )	cm <sup>3</sup>	(cubic inches)
18	(0.8)	24.6	1.50
16	(1.3)	28.7	1.75
14	(2.1)	32.77	(2.00)
12	(3.3)	36.87	(2.25)
10	(5.3)	40.97	(2.50)
8	(8.4)	49.16	(3.00)
6	(13.3)	81.94	(5.00)

13.3.4 A motor containing an integral wiring compartment shall comply with the requirements of UL 1004, the Standard for Electric Motors.

13.3.4 revised December 23, 2003

13.3.5 An electrical component shall not be mounted on a part, such as the cover of a wiring-terminal compartment, that is removed to permit field-wiring connections or inspections.

*Exception No. 1: A ceiling-insert, wall-insert, or hood-type fan, having a blade diameter of 304.8 mm (12 inches) or less, in which the power-supply-circuit wires are intended to be connected to an attachment-plug receptacle into which the leads to the motor or other electrical component are plugged are not prohibited from having the receptacles with integral leads mounted on the cover.*

*Exception No. 2: Components such as switches, thermostats, or the like shall not be mounted on a wiring compartment cover unless:*

- a) *The component is mounted so as to be prevented from turning;*
- b) *The leads are of sufficient length to permit examination of splice connections without placing stress on the terminals;*
- c) *The length of the leads prevents contact with a moving part or a part that operates at a temperature higher than the rating of the wiring;*
- d) *The component wiring terminals are not field-wired;*
- e) *Factory-installed pigtail leads can withstand a pull of 22.24 N (5 pounds) for 1 minute;*
- f) *Strain relief is provided to prevent stress from being placed on the terminals;*
- g) *The minimum size of the pigtail leads is 18 AWG (0.82 mm<sup>2</sup>); and*
- h) *There are no exposed wiring terminals on the back of the switch, thermostat, and the like.*

13.3.5 revised February 21, 2003

13.3.6 A field-wiring compartment intended for connection of a supply raceway and mounted integrally with the appliance shall be attached so as to be prevented from turning with respect to the appliance.

13.3.7 When the constructional features of an appliance permit field-wiring connections to be made in the motor terminal compartment, the compartment shall comply with the applicable requirements for electric motors.

13.3.8 An opening in a roof-mounted appliance for a power-supply or external control-circuit connection shall be threaded unless:

- a) It is located entirely below the lowest uninsulated live part within the enclosure; or
- b) Its location prevents drainage into the enclosure.

The metal at a threaded opening for a wiring system shall be not less than 6.35 mm (1/4 inch) thick, and an end-stop shall be provided, unless the thread is tapered. See 135.6.8.

### 13.4 Wiring terminals and leads

13.4.1 A field-wiring terminal is a terminal to which a wire is connected in the field, unless the wire and a means of making the connection – a pressure terminal connector, soldered loop, crimped eyelet, or the like – factory-assembled to the wire, are provided as part of the appliance.

13.4.2 A fan intended to be permanently connected electrically and rated 12 Amps or less shall be provided with wiring terminals, including an equipment grounding terminal, for the connection of conductors having an ampacity acceptable for the appliance. Otherwise, the fan shall be provided with leads not smaller than 18 AWG (0.82 mm<sup>2</sup>). When the fan rating exceeds 12 Amps, terminals shall be suitable for 125 percent of the current rating of the fan.

*Exception: Leads shall not be smaller than 18 AWG unless they are taped together and connected so that the individual conductors have a total cross-sectional area of at least 0.82 mm<sup>2</sup>.*

13.4.2 revised February 21, 2003

13.4.3 A wiring terminal shall be provided with an acceptable pressure terminal connector securely fastened in place – for example, firmly bolted or held by a screw.

*Exception: A wire-binding screw is not prohibited from being employed at a wiring terminal intended for connection of a 8 AWG (8.4 mm<sup>2</sup>) or smaller conductor when upturned lugs or the equivalent are provided to hold the wire in position.*

13.4.3 revised February 21, 2003

13.4.4 A wiring terminal shall be prevented from turning or shifting in position.

13.4.5 A wire-binding screw at a field-wiring terminal shall not be smaller than No. 10 (4.8 mm diameter).

*Exception No. 1: This requirement does not apply to a No. 8 screw (4.2 mm diameter) being used at a terminal intended only for the connection of a No. 14 AWG (2.1 mm<sup>2</sup>) or smaller conductor.*

*Exception No. 2: This requirement does not apply to a No. 6 screw (3.5 mm diameter) being used at terminal intended only for connection of a No. 16 or 18 AWG (1.3 mm<sup>2</sup> or 0.82 mm<sup>2</sup>) conductor.*

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13.4.6 It should be noted that 14 AWG (2.1 mm<sup>2</sup>) is the smallest conductor that shall be used for branch-circuit wiring, and thus is the smallest conductor that shall be anticipated at a terminal for connection of a power-supply wire.

13.4.6 revised February 21, 2003

13.4.7 A terminal plate tapped for a wire-binding screw shall be of metal not less than 1.27 mm (0.050 inch) thick. There shall be two or more full threads in the metal, which may be extruded if necessary to provide the threads.

*Exception: A plate not less than 0.76 mm (0.030 inch) thick meets the intent of this requirement when the tapped threads have equivalent strength in accordance with the Standard for Terminal Blocks, UL 1059.*

13.4.8 Upturned lugs, a cupped washer, or the equivalent shall be capable of retaining a conductor of the size specified in 13.4.2 under the head of a screw or washer.

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

*Exception: A lead shall not be less than 152.4 mm long unless it is evident that use of a longer lead results in a risk of fire, electric shock, or injury to persons.*

13.4.10 A screw used to secure an equipment grounding lead to an enclosure shall engage at least two full threads in the metal, which is not prohibited from being extruded to provide the threads.

### 13.5 Identification

13.5.1 A permanently connected appliance rated 125 volts or 125/250 volts (3-wire) or less, and employing a lamp- or element-holder of the Edison screw-shell type, or a single-pole switch or overcurrent-protective device other than an automatic control without a marked "off" position shall have one terminal or lead identified for the connection of the grounded conductor of the supply circuit. The terminal or lead so identified shall be the one that is electrically connected to the screw shell of a lamp- or element-holder but to which shall not be connected a single-pole switch or single-pole overcurrent-protective device, other than an automatic control without a marked "off" position.

13.5.2 With reference to 13.5.1, if leads from the motor or other component terminate in an attachment plug intended for insertion in a receptacle that is:

- a) Provided as part of the appliance; and
- b) Intended for connection of the branch-circuit power-supply conductors.

The plug and receptacle shall be polarized if a single-pole switch or an Edison-base lampholder is connected to the plug.

13.5.3 A terminal intended for connection of a grounded power-supply conductor shall be made of or plated with metal substantially white in color and shall be readily distinguishable from the other terminals; or identification of that terminal shall be clearly shown in some other manner, such as on an attached wiring diagram.

13.5.4 The surface of a lead intended for the connection of a grounded power-supply conductor shall have a white or gray color and shall be readily distinguishable from the other leads.

13.5.4 revised February 21, 2003

13.5.5 The surface of a lead intended for connection of an equipment-grounding conductor shall be green with or without one or more yellow stripes, and no other lead shall be so identified.

13.5.6 A terminal intended for the connection of an equipment-grounding conductor shall be identified by:

- a) Use of a wire-binding screw with a green-colored head that is slotted or hexagonal, or both;
- b) Use of a threaded stud with a green-colored hexagonal nut;
- c) Use of a green-colored pressure-terminal connector;
- d) Being marked "G," "GR," "GND," "Ground," "Grounding," the grounding symbol, ⊕, or the like; or
- e) A marking on a wiring diagram provided on the appliance.

## 14 Power Supply Connections – Cord-Connected Appliances

### 14.1 Cords and plugs

14.1.1 A portable appliance shall be provided with a flexible cord in accordance with Table 14.1 or of a type equally serviceable for the application, and an attachment plug for connection to the power-supply circuit. The length of cord external to the appliance shall be measured from the face of the attachment plug to the point of attachment or entry into the enclosure.

*Exception: A power supply cord provided on an air filtering appliance also evaluated to UL 1017, Vacuum Cleaners, Blower Cleaners and Household Floor Finishing Machines, may exceed the maximum length specified in Table 14.1 provided it meets all other requirements in both UL 507 and UL 1017.*

14.1.1 revised February 21, 2003

**Table 14.1**  
**Cords for appliances**

Table 14.1 revised February 21, 2003

Appliance	Type of cord <sup>a</sup>	Length, m (ft)
1. Fan not intended to rest directly on floor when in use. For example, a bracket fan, window only fan, or portable wall fan mounted with keyhole slots.	SP-1, SPT-1	1.5 – 3 (5 – 10)
2. Fan that rests directly on floor when in use, except for the type of fan indicated in item 3, 6, or 7. For example, a desk fan, box fan, or household air filtering appliance.	SP-2, SPT-2	1.5 – 3 (5 – 10)
3. Fan intended for commercial or industrial use, except for the type of fan indicated in item 7. For example, a commercial air filtering appliance.	SJ, SJT, SJO, SJTO, or any hard service cord or junior hard service cord in accordance with Table 400.4 of the National Electrical Code, ANSI/NFPA 70-2002	1.5 – 7.6 (5 – 25)

Table 14.1 Continued on Next Page



Table 14.1 Continued

Appliance	Type of cord <sup>a</sup>	Length, m (ft)
4. Portable or window-type evaporative household cooler.	SP-2, SPT-2	1.5 – 3 (5 – 10)
5. Commercial, industrial, or agricultural fan mounted as specified in Exception No. 3 of 13.1.2.	SJ, SJT, SJO, SJTO, or any hard service cord or junior hard service cord in accordance with Table 400.4 of the National Electrical Code, ANSI/NFPA 70-2002	0.5 – 3.7 (1.5 – 12)
6. Portable fan employing a general use convenience receptacle.	SJ, SJE, SJO, SJT, SJTO or equivalent	0.5 – 7.6 (1.5 – 25)
7. Dryer type fan and commercial blower inflator type fan except as noted in Item 8.	SJ, SJT, SJO, SJTO, or any hard service cord or junior hard service cord in accordance with Table 400.4 of the National Electrical Code, ANSI/NFPA 70-2002	1.5 – 30.5 (5 – 100)
8. Dryer type fan and commercial blower inflator type fan provided with a "stubby cord" for use with an extension cord.	SJ, SJT, SJO, SJTO, or any hard service cord or junior hard service cord in accordance with Table 400.4 of the National Electrical Code, ANSI/NFPA 70-2002	0.203 – 0.457 (0.67 – 1.5)

<sup>a</sup> An SVT cord type is considered equally serviceable to SPT-2.

14.1.2 The flexible cord shall be rated for use at a voltage not less than the rated voltage of the appliance, and shall have an ampacity not less than the current rating of the appliance.

14.1.3 The flexible cord shall either be attached permanently to the appliance or be in the form of a separate cord set with acceptable means for connection to the appliance.

14.1.4 An appliance intended for use with a detachable cord set shall not be provided with terminal pins that accommodate a standard flatiron or appliance plug.

14.1.5 The voltage rating of the attachment plug shall not be less than that of the appliance. When an appliance can be adapted for use on two or more different values of voltage by field alteration of internal connections, the attachment plug shall be rated for the voltage for which the appliance is connected when shipped from the factory. See 62.2.2.

14.1.6 The current rating of the attachment plug for an appliance rated 12 amperes or less shall not be less than the current rating of the appliance. For an appliance rated more than 12 amperes, the current rating of the attachment plugs shall not be less than 125 percent of the current rating of the appliance.

14.1.6 revised February 21, 2003

14.1.7 The attachment plug of the power supply cord of an appliance provided with a 15- or 20-ampere general-use convenience receptacle shall be of the 3-wire grounding type. The attachment plug of the power supply cord of all other appliances not required to be grounded shall be polarized or of the grounding type.

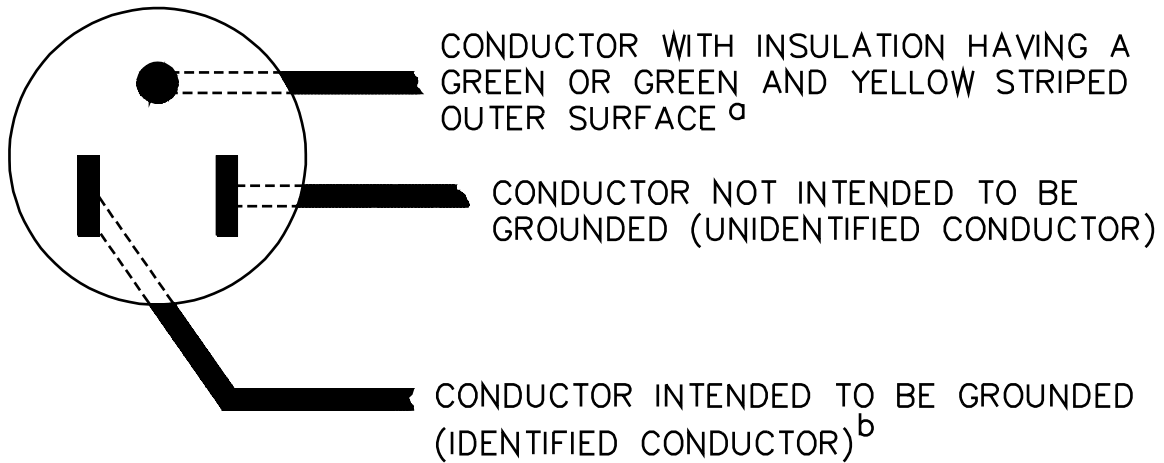
14.1.8 When a 3-wire grounding-type attachment plug or a 2-wire polarized attachment plug is provided, the attachment plug connections shall comply with Figure 14.1, and the polarity identification of the flexible cord shall comply with Table 14.2.

14.1.9 The conductor of the power supply cord that is intended to be grounded shall have the following items connected to it:

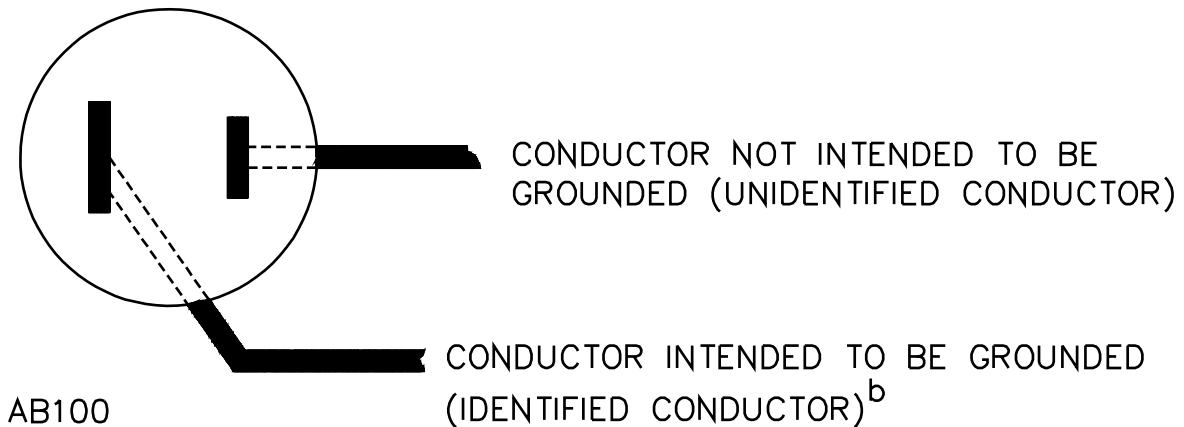
- a) The screw shell of an Edison-base lampholder; and
- b) The terminal or lead receptacle intended to be grounded. Table 14.2 identifies the supply cord conductor intended to be grounded.

**Figure 14.1**  
**Connection to attachment plug**

CONNECTIONS OF CORD CONDUCTORS TO GROUNDING – TYPE ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



CONNECTIONS OF CORD CONDUCTORS TO POLARIZED ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



<sup>a</sup> The blade to which the green conductor is connected may have a U-shaped or circular cross section.

<sup>b</sup> Signifies a conductor identified in accordance with Table 14.2.

**Table 14.2**  
**Polarity identification of flexible cords**

Table 14.2 revised February 21, 2003

Method of polarity identification	Acceptable combinations	
	Wire intended to be grounded <sup>d</sup>	All other wires
Colored braid	Solid white or gray	Solid color other than white or gray
Tracer in braid	Solid white or gray braid with no tracer in braid <sup>b</sup>	Solid white or gray braid with a colored tracer in braid <sup>b</sup>
	Colored tracer in braid of a color other than white or gray	No tracer in braid of solid color other than white or gray
Colored insulation <sup>c</sup>	Solid white or gray <sup>a</sup>	Solid color other than white or gray
	Light blue <sup>d</sup>	Solid color other than light blue, white, or gray <sup>d</sup>
Colored separator <sup>e</sup>	White or gray	Color other than white or gray
Tinned conductors <sup>f</sup>	Tin or other white metal on all strands of the conductor	No tin or other white metal on the strands of the conductor
Surface marking <sup>e</sup>	One or more stripes, ridges, or grooves, or a combination of these on the exterior surface of the cord	

<sup>a</sup> A conductor having insulation finished to show a green color with or without one or more straight or helical unbroken yellow stripes or having a green braid with or without one or more yellow tracers is to be used only as an equipment grounding conductor. See Figure 14.1 for the connection of conductors to attachment plugs.

<sup>b</sup> Only for Types C and PD cords.

<sup>c</sup> Only for a cord having no braid on any individual conductor.

<sup>d</sup> Only for a cord having a jacket that is not integral with the circuit conductor insulation.

<sup>e</sup> Only for Types SP-1, SP-2, SPE-1, SPE-2, SPT-1, and SPT-2 cords.

<sup>f</sup> Only for Types SPT-1 and SPT-2 cords.

14.1.10 A flexible power supply cord shall not be smaller than 18 AWG (0.82 mm<sup>2</sup>).

14.1.11 The ampacity of a flexible power supply cord shall be as specified in Table 400-5(A) of the National Electrical Code, ANSI/NFPA 70-1999. For reference purposes, an abbreviated table showing the ampacities for flexible cord with two current carrying copper conductors is shown in Table 14.3.

**Table 14.3**  
**Ampacities for flexible cords**

Conductor size		Ampacity (Amperes)
AWG	(mm <sup>2</sup> )	
18	(0.82)	10
17	(1.04)	12
16	(1.31)	13
14	(2.08)	18
12	(3.31)	25

## 14.2 Strain relief

14.2.1 Strain relief shall be provided so that the mechanical stress on the flexible cord is not transmitted to terminals, splices, or internal wiring. See 42.1.

14.2.2 A metal strain-relief clamp or metal band is acceptable without supplementary protection on a Type SJ, SJO, SJT, SJTO, S, SO, ST, STO, SV, or SVO cord.

14.2.3 A metal strain-relief clamp or metal band shall not be used on Type SP-2 or lighter rubber-insulated cord or on Type SPT-1, SPT-2, SVT, or SVTO cord unless such a cord is protected by varnished cloth tubing or the equivalent under the clamp, and the construction complies with the requirements specified in 42.4.

14.2.4 Means shall be provided to prevent the supply cord or lead from being pushed into the enclosure of an appliance through the cord-entry hole when such displacement results in:

- a) Subjecting the supply cord or lead to mechanical damage;
- b) Exposing the supply cord or lead to a temperature higher than that for which it is rated;
- c) Reducing spacings (such as to a metal strain-relief clamp) below the minimum required values; or
- d) Damaging internal connections or components.

To determine compliance, the supply cord or lead shall be tested in accordance with Section 44, Push Back Relief Test.

14.2.5 When a knot in a flexible cord serves as the strain relief, the surfaces that the knot touches shall be free from projections, sharp edges, burrs, fins, or similar edges that damage the conductors.

*Exception: A knot shall not be employed to provide strain relief for cord-connected rangehoods.*

14.2.5 revised September 24, 2001

### 14.3 Bushings

14.3.1 A bushing or the equivalent shall be provided at a point where a flexible cord passes through an opening in a wall, barrier, or enclosing case. The bushing shall be substantial, secured in place, and shall have a smooth, well-rounded surface against which the cord may bear. An insulating bushing shall be provided when:

- a) The cord is Type SP-1, SPT-1, SP-2, or SPT-2, or other type lighter than Type SV;
- b) The wall or barrier is of metal; and
- c) The construction is such that the cord is subjected to stress or motion.

*Exception: For a cord hole in wood, porcelain, phenolic composition, or other nonconductive material, a smoothly rounded surface is considered to be the equivalent of a bushing.*

14.3.2 Ceramic materials and some molded compositions are acceptable for insulating bushings.

14.3.3 Vulcanized fiber is not prohibited from being employed if the bushing is not less than 1.2 mm (3/64 inch) thick, and if formed and secured in place so that it is not damaged by conditions of ordinary moisture.

14.3.4 A separate soft-rubber, neoprene, or polyvinyl chloride bushing is not prohibited from being employed in a fan, or in the frame of a motor, or in the enclosure of a capacitor attached to a motor of an evaporative cooler, or a room-type filter unit if the bushing is:

- a) Not less than 1.2 mm (3/64 inch) thick; and
- b) Located so that it is not exposed to oil, grease, oily vapor, or other substances that deteriorate the compound employed.

14.3.5 A bushing of a material mentioned in 14.3.4 shall not be employed in an appliance unless used in conjunction with a type of cord for which an insulating bushing is not required.

14.3.6 When a bushing of a material mentioned in 14.3.4 is used, the hole in which the bushing is mounted shall be smooth and free from sharp edges.

14.3.7 A bushing of the same material as, and molded integrally with, the supply cord is acceptable on a Type SP-1 or heavier cord, only when the built-up section is not less than 1.6 mm (1/16 inch) thick at the point where the cord passes through the enclosure.

14.3.8 An insulated metal grommet is acceptable in place of an insulating bushing if the insulating material is not less than 0.8 mm (1/32 inch) thick and completely fills the space between the grommet and the metal in which it is mounted.

## 15 Live Parts

15.1 A current-carrying part shall be silver, copper, a copper alloy, or other material acceptable for the application.

15.2 Ordinary iron or steel that is provided with a corrosion-resistant coating is not prohibited from being used as a current-carrying part in accordance with the following:

- a) When acceptable in accordance with 3.1; or
- b) Within a motor or associated governor, but the use of ordinary iron or steel for current-carrying parts elsewhere in the appliance is not acceptable.

15.3 An uninsulated live part shall be secured to the surface on which it is mounted, and supporting insulating materials shall be secured in place, so that the part is prevented from turning or shifting in position when spacings are reduced below the minimum values specified in Spacings, Section 24.

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15.4 Friction between surfaces is not acceptable as a means to prevent shifting or turning of a live part. A toothed lock washer with spring take-up, applied as intended, is acceptable.

## 16 Internal Wiring – Electrical Connections

16.1 The internal wiring and connections between parts of an appliance shall be protected or enclosed in accordance with 16.2.

*Exception: A length of flexible cord is not prohibited from being employed for external interconnection only when flexibility is essential.*

16.2 Internal wiring, consisting of individual insulated conductors either separate or in a harness, and electrical connections are considered to be acceptably protected when either of the following apply:

- a) When judged as though it were film-coated wire, the wiring complies with 9.1.1; or
- b) Even though it could be touched by the probe specified in 9.1.1, the wiring is secured so that it cannot be grasped or hooked in such manner that it or related electrical connections are subjected to undue stress.

A grill, louver, or the like, regardless of how secured in place, is not to be removed when the exposure of internal wiring is being judged, but a filter, or other device provided in lieu of a filter, on a fan intended for use in a cooking area is to be removed during the examination. The location in which the appliance is intended to be mounted when in service is also to be taken into consideration in determining compliance with this requirement – that is, a relatively greater degree of exposure of internal wiring is acceptable if the appliance is likely to be installed in a location, such as an attic, where it will be remote from persons.

16.3 The internal wiring and connections of an appliance shall consist of components of a type or types that are acceptable for the particular application, when considered with respect to:

- a) The temperature and voltage to which they are likely to be subjected;
- b) Exposure to oil, grease, or moisture; and
- c) To other conditions of service to which they are likely to be subjected.

16.4 Unless the spacing or the insulation between the stator winding and the shading-coil circuit is as specified in 24.7, the shading-coil circuit is to be considered as though it were directly connected to the power-supply circuit.

16.5 Type AF wire is not acceptable in the following cases:

- a) When the wire is exposed to moisture, including any condensation resulting from operation of the appliance; or
- b) When the fan is intended to be used in a cooking area.

16.6 Wiring shall be protected from sharp edges including male screw threads, burrs, moving parts, and other agents that might cause abrasion of the insulation on conductors.

16.7 A flexible cord used for external interconnection as mentioned in 16.1 shall be provided with bushings and strain relief that comply with Section 42, Strain Relief Test.

16.8 Insulated conductors that pass through an opening in a sheet-metal wall that is not more than 1.07 mm (0.042 inch) thick shall be:

- a) Securely held away from the edges of the opening;
- b) Protected by a bushing, metal grommet, eyelet, or the equivalent; or
- c) Protected by rolling the edge of the metal opening at least 120 degrees.

16.9 A non-metallic bushing as mentioned in 16.8(b) shall:

- a) Be securely held in place; and
- b) Have a minimum wall thickness of 1.2 mm (3/64 inch).

16.10 The edges of an opening in sheet metal more than 1.07 mm (0.042 inch) thick shall be treated to prevent abrasion of the insulation by removal of burrs, fins, and sharp edges.

16.11 Insulated wires are not prohibited from being bunched and passed through a single opening in a metal wall within the enclosure.

16.12 All splices and connections shall be mechanically secure and shall maintain electrical contact.

16.13 A soldered connection shall be made mechanically secure before being soldered when breaking or loosening of the connection causes a risk of fire, electric shock, or injury to persons.

16.14 With reference to 16.13, a lead is considered to be mechanically secure when one or more of the following are provided:

- a) At least one full wrap around a terminal;
- b) The lead is passed through an eyelet or opening;
- c) The lead is twisted together with another conductor.

16.15 A splice shall be provided with adequate insulation equivalent to that on the wires involved when permanence of spacing between the splice and other metal parts is not maintained.

16.16 Insulation consisting of two layers of friction tape, two layers of thermoplastic tape, or of one layer of friction tape wrapped over one layer of rubber tape, is acceptable on a splice when the voltage involved is less than 250 volts. In determining if splice insulation consisting of coated-fabric, thermoplastic, or other tubing is acceptable, consideration is to be given to such factors as dielectric properties, heat-resistant and moisture-resistant characteristics, and the like. Thermoplastic tape wrapped over a sharp edge is not acceptable.

16.17 The means of connecting stranded internal wiring to a wire-binding screw shall be such that loose strands of wire are prevented from contacting other live parts not of the same polarity as the wire and from contacting dead-metal parts. This shall be accomplished by using pressure terminal connectors, crimped eyelets, soldering all strands of the wire together, or equivalent means.

16.18 Wiring that connects the motor and the base of an oscillating fan shall:

- a) Have conductors with individual strands not larger than 34 AWG (0.02 mm<sup>2</sup>);
- b) Have rubber or other insulation not less than 0.4 mm (1/64 inch) thick on each conductor;  
and
- c) Not be of such length and location that results in damage by intended operation.

16.18 revised February 21, 2003

16.19 Internal connections from the motor or light in a wall-insert fan, a ceiling-insert fan, or a ceiling-insert fan/light combination to the fan shall be made by a plug and receptacle connection.

Added 16.19 effective September 24, 2003

16.20 Internal wiring and tubing in an in-line duct fan that is not vented to the outdoors shall not be exposed to the main air stream, and shall be installed in accordance with the requirements for wiring in ducts in the National Electrical Code, ANSI/NFPA 70.

Added 16.20 effective February 21, 2005

## 17 Insulating Material

17.1 Insulating material employed in an appliance is to be judged with respect to its acceptability for the particular application. Materials such as mica and certain refractory materials are acceptable for use as the sole support of live parts. Other materials not acceptable for general use, such as magnesium oxide, may be acceptable if used in conjunction with other insulating materials, or if so located and protected that the risk of mechanical damage and the absorption of moisture are reduced. When it is necessary to investigate a material to determine its acceptability, consideration is to be given to its mechanical strength, insulation resistance, heat-resistant qualities, the degree to which it is enclosed or protected, and any other features having a bearing on the risk of fire, electric shock, or injury to persons involved in conjunction with conditions of service. All these factors are to be considered with respect to thermal aging. Polymeric materials shall comply with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

17.2 Vulcanized fiber is not prohibited from being used for an insulating bushing, washer, separator, or barrier and shall not be used as support for uninsulated live parts.

17.3 A molded part shall have mechanical strength and rigidity to withstand the stresses of intended service. Brush caps shall be secured or located so as to be protected from mechanical damage that occurs during intended use.

## 18 Receptacles

18.1 A 15- or 20-ampere attachment-plug receptacle intended for general use as a convenience receptacle in a fan shall be of the grounding type, and shall comply with UL 498 , the Standard for Attachment Plugs and Receptacles.

18.1 effective December 3, 2000

18.2 A fan shall not be provided with more than two single or one duplex convenience receptacles.

18.2 effective December 3, 2000

18.3 A general use convenience receptacle provided on a fan shall be wired so that it provides the same polarized supply as the attachment plug of the fan.

18.3 effective December 3, 2000

18.4 The minimum power supply cord size for a portable fan shall be in accordance with Table 18.1.

18.4 effective December 3, 2000

**Table 18.1**  
**Minimum power supply cord size for portable fans employing a general use convenience receptacle**

Table 18.1 effective December 3, 2000

Rating of fan (Amperes)	Minimum power supply cord (AWG)
12 or less	14
12 – 16	12

18.5 The power supply cord of a portable fan employing a general use convenience receptacle shall not employ a through cord switch.

18.5 effective December 3, 2000

18.6 A detachable power supply cord shall not be used with a portable fan employing a general use convenience receptacle.

18.6 effective December 3, 2000

18.7 A general use convenience receptacle shall not be provided on any fan intended to be installed in a cooking area.

*Exception: This requirement does not apply to a ventilating-hood-fan shelf. See Section 98, Construction.*

18.7 effective December 3, 2000

18.8 Internal wiring for a general use convenience receptacle shall be in accordance with Table 18.2.

18.8 effective December 3, 2000

**Table 18.2**  
**Internal wiring for fans employing a general use convenience receptacle**

Table 18.2 effective December 3, 2000

Ampacity of receptacle (Amperes)	Internal wiring (AWG)
15	14
20	12

18.9 When the face of a general use convenience receptacle is less than 15.9 mm (5/8 inch) wide or less than 22.2 mm (7/8 inch) long, the face of the receptacle shall project not more than 4.8 mm (3/16 inch) from the part of the mounting surface that is within a rectangle 22.2 mm (7/8 inch) long and 15.9 mm (5/8 inch) wide symmetrically located about the receptacle contacts; and when the mounting surface is conductive, the face of the receptacle shall project not less than 2.4 mm (3/32 inch) from that part of the mounting surface.

18.9 effective December 3, 2000

18.10 The area surrounding a general use convenience receptacle shall be free of any projection that prevents full insertion of the blades of an attachment plug having a face diameter of 49.2 mm (1-15/16 inches) and rectangular attachment plug having a face of 38.1 by 41.3 mm (1-1/2 by 1-5/8 inch).

*Exception: This requirement does not apply to projections that prevent the blades of the attachment plug from making electrical contact with the female contacts of the convenience receptacle.*

18.10 effective December 3, 2000

18.11 A Class A ground-fault circuit interrupter (GFCI) with open neutral protection shall be provided for general use convenience receptacles that are part of a fan intended to be used outdoors or in wet or damp locations. The convenience receptacle shall be located so that it is not wetted. See Sections 134 – 138 and 156.

18.11 effective December 3, 2000

18.12 A fan provided with a general use convenience receptacle intended for use in an outdoor location with the receptacle cover closed shall be provided with a self-closing cover and shall be marked in accordance with 63.13.

18.12 effective December 3, 2000

18.13 Supplementary overcurrent protection shall be provided for each general use convenience receptacle and shall be connected between the power supply cord and the receptacles. The overcurrent protective device shall comply with the requirements in UL 1077 , the Standard for Supplementary Protectors for Use in Electrical Equipment, for use with motor loads. The supplementary overcurrent protection device shall have been subjected to the Overload Test in UL 1077 , the Standard for Supplementary Protectors for Use in Electrical Equipment, tested for motor starting at 6 times the AC full load current rating.

*Exception: A fuse that complies with the requirements in the Standard for Low-Voltage Fuses – Part 14: Supplemental Fuses, UL 248-14, is not prohibited from being used as a supplementary overcurrent protection device.*

18.13 revised February 21, 2003

18.14 A single-pole supplementary protection device shall be connected in the ungrounded (line) conductor of the supply circuit only. A double-pole device shall be connected on both the ungrounded and grounded (neutral) conductors such that when it operates, it opens both ungrounded and grounded conductors.

18.14 effective December 3, 2000

18.15 A supplementary protection device shall not be connected to the grounding conductor.

18.15 effective December 3, 2000

18.16 The ampere rating of the overcurrent protective device shall not be greater than the ampacity of:

- a) The configuration of the convenience receptacles it is to protect; or
- b) The power-supply cord.

18.16 effective December 3, 2000

18.17 A supplementary protection device shall not open during the Temperature Test, Section 36.

18.17 effective December 3, 2000

18.18 When a single overcurrent protective device does not protect all receptacle outlets, more than one overcurrent protective device shall be used, and each receptacle outlet shall be marked to indicate the rating of the overcurrent protective device connected to it. See 62.1.8.

18.18 effective December 3, 2000

18.19 A fan employing a receptacle having a fuse that is intended to be replaced in the field shall be marked as specified in 63.11.

18.19 effective December 3, 2000

## 19 Motors

19.0 A motor shall comply with the construction requirements of UL 1004, the Standard for Electric Motors.

19.0 added December 23, 2003

19.1 A motor shall be acceptable for the particular application, and shall be capable of handling the maximum normal load of the appliance without resulting in a risk of fire, electric shock, or injury to persons.

19.2 A motor winding shall resist the absorption of moisture as evaluated by the Humidity Conditioning Test, Section 41.

19.3 With reference to 19.2, film-coated wire and wire employing cotton over film coating are not required to be additionally treated to prevent absorption of moisture in an appliance not intended to be exposed to the weather – see 38.3.1 – 38.3.3. A treatment of the winding is required when the appliance is to comply with the requirements in 38.1.1, 38.1.2, and 38.3.1 – 38.3.3.

19.4 A brush holder assembly shall be constructed so that when a brush is worn out – no longer capable of performing its function – the brush, spring, and other part of the assembly is retained to the degree which does not result in:

- a) An accessible dead-metal part becoming energized; and
- b) A live part becoming accessible.

19.5 Motors for use in unattended areas shall be tested in accordance with Section 139, General, and Section 140, Performance.

19.6 A bobbin-wound skeleton motor used in a ceiling-insert fan, wall-insert fan, or rangehood must comply with the following requirements:

- a) The motor is to be provided with a coil cover meeting the 5VA flammability requirements as defined by the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C;
- b) The coil is to be completely wrapped with insulation at least 0.8 mm (1/32 inch) thick. This wrap is to employ at least two layers of insulation of minimum 0.4 mm (1/64 inch) thick;
- c) The adhesive used to secure the coil cover shall comply with the requirements for adhesives in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. In addition to this adhesive, the coil cover is also to be provided with a means for mechanical securement;
- d) The space between the bobbin and the wrap is not to exceed 0.8 mm total;
- e) The space between the windings and the wrap is to be minimized, allowing for minimal air volume inside the coil wrap; and
- f) The coil cover is to possess a minimum electrical RTI of 90°C, but not less than the maximum temperature measured on the motor winding.

Added 19.6 effective June 23, 2005

## 20 Motor Protection

20.1 Over-temperature protection shall be provided for the motor of an appliance by one of the following:

- a) Thermal protection complying with the applicable requirements in UL 2111 , the Standard for Overheating Protection for Motors.

*Exception No. 1: A fan employing a fan blade or blower wheel attached directly to the motor shaft need comply only with the requirements for protection during locked-rotor conditions.*

*Exception No. 2: A thermally protected Type F shaded pole motor used in a ceiling insert fan, wall insert fan, or a fan intended for use in cooking areas shall not exceed a temperature of 200°C (392°F) when subjected to the Locked-Rotor Temperature Test specified in UL 2111. See 62.2.5.*

- b) Impedance protection complying with UL 2111 , the Standard for Overheating Protection for Motors.

*Exception: An impedance-protected Type F shaded pole motor used in a ceiling insert fan, wall insert fan, or a fan intended for use in cooking areas shall not exceed a temperature of 200°C when subjected to the Locked-Rotor Temperature Test specified in UL 2111. See 62.2.6.*

- c) Other protection that is shown by test to be equivalent to the protection specified in (a).

20.1 revised December 23, 2003

20.2 When a multispeed motor is provided with protection in accordance with these requirements, the protection shall accomplish the intended result at each setting of the speed-control device.

20.3 When a multispeed motor is not provided with protection in accordance with these requirements, and when the protection with which the appliance is provided upon installation does not function to protect the motor for one or more settings of the speed-control device, protection at each setting shall be provided as part of the appliance.

## 21 Protective Devices

21.1 A protective device, the intended functioning of which requires replacement or resetting, shall be in a readily accessible location.

21.2 A protective device shall be inaccessible from outside the appliance without opening a door or cover.

*Exception: This requirement does not apply to the operating handle of a circuit breaker, the operating button of a manually operable motor protector, and similar parts which project outside the enclosure.*

21.3 A fuseholder shall be constructed and installed so that no uninsulated live part other than the screw shell or clips is exposed to contact by a person removing or replacing a fuse. The screw shell of a plug-type fuseholder shall be connected toward the load.



21.4 A door or cover of an enclosure shall be hinged or attached in an equivalent manner when it gives access to any overload-protective device, the intended functioning of which requires renewal, or if it is necessary to open the cover in connection with the intended operation of the protective device.

21.5 Means shall be provided for holding closed a door or cover over a fuseholder, and the door or cover shall fit tightly.

21.6 A protective device shall not open the circuit during intended operation of the appliance.

21.7 In an automatic appliance, when breakdown of a capacitor that is not part of a permanent-split-capacitor motor or a part of a capacitor-start motor results in a risk of fire or electric shock, thermal or overcurrent protection shall be provided in the appliance.

## 22 Switches, Including Motor Controllers

22.1 A switch or other control device shall:

- a) Be acceptable for the application;

*Exception: A switch or other device that controls a motor that has not been previously investigated for its suitability of controlling a motor shall be subjected to the Tests of Switches and Controls, Section 45.*

- b) Have a current and voltage rating not less than that of the load that it controls; and

- c) Be located within the confines of the frame or enclosure of the appliance or be additionally protected so as to reduce the likelihood of contact by external objects.

*Exception: The actuating part of a switch is not required to be located within the confines of the frame or enclosure.*

22.1 revised February 21, 2003

22.2 With reference to the requirement in 22.1, the current rating of a switch that controls an inductive load, other than a motor, such as a transformer or a fluorescent-lamp ballast, shall not be less than twice the rated full-load current of the transformer or ballast, unless the switch is known to be acceptable for the particular application.

22.2 revised December 23, 2003

22.3 A manually operated, line-connected, single pole switch for appliance on-off operation shall not be connected to the conductor of the power supply cord intended to be grounded. Table 14.2 specifies the identification of the power supply cord conductor intended to be grounded.

22.4 A switch is considered to be acceptable for controlling a tungsten-filament lamp load when:

- a) It has a T or L rating and a current rating at least equal to the tungsten-filament lamp load; or

- b) It has an alternating-current rating at least six times, or a direct-current rating at least ten times that of the tungsten-filament lamp load.

22.5 A switch provided for the control of a fluorescent lamp and not integral with the lampholder shall have a current rating at least twice the primary rating of the ballast. Each ballast is to be considered as requiring its rated input current.

22.6 When an appliance provided with a direct-plug in power-supply cord and an attachment plug employs a motor rated more than 250 watts (1/3 horsepower) output, a motor controller – a device for starting and stopping the motor – shall be provided in the appliance.

22.6 revised February 21, 2003

22.7 A speed-control switch shall be provided with an appliance that employs a multispeed motor – a motor with a winding capable of various pole groupings.

22.8 The construction of a switch shall be such that only one circuit can be energized at a time.

*Exception: A switch that is constructed to energize more than one circuit at a time shall not be employed unless it has been investigated and found acceptable for such use.*

22.9 When a fan is provided with a timing or temperature device that automatically starts the fan, the automatic restarting of moving parts shall not result in a risk of injury to persons. See 63.2.

*Exception: This requirement does not apply to a fan impeller having a diameter of 304.80 mm (12 inches) or less.*

22.9 revised December 23, 2003

22.10 Automatic restarting of a fan provided with an automatically reset thermally actuated device, such as a room thermostat or a motor thermal protector, shall not result in a risk of injury to persons. See 63.2.

*Exception: This requirement does not apply to a fan impeller having a diameter of 304.80 mm (12 inches) or less.*

22.11 A permanently connected fan employing a factory wired component solid-state speed control shall include a positive marked "off" position provided by an air-gap-type switch that complies with the applicable requirements in the Standard for General-Use Snap Switches, UL 20, or in the Standard for Special-Use Switches, UL 1054, or the equivalent.

*Exception No. 1: This requirement does not apply to a fan speed control that complies with UL 991, Tests for Safety-Related Controls Employing Solid-State Devices.*

*Exception No. 2: An air-gap-type switch is not required when the factory wired solid state speed control de-energizes all circuits that involve open circuit potentials in excess of 30 V ac (42.4 V peak), and where the continuous current flow through a 1500 ohm resistor connected across the potential exceeds 0.5 mA.*

Added 22.11 effective September 24, 2003

## 23 Capacitors

23.0 A motor start or run capacitor shall comply with the construction requirements in the Standard for Capacitors, UL 810.

Added 23.0 effective December 23, 2005

23.1 A capacitor of a capacitor motor – such as a capacitor for power-factor correction – shall be housed within an enclosure or container that protects the plates against mechanical damage and that prevents emission of flame or molten material resulting from malfunction of the capacitor. The container shall be metal providing strength and protection not less than that of uncoated sheet steel having a thickness of 0.51 mm (0.020 inch). Sheet metal having a thickness less than 0.66 mm (0.026 inch) shall not be used.

*Exception: The container of a capacitor shall not be of sheet metal thinner than 0.66 mm, or of material other than metal, unless the capacitor is mounted in an enclosure that houses other parts of the appliance, and if such container is acceptable for the enclosure of the live parts.*

23.2 Except for a cord-connected appliance rated for a nominal 120-volt supply – see 32.1 – the total capacitance of capacitors connected from one side of the line to the frame or enclosure of an appliance shall not result in the flow of more than 5 milliamperes in the grounding conductor when the frame or enclosure is connected to ground.

23.3 Under both normal and abnormal conditions of use, a capacitor employing a dielectric medium more combustible than askarel shall not result in a risk of electric shock or fire and shall be protected against expulsion of the dielectric medium. See 24.9.

23.4 Capacitors connected across-the-line or line to ground in other than a secondary circuit shall comply with Section 37, Dielectric Voltage Withstand Test.

*Exception: This requirement does not apply to a capacitor that does not exceed its temperature rating during the Normal Temperature Test, Section 36, and complies with the Dielectric Voltage Withstand Test of UL 1283, the Standard for Electromagnetic Interference Filters.*

23.4 revised February 21, 2003

23.5 Capacitors connected line-to-line or line-to-ground shall comply with the requirements in UL 1414 , the Standard for Capacitors and Suppressors for Radio- and Television-Type Appliances.

*Exception: This requirement does not apply to capacitors that comply with the Dielectric Voltage Withstand Test, Insulation Resistance Test, and Endurance Test of UL 1283, the Standard for Electromagnetic Interference Filters.*

23.5 revised February 21, 2003

## 24 Spacings

24.1 The spacings between field-wiring terminals of opposite polarity, and between a wiring terminal and any other uninsulated metal part (dead or live) not of the same polarity, shall not be less than that specified in Table 24.1. See 13.4.1.

*Exception No. 1: The spacing requirements in Table 24.1 do not apply to the inherent spacings of a component of an appliance, such as a switch. Such spacings are to comply with the requirements for the component in question.*

*Exception No. 2: Spacings on printed wiring board assemblies may comply with the requirements in 24.10 and Table 24.3.*

*Exception No. 3: Circuits that comply with the requirements for Secondary Circuits, Section 25, are not required to be evaluated for spacings. The spacings between these circuits and other circuits shall comply with Tables 24.1 – 24.3 as applicable.*

24.2 Spacings, other than at field-wiring terminals, between uninsulated live parts of opposite polarity, and between an uninsulated live part and a dead-metal part, shall not be less than the applicable value specified in Table 24.2. When an uninsulated live part is not rigidly fixed in position by means other than friction between surfaces, or when a movable dead-metal part is in proximity to an uninsulated live part, the construction shall be such that the minimum acceptable spacing will be maintained.

*Exception: The spacing requirements in Table 24.2 do not apply to the inherent spacings of a component of an appliance, such as a switch. Such spacings are to comply with the requirements for the component in question.*

**Table 24.1**  
**Minimum required spacings at field-wiring terminals**

Potential involved, volts	Minimum spacings, mm (inch)		
	Between field-wiring terminals, through air or over surface	Between field-wiring terminals and other uninsulated metal parts not always of the same polarity <sup>a</sup>	
		Over surface	Through air
250 or less	6.35 (1/4)	6.35 (1/4)	6.35 (1/4)
More than 250	12.70 (1/2) <sup>b</sup>	12.70 (1/2) <sup>b</sup>	9.52 (3/8)

<sup>a</sup> Applies to the sum of the spacings involved where an isolated dead part is interposed.  
<sup>b</sup> A spacing of not less than 9.52 mm (3/8 inch), through air and over surface, is acceptable at wiring terminals in a wiring compartment or terminal box if the compartment or box is integral with a motor.

**Table 24.2**  
**Minimum required spacings at other than field-wiring terminals**

Potential involved, volts	Minimum spacings, mm (inch)			
	An appliance employing a motor having a diameter of 177.80 mm (7 inches) or less <sup>a</sup>		An appliance employing a motor having a diameter of more than 177.80 mm (7 inches) <sup>a</sup>	
	Over surface	Through air	Over surface	Through air
0 – 50	1.59 (1/16)	1.59 (1/16)	6.35 <sup>C</sup> (1/4)	3.18 <sup>C</sup> (1/8)
51 – 125	2.38 <sup>b</sup> (3/32)	2.38 <sup>b</sup> (3/32)	6.35 <sup>C</sup> (1/4)	3.18 <sup>C</sup> (1/8)
126 – 250	2.38 (3/32)	2.38 (3/32)	6.35 <sup>C</sup> (1/4)	6.35 <sup>C</sup> (1/4)
251 – 600	12.70 <sup>C</sup> (1/2)	9.52 <sup>C</sup> (3/8)	12.70 <sup>C</sup> (1/2)	9.52 <sup>C</sup> (3/8)

<sup>a</sup> This is the diameter, measured in the plane of the laminations, of the circle circumscribing the stator frame, excluding lugs, fins, boxes, and the like, used solely for the motor mounting, cooling, assembly, or connection.

<sup>b</sup> For an appliance employing only motors rated 248.57 watts or less, these spacings may be not less than 1.59 mm.

<sup>c</sup> Film-coated wire is considered to be an uninsulated live part. However, a spacing of not less than 2.38 mm over surface and through air between film-coated wire, rigidly supported and held in place on a coil, and a dead-metal part is acceptable.

24.3 An uninsulated conductor or a rotor circuit shall be regarded as a dead-metal part with respect to the stator circuit, and the required spacing shall be provided between uninsulated stator and rotor conductors.

24.4 In the application of 24.2, 37.1, and Table 24.2 to an appliance employing a motor not rated in watts, Tables 430-147 through 430-150 of the National Electrical Code, ANSI/NFPA 70-1999, are to be used as applicable to determine the relationships between watts and full-load current for motors.

24.5 At terminal screws and studs to which connections are made in the field by wire connectors, eyelets, or the like described in 13.4.1, spacings shall not be less than those specified in Table 24.2 with the connectors, eyelets, or the like, in such position that minimum spacings – opposite polarity and to dead metal – exist.

24.6 A barrier or liner of vulcanized fiber or similar material employed in lieu of spacings shall be of a material acceptable for the application and shall not be less than 0.8 mm (1/32 inch) thick.

*Exception No. 1: A barrier or liner used in conjunction with not less than one-half the required spacing through air, shall not be less than 0.4 mm (1/64 inch) thick, only when the barrier or liner is of acceptable insulating material, resistant to moisture, of adequate mechanical strength if exposed or otherwise subjected to mechanical damage, secured in place, and located so that it is not damaged by operation of the appliance in service – particularly arcing.*

*Exception No. 2: Insulating material having a thickness less than that specified shall not be used unless, upon investigation, it is found to be acceptable for the particular application.*

24.7 Deleted February 21, 2003

24.8 Motor spacings shall comply with the spacing requirements in the Standard for Electric Motors, UL 1004.

24.8 revised February 21, 2003

24.9 Electrical spacings for a capacitor employing a dielectric medium more combustible than askarel shall not be less than the sum of the following values:

- a) 12.7 mm (1/2 inch) for capacitor expansion under fault conditions; and
- b) An additional clearance of 1.59 mm (1/16 inch) for circuits not exceeding 300 volts, and 3.2 mm (1/8 inch) for circuits of 301 to 600 volts.

24.10 Spacings on a printed wiring board assembly that are less than indicated in Table 24.2 shall be provided with a coating and spacings as specified in Table 24.3.

*Exception: A coating is not required when the available rms voltage is 50 volts or less and the board is located in such a manner that it is not readily subject to contamination by dust or electrolyte.*

**Table 24.3**  
**Minimum required spacings on printed-wiring board assemblies<sup>a,e</sup>**

Voltage available <sup>c</sup>	Energy available	Minimum spacings		Conformal coating
		mm	Inch	
51 – 600	Unlimited	0.8	1/32	d
0 – 50 <sup>b,c</sup>	Unlimited	0.8	1/32	d

<sup>a</sup> The minimum spacings are required between live parts of opposite polarity. Spacings between live parts and dead metal shall comply with Table 24.1 or Table 24.2 as applicable.

<sup>b</sup> A coating is not required when the board assembly is in compliance with the Exception to 24.10.

<sup>c</sup> For peak voltages and battery voltages multiply applicable rms voltage by 1.4.

<sup>d</sup> In accordance with UL 746C , Polymeric Materials – Use in Electrical Equipment Evaluations.

<sup>e</sup> A printed-wiring board intended to be completely encapsulated in a potting compound or epoxy in accordance with UL 746C shall not have any spacing less than 0.8 mm (1/32 inch).

24.11 The overcurrent protective device mentioned in 25.4.4 or 25.5.4 shall:

- a) Not be of the automatic reset type;
- b) Be trip-free from the reclosing mechanism when of the manual reset type; and
- c) Not be interchangeable with one of a larger current rating when it is a renewable device.

## 25 Secondary Circuits

### 25.1 General

25.1.1 A secondary circuit shall comply with the requirements for one of the following types of secondary circuits:

- a) A Class 2 circuit;
- b) A limited voltage/current circuit;
- c) A limited energy circuit; or
- d) A limiting impedance circuit.

25.1.2 An optical isolator that is relied upon to provide isolation between primary and secondary circuits or between other circuits as required by this Standard shall be constructed in accordance with the Standard for Optical Isolators, UL 1577, and shall be able to withstand for 1 minute, without breakdown, an ac dielectric voltage withstand potential equal to 1000 V plus twice rated voltage between the input and output circuits.

25.1.3 A power switching semiconductor device that is relied upon to provide isolation to ground shall be constructed in accordance with the Standard for Electrically Isolated Semiconductor Devices, UL 1557. The dielectric voltage withstand tests required by UL 1557 shall be conducted at a dielectric potential of 1000 V plus twice rated voltage for 1 minute.

### 25.2 Difference between the level of evaluation required within each type of secondary circuit

25.2.1 The following applies to secondary circuits that comply with the Class 2 requirements of 25.3.1 or the limited voltage/current requirements of 25.4.1 – 25.4.7:

- a) Components located within these circuits are not required to be evaluated.
- b) Spacings located within these circuits and from these circuits to earth ground or to the enclosure are not required to be evaluated. However, spacings from these circuits to other circuits shall be in accordance with Spacings, Section 24.
- c) These circuits are not prohibited from being accessible from outside the enclosure.

25.2.2 The following applies to secondary circuits that comply with the limited energy requirements of 25.5.1 – 25.5.4 circuit requirements and that involve open circuit potentials less than or equal to 30 V ac or 42.4 V peak:

- a) Components located within these circuits are not required to be evaluated.

*Exception: Printed-wiring boards shall be evaluated in accordance with Section 26, Printed-Wiring Boards. Wiring shall be evaluated in accordance with Section 16, Internal Wiring – Electrical Connections.*

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b) Spacings located within these circuits and from these circuits to earth ground or to the enclosure are not required to be evaluated. However, spacings from these circuits to other circuits shall be in accordance with Section 24, Spacings.

c) These circuits shall not be accessible from outside the enclosure. Therefore, when these circuits provide power to components that extend through the enclosure, the ability of these components to serve as an enclosure shall be evaluated.

25.2.3 The following applies to secondary circuits that comply with the limited energy requirements of 25.5.1 – 25.5.4 and that involve open circuit potentials in excess of 30 V ac or 42.4 V peak:

a) Components located within these circuits are not required to be evaluated.

*Exception: Printed-wiring boards shall be evaluated in accordance with Section 26, Printed-Wiring Boards. Wiring shall be evaluated in accordance with Section 16, Internal Wiring – Electrical Connections. The effects of heat generating power components on adjacent components such as printed wiring boards and wiring shall be evaluated in accordance with the temperature requirements in Temperature Test, Section 36.*

b) Spacings located within these circuits are not required to be evaluated. However, spacings from these circuits to earth ground or to the enclosure and spacings from these circuits to other circuits shall be in accordance with Spacings, Section 24.

c) These circuits shall not be accessible from outside the enclosure. Therefore, when these circuits provide power to components that extend through the enclosure, the ability of these components to serve as an enclosure shall be evaluated.

25.2.4 The following applies to secondary circuits that comply with the limiting impedance requirements of 25.6.1 – 25.6.2:

a) Components located within these circuits are not required to be evaluated.

b) Spacings located within these circuits and from these circuits to earth ground or to the enclosure are not required to be evaluated. However, spacings from these circuits to other circuits shall be in accordance with Section 24, Spacings.

c) These circuits are not prohibited from being accessible from outside the enclosure.

*Exception: Circuits supplied from a limiting impedance that complies with Exception No. 1 to 25.6.2 shall not be accessible from outside the enclosure. Therefore, when these circuits provide power to components that extend through the enclosure, the ability of these components to serve as an enclosure shall be evaluated.*

### 25.3 Class 2 circuit requirements

25.3.1 A Class 2 circuit shall be supplied by an isolating source that complies with the requirements in UL 1310, the Standard for Class 2 Power Units, or the requirements in UL 1585, the Standard for Class 2 and Class 3 Transformers.

## 25.4 Limited voltage/current circuit requirements

25.4.1 A limited voltage/current circuit shall be supplied by an isolating source such that the maximum open circuit voltage potential available to the circuit is not more than 30 V ac or 42.4 V peak and the current available is limited to a value not exceeding 8 amperes measured after 1 minute of operation. The secondary winding of an isolating type transformer meets the intent of compliance with this requirement. The transformer shall comply with the requirements in the appropriate UL Standards for Transformers.

25.4.2 With reference to these secondary voltage and current limits, these measurements are to be made as follows:

- a) The input to the source of that secondary is to be connected as intended;
- b) The maximum open circuit voltage potential available to the secondary circuit under consideration is to be measured across the source of that secondary; and
- c) The current available to the secondary circuit under consideration is to be measured by connecting a variable resistive load across the source of that secondary and then varying the load until an available current of 8 amperes is obtained for 1 minute of operation. When an available current of 8 amperes is not obtained under any condition of loading, up to and including a short circuit, then the test is to be discontinued for that circuit.

25.4.3 For a transformer, only one secondary circuit of a multiple secondary transformer is to be tested at a time and all other secondaries not under test are to be loaded as intended. The voltage and current measurements are to be made directly across the secondary output terminals of the transformer. When a tapped transformer winding is used to supply a full-wave rectifier, the measurements are to be made from either end of the winding to the tap. When the transformer is used as part of a switching-type power supply, the voltage and current measurements are to be made after the transformer secondary winding rectification means.

25.4.4 A secondary fuse or other such secondary circuit protective device used to limit the available current in accordance with 25.4.1, shall be rated at not more than the values specified in Table 25.1. See 24.11.

**Table 25.1**  
**Rating for fuse or circuit protective device**

Open circuit volts (peak)	Amperes
0 – 20	5.0
Over 20 – 30	100/V <sup>a</sup>
<sup>a</sup> V is defined as the peak open circuit voltage.	

25.4.5 The secondary circuit protective device referenced in 25.4.4 is not prohibited from also being provided in the primary circuit. When provided in the primary circuit, there are no restrictions on the current rating of the protective device as long as it limits the available secondary current in accordance with Table 25.1.

25.4.6 When a protective device is used as specified in 25.4.4 or 25.4.5, this protective device shall comply with the requirements in Section 24, Spacings, and shall be provided with an adjacent replacement marking and replacement instructions that include the required voltage and current rating. The printed wiring board, wiring, and spacings prior to the point at which the voltage and current are suitably limited shall comply with the requirements of this Standard.

25.4.7 A fixed impedance (such as a component or grouping of components in the same circuit) or a regulating network (such as used in a switching type power supply) meets the intent of limiting the voltage and/or the available current in accordance with 25.4.1. Such a fixed impedance or regulating network shall be able to function under single component fault conditions.

## 25.5 Limited energy circuit requirements

25.5.1 A limited energy circuit shall be supplied by an isolating source such that the maximum volt-ampere capacity available to the circuit is 200 volt-amperes or less at a maximum open circuit voltage potential of 100 V ac. The secondary winding of an isolating type transformer meets the intent of compliance with this requirement. The transformer shall comply with the requirements in the appropriate UL Standard for Transformers.

25.5.2 With reference to the secondary voltage and volt-ampere capacity limits, the measurements are to be made as follows:

- a) The input to the source of that secondary is to be connected as intended;
- b) The maximum open circuit voltage potential available to the secondary circuit under consideration is to be measured across the source of that secondary; and
- c) The maximum volt-ampere capacity available to the secondary circuit under consideration is to be measured by connecting a variable resistive load across the source of that secondary and then measuring the voltage and current while varying the resistive load from open circuit to short circuit in 1-1/2 to 2-1/2 minutes. The maximum available volt-ampere capacity is then calculated by multiplying the simultaneously measured values of secondary voltage and secondary current.

25.5.3 For a transformer, only one secondary circuit of a multiple secondary transformer is to be tested at a time and all other secondaries not under test are to be loaded as intended. The voltage and volt-ampere capacity measurements are to be made directly across the secondary output terminals of the transformer. When a tapped transformer winding is used to supply a full-wave rectifier, the measurements are to be made from either end of the winding to the tap. When the transformer is used as part of a switching-type power supply, the voltage and volt-ampere capacity measurements are to be made after the transformer secondary winding rectification means.

25.5.4 A primary or secondary circuit fuse or other such circuit protective device meets the intent of limiting the maximum available volt-ampere capacity in accordance with 25.5.1. While there are no restrictions on the current rating of this protective device as long as it limits the available secondary volt-ampere limit in accordance with 25.5.2, the protective device shall comply with the requirements of this Standard and shall be provided with an adjacent replacement marking or replacement instructions that includes the required voltage and current rating. The printed wiring board, wiring, and spacings prior to the point at which the voltage and volt-ampere capacity are suitably limited shall comply with the requirements of this Standard.

## 25.6 Limiting impedance circuit requirements

25.6.1 A limiting impedance circuit shall be supplied by an impedance that complies with the following:

- a) The calculated power dissipation of the impedance, as the result of a direct short applied across the circuit downstream of the impedance, does not exceed the power rating of the impedance;

- b) The power dissipation of the impedance is not greater than 15 Watts; and
- c) There does not exist a risk of shock, as defined in 2.3.6, downstream of the impedance.

*Exception: A limiting impedance circuit is not prohibited from being supplied by an impedance that complies with the following:*

- a) The impedance shall be rated such that the calculated power dissipation of the impedance, as the result of a direct short applied across the circuit downstream of the impedance, exceeds the power rating of the impedance and is still less than 15 Watts;*
- b) The impedance shall not open or short when subjected to the effects of a direct short applied across the circuit downstream of the impedance. The method for setting up this limiting impedance test is the same as the method for setting up the Breakdown of Components Test, Section 51; and*
- c) There does not exist a risk of shock, as defined in 2.3.6, downstream of the impedance.*

25.6.2 The limiting impedance referred to in 25.6.1 shall be able to function under single component fault conditions.

*Exception No. 1: When the circuit limited by this impedance is enclosed, this limiting impedance is not required to function under single component fault conditions.*

*Exception No. 2: A single resistor serving as a limiting impedance is determined to comply with this requirement without further investigation.*

*Exception No. 3: A single capacitor serving as a limiting impedance is determined to comply with this requirement without further investigation when the capacitor complies with requirements in the Standard for Capacitors and Suppressors for Radio- and Television-Type Appliances, UL 1414.*

25.6.2 revised February 21, 2003

## **26 Printed-Wiring Boards**

26.1 A printed-wiring board shall comply with the requirements in UL 796 , the Standard for Printed-Wiring Boards, including direct support criteria, and shall be classed V-0, V-1, or V-2 in accordance with the requirements in UL 94 , the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

26.2 A resistor, capacitor, inductor, or other part that is mounted on a printed-wiring board to form a printed-wiring assembly shall be secured so that it is not displaced to result in a risk of electric shock or fire by a force typically exerted during assembly, normal operation, or servicing of the fan.

26.3 Consideration is to be given to a barrier or a partition that is part of the device and that provides mechanical protection and electrical insulation of a component connected to the printed-wiring board.

## 27 Electronic Circuits

27.1 Malfunction of a component such as a diode, a transistor, a thyristor, an electrolytic capacitor, an integrated circuit, an optical isolator, or other solid-state device (any device whose operation is dependent upon any combination of optical, electrical, or magnetic phenomena within a solid) that has not been investigated for reliability and determined to be reliable shall not result in a risk of fire, electric shock or injury to persons when subjected to the Component Breakdown Test in Section 51.

*Exception No. 1: A component located in the following circuits is not required to be subjected to the Component Breakdown Test:*

- a) *Circuits that comply with the requirements for Secondary Circuits, Section 25;*
- b) *A circuit that has been investigated to the requirements in UL 991 , the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, for reliability; and*
- c) *Circuits used in low voltage component fans.*

*Exception No. 2: This requirement does not apply to resistors, non-electrolytic capacitors, inductors, transformers, electromechanical devices such as switches and relays, and optical isolators that comply with the applicable requirements as specified elsewhere in this Standard.*

27.2 Compliance with 27.1 requires an analysis of the circuit to determine whether malfunction of a component results in a risk of fire, electric shock or injury to persons. This analysis requires the opening and short circuiting of a component (electrolytic capacitor, transistor junction, and the like) and observation of the ultimate results of the simulated malfunction or breakdown. Only one condition of simulated malfunction or breakdown is to be imposed at a time.

## 28 Grounding

### 28.1 General

28.1.1 In addition to the requirements specified in 28.1 – 28.3, an appliance shall comply with the applicable requirements in 13.4.1 – 13.4.10, 13.5.5, and 13.5.6.

28.1.2 Electrical continuity shall be provided between all exposed dead-metal parts and all dead-metal parts within the enclosure that are exposed to contact during any user-servicing operation and that can become energized and:

- a) The equipment grounding terminal or lead, and to the metal surrounding the knockout, hole, bushing, or metallic fitting (at the end of flexible armored cable for attachment to a field-provided metallic outlet box) provided for field power-supply connection for an appliance intended for permanent electrical connection; or
- b) The point of connection of the grounding conductor of the power-supply cord of an appliance equipped with a power-supply cord of the grounding type. See 28.3.1.

28.1.2 revised February 21, 2003

28.1.3 With reference to the requirement in 28.1.2, two pieces of enameled or painted sheet metal are not considered to be adequately bonded together unless measures are taken to penetrate the enamel or paint at points of bonding.

*28.1.4 Revised and relocated as 28.5.1 February 21, 2003*

*28.1.5 Revised and relocated as 28.5.2 February 21, 2003*

28.1.5 added February 21, 2003

*28.1.6 Revised and relocated as 28.5.3 February 21, 2003*

*28.1.7 Revised and relocated as 28.5.4 February 21, 2003*

*28.1.8 Revised and relocated as 28.5.5 February 21, 2003*

28.1.9 Sheet metal screws shall not be used for:

- a) Field connection of equipment grounding conductors to an enclosure; and
- b) Connection of a factory-provided grounding lead to an enclosure.

For the purposes of this requirement, a sheet metal screw is defined as a screw with a thread pitch that exceeds the thickness of the sheet metal and is designed to engage an unextruded, unthreaded hole in the metal.

28.1.10 Removal of a motor or light in a wall-insert fan, a ceiling-insert fan, or a ceiling-insert fan/light combination shall not result in disconnection of the field wired equipment grounding conductor or internal bonding jumper.

*Exception: Disconnection of an internal bonding jumper made by the plug and receptacle disconnection meets the intent of this requirement.*

Added 28.1.10 effective September 24, 2003

28.1.11 The means for grounding continuity shall be constructed so that contact pressure is not transmitted through insulating material which is liable to shrink or to distort unless there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage or distortion of the insulating material.

Added 28.1.11 effective September 24, 2003

28.1.12 The grounding means shall not be used for any other purpose than to provide a grounding conductor path.

Added 28.1.12 effective September 24, 2003

## 28.2 Permanently connected appliances

28.2.1 An equipment-grounding connection, a grounding conductor, an enclosure, a frame, a component-mounting panel, or any other part connected to earth ground shall not carry current except during an electrical fault.

*Exception: A permanently connected appliance provided with double insulation in accordance with the Standard for Double Insulation Systems for use in Electrical Equipment, UL 1097, need not comply with this requirement.*

28.2.2 The equipment-grounding terminal shall secure a conductor of a size acceptable for the application in accordance with the National Electrical Code, ANSI/NFPA 70-1999. The terminal shall not be smaller than No. 10 (4.8 mm diameter).

28.2.3 A pressure wire connector provided for an equipment-grounding conductor shall comply with the applicable requirements in the Standard for Wire Connectors and Soldering Lugs for Use With Copper Conductors, UL 486A, or the Standard for Wire Connectors for Use With Aluminum Conductors, UL 486B. A connector not covered by UL 486A or UL 486B shall exhibit, upon investigation, performance equivalent to that specified in those standards.

28.2.4 A product intended for mounting in a flush-device box shall be so constructed such that electrical continuity is provided between a metal faceplate and the equipment grounding means in the box when the device and the faceplate are installed in the intended manner.

## 28.3 Cord-connected appliances

28.3.1 A power-supply cord of an appliance intended for use on a circuit operating at a potential of more than 150 volts to ground shall include an equipment-grounding conductor.

*Exception: Appliances with no parts requiring electrical continuity in accordance with 28.1.2 are not required to be provided with an equipment grounding conductor.*

28.3.1 revised September 24, 2001

28.3.2 A cord-connected appliance provided with double insulation in accordance with the Standard for Double Insulation Systems for Electrical Equipment, UL 1097, is not required to be provided with an equipment-grounding conductor. Also see 14.1.7.

28.3.3 A power-supply cord of an evaporative cooler, a stationary fan, or a fan intended to be used, or that may be used, outdoors in accordance with the literature provided with the fan shall include an equipment-grounding conductor.

*Exception: Appliances with no parts requiring electrical continuity in accordance with 28.1.2, and having no dead metal parts likely to become energized which are in contact with water, are not required to be provided with an equipment grounding conductor.*

28.3.3 effective December 13, 2001

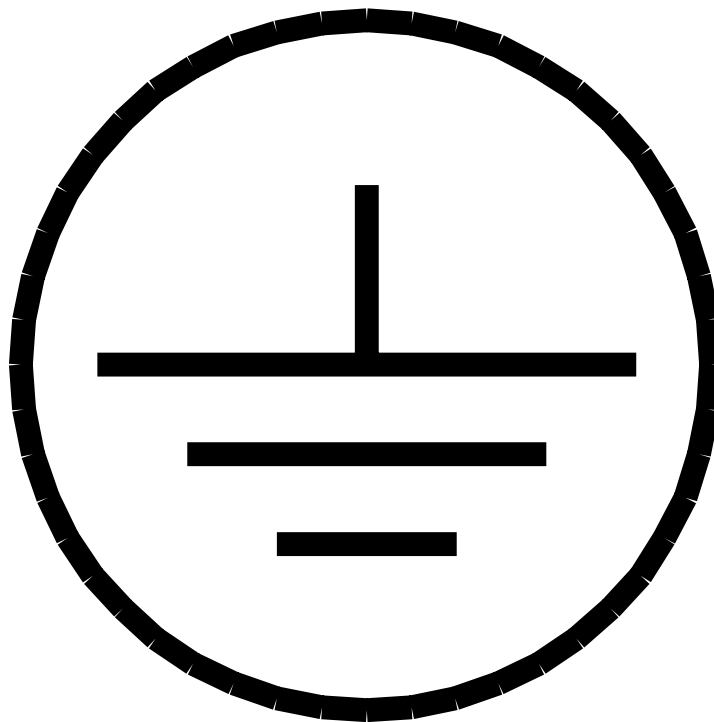
28.3.4 An equipment-grounding conductor of a flexible cord shall be:

- a) Finished to show a green color with or without one or more yellow stripes;
- b) Connected to the grounding member of an attachment plug of the grounding type; and
- c) Connected to the dead-metal parts mentioned in 28.1.2 by a screw or other means that is not removed during servicing. Solder alone shall not be used for making this connection.

28.3.5 The screw mentioned in 28.3.4(c) shall be of corrosion-resistant metal, or shall be adequately protected against corrosion, and shall not be smaller than No. 10 (4.8 mm diameter). A lock washer or equivalent means shall be employed to prevent the screw from becoming loosened by vibration.

28.3.6 A pressure wire connector intended solely for the connection of an equipment-grounding conductor shall be identified by being colored green, marked "G," "GR," "Ground," "Grounding," the grounding symbol illustrated in Figure 28.1, or the like, or by a marking on a wiring diagram provided on the fan. The pressure wire connector shall be located so that it is not removed during intended servicing of the fan.

**Figure 28.1**  
**Grounding symbol**



#### **28.4 Grounding for low-voltage power-limited circuits**

28.4.1 The circuit grounding conductor shall not be smaller than the transformer output conductors, and in no case smaller than 14 AWG copper. The conductor shall be bare or insulated with green (or green with one or more yellow stripes) insulation.

28.4.1 revised February 21, 2003



## 28.5 Fans employing convenience receptacles

28.5.1 A metallic enclosure and other dead metal parts of a fan employing a convenience receptacle that are exposed to contact by persons shall be conductively connected to the grounding conductor of the power-supply cord.

*Exception: A small metal part, such as an adhesive-attached foil label or a screw, that is on the exterior of the enclosure and separated from all electrical components by grounded metal or is electrically isolated from all components is not required to be connected to the grounding conductor of the power supply cord.*

28.1.4 revised and relocated as 28.5.1 February 21, 2003

28.5.2 The conductive connection of parts required by 28.5.1 shall be made by a clamp, bolt, screw, braze, weld, or an equivalent positive means that cannot be loosened from the outside and is not prohibited from including a corrosion resistant strap or jumper. Mechanical connections shall be secured. A solder connection is not prohibited from being used when the power supply cord grounding lead is mechanically secure to the enclosure in accordance with 16.14. A push-in (screwless), quick-connect, or similar friction-fit connector shall not be used for this connection.

28.1.5 revised and relocated as 28.5.2 February 21, 2003

28.5.3 Connections in the equipment grounding conductor path from the convenience receptacle grounding contact to the equipment grounding conductor of the power supply cord shall be welded, bolted, mechanically secured and soldered, or made by equivalent positive means. A quick-connect, or similar friction-fit connector, shall not be used in the grounding conductor path.

28.1.6 revised and relocated as 28.5.3 February 21, 2003

28.5.4 The yoke or faceplate mounting screws of the convenience receptacle shall not be used to provide or maintain the grounding means of the convenience receptacle.

28.1.7 revised and relocated as 28.5.4 February 21, 2003

28.5.5 When a convenience receptacle used on a fan is provided with a grounding screw, this screw shall be used to provide the ground connection to the convenience receptacle.

28.1.8 revised and relocated as 28.5.5 February 21, 2003

## 29 Filters

29.1 A fan employing one or more filters that have not been determined to be acceptable, with or without one or more acceptable filters, is acceptable if, when tested, the filter in a single filter fan or the assembly of filters in a multifilter fan is found to be equivalent in performance to the class of filter specified for that fan in 29.2. A test on an assembly of filters is to be conducted with the filters mounted in the intended manner.

29.2 A filter provided with an air filtering appliance intended for connection to a duct shall be a Class 1 or a Class 2 filter.

29.3 A Class 1 filter is one that, when clean, does not contribute fuel when attacked by flame, and that emits only negligible amounts of smoke. A Class 2 filter is one that, when clean, burns moderately when attacked by flame or emits moderate amounts of smoke, or both. When used with reference to an evaporative cooler, the term filter signifies a moisture-bearing evaporator or wick for introducing moisture into the air stream.

### 30 Accessories

30.1 Use of an accessory that is furnished with a fan shall not cause a risk of fire, electric shock, or injury to persons.

## PERFORMANCE – ALL APPLIANCES

### 31 Test Voltages

31.1 Unless otherwise specified, products shall be tested at a potential in accordance with Table 31.1 for each test described.

**Table 31.1**  
**Test voltages**

Rated voltage	Input test voltage	Temperature test voltage	Blade ignition test voltage
110 – 120	Rated	120	120
191 – 208	Rated	208	208
210 – 240	Rated	240	240
254 – 277	Rated	277	277
440 – 480	Rated	480	480
550 – 600	Rated	600	600

Note – For nameplate rating other than one of those specified in the table, the motor is to be tested at 100 – 105 percent of the rated voltage. However, consideration is to be given to the voltage of the intended source of supply for a motor.

### 32 Leakage Current Test

32.1 A cord-connected product rated for a nominal 240-volt or less supply shall be tested in accordance with 32.3 – 32.6. Leakage current shall not exceed:

- a) 0.5 milliamperere for an ungrounded 2-wire product;
- b) 0.5 milliamperere for a grounded, 3-wire, portable product; and
- c) 0.75 milliamperere for a grounded, 3-wire, product:
  - 1) Employing a standard attachment plug rated 20 amperes or less; and
  - 2) Intended to be fastened in place or located in a dedicated space.

32.2 Leakage current refers to all currents, including capacitively coupled currents, that are conveyed between exposed conductive surfaces of an appliance and ground or other exposed conductive surfaces of an appliance.

32.3 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 where simultaneously accessible. Parts are considered to be exposed surfaces unless guarded by an enclosure determined to reduce the risk of electric shock as defined in 9.1 – 9.4. 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 that are not considered to involve a risk of electric shock. When all accessible surfaces are bonded together and connected to the grounding conductor of the power-supply cord, the leakage current can be measured between the grounding conductor and the grounded supply conductor.

32.4 When 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 having an area of 10 by 20 centimeters (3.9 by 7.9 inches) in contact with the surface. When the surface has an area of less than 10 by 20 centimeters (3.9 by 7.9 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 appliance.

32.5 The measurement circuit for leakage current is to be as illustrated in Figure 32.1. The measurement instrument is defined in (a) – (d). The meter that is actually used for a measurement need not only indicate the same numerical value for a particular measurement as would the defined instrument. The meter used is not required to have all the attributes of the defined instrument:

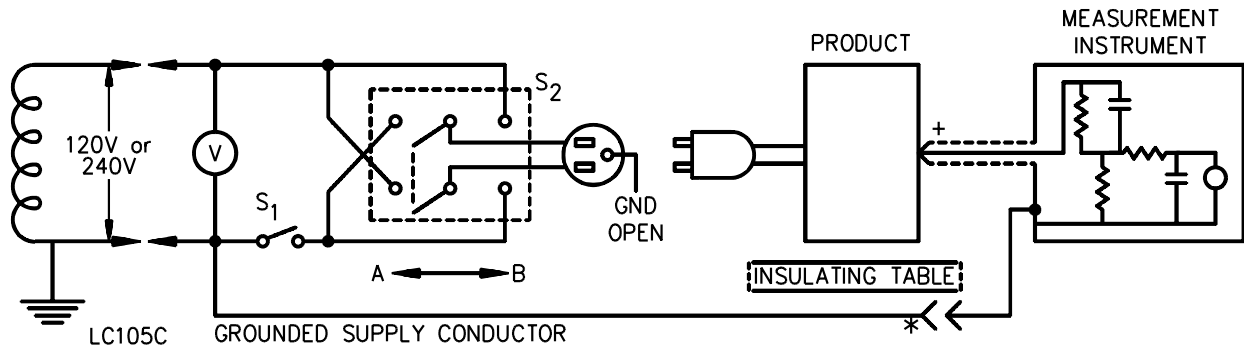
- a) The meter is to have an input impedance of 1500 ohms resistive shunted by a capacitance of 0.15 microfarad.
- b) The meter is to indicate 1.11 times the average of the full-wave rectified composite waveform of the voltage across the resistor or current through the resistor.
- c) Over a frequency range of 0 – 100 kilohertz, the measurement circuitry is to have a frequency response – ratio of indicated to actual value of current – 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 0.5 milliampere, the measurement is not to have an error of more than 5 percent at 60 hertz.
- d) Unless the meter is being used to measure leakage from one part of an appliance to another, the meter is to be connected between the accessible parts and the grounded supply conductor.

32.6 A sample of the appliance is to be tested for leakage current in the as-received condition, without prior energization except as occurs as part of the production line testing, but with the grounding conductor open at the attachment plug. The supply voltage is to be adjusted to the values specified in 36.1.8. The test sequence, with reference to the measuring circuit, Figure 32.1, is to be as follows:

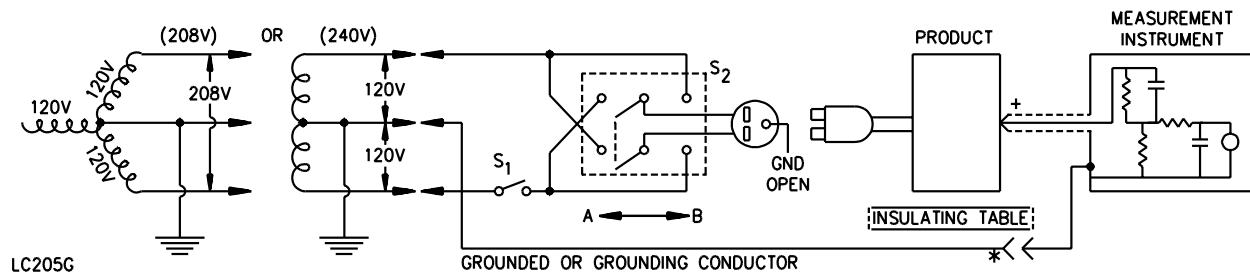
- a) With the switch S1 open, the appliance is to be connected to the measuring circuit. Leakage current is to be measured using both positions of switch S2, and with the appliance switching devices in all their normal operating positions.
- b) Switch S1 is then to be closed, energizing the appliance, and within 5 seconds, the leakage current is to be measured using both positions of switch S2 and with the appliance switching devices in all their normal operating positions.
- c) The leakage current is to be monitored until thermal stabilization. Both positions of switch S2 are to be used in determining this measurement. Thermal stabilization is to be obtained by operation as in the normal temperature test.

32.7 Normally the complete leakage current test, as described in 32.6, is to be conducted without interruption for other tests. However, with the concurrence of those concerned, the leakage current test is not prohibited from being interrupted to conduct other nondestructive tests.

**Figure 32.1**  
**Leakage current measurement circuits**



Product intended for connection to a 120-V or an end-grounded 2-wire 240-volt power supply



Product intended for connection to a 3-wire 208-volt or a 3-wire 240-volt grounded neutral power supply

**NOTES:**

+ – Probe with shielded lead.

\* – Separated and used as a clip when measuring current from one part of appliance to another.

### 33 Continuity of Grounding Circuit Test

33.1 The resistance shall be not more than 0.1 ohm between any point required to be grounded, as specified in 28.1.2, and:

- a) For an appliance intended for permanent electrical connection, the point on the enclosure at which the power-supply system is connected.
- b) For a cord-connected appliance employing a grounding conductor in the cord, the point to which the grounding conductor of the power-supply cord is connected.

33.2 The resistance shall be determined by any convenient method. When unacceptable results are obtained, either a direct or alternating current equal to the current rating of the maximum-current-rated branch-circuit overcurrent-protective device that is employed with the appliance is to be passed from the equipment grounding terminal or the point of attachment of the wiring system to the dead metal part, and the resulting drop in potential is to be measured between these two points. The resistance in ohms is determined by dividing the drop in potential in volts by the current in amperes passing between the two points.

### 34 Starting Current Test

34.1 When operated as described in 34.3, an appliance shall start and operate normally without:

- a) Tripping an overload protector provided as part of the appliance; or
- b) Opening the fuse, when connected to a circuit protected by a fuse as described in 34.2.

34.2 The fuse mentioned in 34.1(b) is to be other than a time-delay type. The current rating of the fuse is to be equal to the current rating of the supply circuit of the lowest rating to which the appliance is intended to be connected.

*Exception: A time-delay fuse shall not be employed, unless the appliance is marked in accordance with 62.1.3 and:*

- a) The construction of the appliance or the nature of its usage is such that it is used continually on the same branch circuit after installation – for example, a window fan, an attic ventilator, or the like; or*
- b) The appliance is of the household type that is used on a 15- or 20- ampere branch circuit.*

34.3 To determine whether an appliance complies with the requirements in 34.1, the appliance is to be connected to a power-supply circuit protected by a fuse as specified in 34.2 or in the exception to 34.2, whichever applies. The appliance is to be at room temperature at the beginning of the test. The appliance is to be started three times without tripping an overload protector provided as part of the appliance, or opening the fuse protecting the supply circuit. Each start of the appliance is to be made under conditions representing the beginning of normal operation – the beginning of the normal operating cycle in the case of an automatic appliance. The motor of the appliance is to be allowed to come to full speed after each start, and to come to rest between successive starts.

34.4 An appliance employing a general use receptacle shall be loaded to the marked rating of the receptacle outlet. See 18.18.

34.4 effective December 3, 2000

### 35 Input Test

35.1 The current input to an appliance shall be not more than 110 percent of the rated value when the appliance is operated under conditions of intended service, when connected to a power-supply circuit of maximum rated voltage and rated frequency.

### 36 Temperature Test

#### 36.1 All fans

36.1.1 When tested as described in 36.1.3 – 36.2.2, an appliance shall not:

- a) Attain constant temperatures at any point on the fan sufficiently high to result in a risk of fire;
- b) Cause deterioration of any materials employed in the appliance; or
- c) Have constant temperature rises at specific points (particularly those surfaces that may be contacted by the user with the fan operating as intended) more than those specified in Table 36.1. (See 36.1.10.)

36.1.2 A thermal protective device shall not operate during the temperature test. See 21.6.

36.1.3 Coil and winding temperatures are to be measured by a minimum of four thermocouples located on exposed surfaces, except the change-in-resistance method is to be used for a coil that is inaccessible for mounting of thermocouples, such as a coil:

- a) Immersed in sealing compound;
- b) Wrapped with thermal insulation; or
- c) Wrapped with more than two layers of material such as cotton, paper, or rayon having a total thickness of more than 0.8 mm (1/32 inch).

In an alternating-current motor having a frame diameter of 177.8 mm (7 inches) or less, the thermocouples are to be mounted on the integrally-applied (enamel) insulation of the windings.

*Exception: The requirement for a minimum of four thermocouples does not apply where physical size does not allow it.*

36.1.3 revised February 21, 2003

36.1.4 Thermocouples are to consist of wires not larger than 24 AWG. When thermocouples are used in the determination of temperatures in connection with the heating of electrical devices, it is common practice to employ thermocouples consisting of 30 AWG iron and constantan wires and a potentiometer-type indicating instrument; and such equipment is to be used whenever referee temperature measurements by thermocouples are necessary.

36.1.4 revised February 21, 2003

**Table 36.1**  
**Maximum acceptable temperature rises**

Table 36.1 revised December 23, 2003

Materials and components		K <sup>i</sup> (Degrees)	R <sup>k</sup> (Degrees)
ALL FANS			
1.	Varnished-cloth insulation	60	108
2.	Fuses	65	117
3.	Fiber employed as electrical insulation	65	117
4.	Wood and other combustible material	65	117
5.	Any point on or within a terminal box of a permanently-wired appliance	65 <sup>g</sup>	117 <sup>g</sup>
6.	A surface upon which a stationary appliance may be mounted in service, and surfaces that may be adjacent to the appliance when so mounted	65	117
7.	Class A insulation systems on coil windings of an a-c motor having a diameter of more than 177.80 mm (7 inches), of a d-c motor and a universal motor, and on a reactor		
	a) In an open motor:		
	Thermocouple method	65 <sup>a</sup>	117 <sup>a</sup>
	Resistance method	75	135
	b) In a totally enclosed motor:		
	Thermocouple method	70	126
	Resistance method	80	144
8.	Class A insulation systems on coil windings of an a-c motor having a diameter of 177.80 mm (7 inches), or less (not including a universal motor)		
	a) In an open motor:		
	Thermocouple or resistance method	75 <sup>a</sup>	135 <sup>a</sup>
	b) In a totally enclosed motor:		
	Thermocouple or resistance method	80	144
9.	Class B insulation systems on coil windings of an a-c motor having a diameter of more than 177.80 mm (7 inches), of a d-c motor and of a universal motor		
	a) In an open motor:		
	Thermocouple method	85 <sup>a</sup>	153 <sup>a</sup>
	Resistance method	95	171
	b) In a totally enclosed motor:		
	Thermocouple method	90	162
	Resistance method	100	180
10.	Class B insulation systems on coil windings of an a-c motor having a diameter of 177.80 mm (7 inches) or less (not including a universal motor) and on a vibrator coil		
	a) In an open motor and on a vibrator coil:		
	Thermocouple or resistance method	95 <sup>a</sup>	171 <sup>a</sup>
	b) In a totally enclosed motor:		
	Thermocouple or resistance method	100	180
10A.	Class E system on coil windings of an ac motor having a frame diameter of 7 inches (178 mm) or less, not including a universal motor.		
	a) In an open motor:		
	Thermocouple or resistance method	85 <sup>a</sup>	153 <sup>a</sup>
	b) In a totally enclosed motor:		
	Thermocouple or resistance method	90	162

Table 36.1 Continued on Next Page



Table 36.1 Continued

Materials and components		K <sup>j</sup> (Degrees)	R <sup>k</sup> (Degrees)
10B.	Class E system on coil windings of an ac motor having a frame diameter of more than 7 inches (178 mm) not including a universal motor.		
	a) In an open motor:		
	Thermocouple method	75 <sup>a</sup>	135 <sup>a</sup>
	Resistance method	85	153
	b) In a totally enclosed motor:		
	Thermocouple or resistance method	80	144
	Resistance method	90	162
11.	Class F system on coil windings of an ac motor having a frame diameter of 178 mm (7 inches) or less, not including a universal motor.		
	a) In an open motor:		
	Thermocouple or resistance method	120	216
	b) In a totally enclosed motor:		
	Thermocouple or resistance method	125	225
12.	Class F system on coil windings of an ac motor having a frame diameter of more than 178 mm (7 inches), not including a universal motor.		
	a) In an open motor:		
	Thermocouple method	110	198
	Resistance method	120	216
	b) In a totally enclosed motor:		
	Thermocouple method	115	207
	Resistance method	125	225
13.	Class H system on coil windings of an ac motor having a frame diameter of 178 mm (7 inches) or less, not including a universal motor.		
	a) In an open motor:		
	Thermocouple or resistance method	135	243
	b) In a totally enclosed motor:		
	Thermocouple or resistance method	140	252
14.	Class H system on coil windings of an ac motor having a frame diameter of more than 178 mm (7 inches), not including a universal motor.		
	a) In an open motor:		
	Thermocouple method	125	225
	Resistance method	135	243
	b) In a totally enclosed motor:		
	Thermocouple method	130	234
	Resistance method	140	252
15.	Phenolic composition employed as electrical insulation or as a part of the deterioration of which would result in a risk of fire, electric shock, or injury to persons	125 <sup>b</sup>	225 <sup>b</sup>
16.	Rubber or thermoplastic-insulated wires and cords	35 <sup>b,c,d</sup>	63 <sup>b,c,d</sup>
17.	Capacitors		
	Electrolytic	40 <sup>e</sup>	72 <sup>e</sup>
	Other types	65 <sup>f</sup>	117 <sup>f</sup>
18.	Sealing compound	40°K (72°R) less than melting point	
19.	Class 105 insulation systems on windings of a relay, a solenoid, and the like		

Table 36.1 Continued on Next Page

Table 36.1 Continued

Materials and components		K <sup>j</sup> (Degrees)	R <sup>k</sup> (Degrees)														
	Thermocouple method	65 <sup>a</sup>	117 <sup>a</sup>														
	Resistance method	85	153														
20.	Class 130 insulation systems on windings of a relay, a solenoid, and the like																
	Thermocouple method	85 <sup>a</sup>	153 <sup>a</sup>														
	Resistance method	105	189														
21.	Lampholder screw shell, center contact, or other connecting device of aluminum or unplated copper	175	315														
22.	Lampholder body of thermosetting material (phenolic, urea, and the like)	125	225														
CEILING INSERT FAN/LIGHT COMBINATIONS																	
23.	Points of fixture support	65	117														
24.	Screen, shield, or recessed housing in contact with insulation	65	117														
SURFACES SUBJECT TO CONTACT <sup>h</sup>																	
25.	Handles or knobs that are grasped for lifting, carrying, or holding:																
	Metallic	25	45														
	Non-metallic	35	63														
26.	Handles or knobs that may be contacted but do not involve lifting, carrying, or holding when heated; and other surfaces that may be contacted during intended operation <sup>i</sup> :																
	Metallic	35	63														
	Non-metallic	60	108														
<p><sup>a</sup> On the surface of an insulated coil where the temperature is affected by an external source of heat (integral lights or light kits of a fan are not considered to be external sources of heat), the temperature rise measured by a thermocouple may be higher than the specified maximum, if the temperature rise of the coil measured by the resistance method is not more than that specified in the table. The additional acceptable temperature rises above the values specified are:</p> <table border="1"> <thead> <tr> <th>Item</th> <th>Temperature</th> </tr> </thead> <tbody> <tr> <td>Part A of item 7</td> <td>15°K (27°R)</td> </tr> <tr> <td>Part A of item 8</td> <td>5°K (9°R)</td> </tr> <tr> <td>Item 17</td> <td>15°K (27°R)</td> </tr> <tr> <td>Part A of item 18</td> <td>20°K (36°R)</td> </tr> <tr> <td>Part A of item 19</td> <td>10°K (18°R)</td> </tr> <tr> <td>Item 20</td> <td>20°K (36°R)</td> </tr> </tbody> </table>				Item	Temperature	Part A of item 7	15°K (27°R)	Part A of item 8	5°K (9°R)	Item 17	15°K (27°R)	Part A of item 18	20°K (36°R)	Part A of item 19	10°K (18°R)	Item 20	20°K (36°R)
Item	Temperature																
Part A of item 7	15°K (27°R)																
Part A of item 8	5°K (9°R)																
Item 17	15°K (27°R)																
Part A of item 18	20°K (36°R)																
Part A of item 19	10°K (18°R)																
Item 20	20°K (36°R)																
<p><sup>b</sup> The temperature limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to a compound that has been investigated and found to have acceptable heat-resistance properties.</p>																	
<p><sup>c</sup> Rubber-insulated conductors within a Class A insulated motor and rubber-insulated motor leads, and a rubber-insulated flexible cord entering a motor may be subjected to a temperature rise of more than 35°K (63°R), provided that an acceptable braid is employed on the conductors of other than a flexible cord. This does not apply to thermoplastic-insulated wires or cords.</p>																	
<p><sup>d</sup> A short length of rubber or thermoplastic-insulated flexible cord exposed to a temperature rise of more than 35°K (63°R), such as at terminals, is acceptable when supplementary heat-resistance insulation of acceptable dielectric strength is employed on the individual conductors of the cord to reduce the risk of deterioration of the conductor insulation, and when the strain-relief means does not depend upon that portion of the insulation subjected to the excessive temperature.</p>																	
<p><sup>e</sup> For an electrolytic capacitor that is integral with or attached to a motor, the temperature rise on insulating material integral with the capacitor enclosure shall not be more than 65°K (117°R).</p>																	
<p><sup>f</sup> A capacitor that operates at a temperature rise of more than 65°K (117°R) may be judged on the basis of its marked temperature limit.</p>																	
<p><sup>g</sup> When the temperature rise is greater than 35°K (63°R), the fan shall be marked in accordance with 62.7.1 – 62.7.3.</p>																	
<p><sup>h</sup> Based on a 25°C (77°F) ambient temperature.</p>																	
<p><sup>i</sup> This does not apply to the motor of a pedestal fan on which either no switches are mounted or on which no switches other than pull-chain type are mounted.</p>																	
<p><sup>j</sup> Equivalent to Celsius (C) degree rises.</p>																	

Table 36.1 Continued on Next Page

Table 36.1 Continued

Materials and components	K <sup>j</sup> (Degrees)	R <sup>k</sup> (Degrees)
<sup>k</sup> Equivalent to Fahrenheit (F) degree rises.		

36.1.5 When the change-in-resistance method is used, determination of the temperature rise of a winding is to be calculated by the following formula:

$$\Delta t = \frac{R_2}{R_1} (K + t_1) - (K + t_2)$$

*in which:*

$\Delta t$  is the temperature rise in °C;

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$R_2$  is the resistance of the coil in ohms at the end of test;

$R_1$  is the resistance of the coil in ohms at the beginning of the test;

$t_1$  is the ambient temperature in degrees C at the beginning of the test;

$t_2$  is the ambient temperature in degrees C at the end of the test; and

$K$  is 234.5 for copper and 225.0 for electrical conductor grade (EC) aluminum; values of the constant for other conductors are to be determined.

36.1.6 When necessary, the value of R at shutdown is to be determined by taking several resistance measurements at short intervals, beginning as quickly as possible after shutdown. A curve of the resistance values and the time is to be plotted and extrapolated to give the value of R at shutdown.

36.1.7 All values for temperature rises in Table 36.1 are based on an assumed ambient temperature of 25°C (77°F). However, tests are to be conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F).

36.1.8 For the temperature test, the test voltage for an appliance is to be as specified in Table 31.1. When the appliance has a single frequency rating, the test is to be conducted at that frequency. An appliance rated 25 – 50 hertz or 50 – 60 hertz is to be tested using a 60-hertz supply.

36.1.9 The appliance is to be operated under each condition of normal service. For a multispeed appliance, this includes operation at each speed and, for a reversible appliance, it includes operation in each direction of rotation. When a reversible appliance continues to rotate in the same direction, but at a slower speed, when the reversing switch is thrown, the requirement applies at the lower speed as well as at the normal speed. The test is to be continued until temperatures have become constant.

36.1.10 A temperature is considered to be constant when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 5 minutes, indicate no further increase.

36.1.11 An appliance employing a general use receptacle shall be loaded to the marked rating of the receptacle. The maximum length of the supply cord is to be used for the Temperature Test.

36.1.11 effective December 3, 2000

36.1.11.1 Appliances shall be tested at the appliance's maximum normal load condition. Maximum normal load is considered to be the load that approximates as closely as possible the most severe conditions of normal use. It is not a deliberate overload except as the conditions of actual use are likely to be somewhat more severe than the maximum load conditions that are recommended by the manufacturer of the appliance. An appliance having features not contemplated in these test procedures may be tested as necessary to meet the intent of these requirements. An appliance intended to normally operate with its intake and/or discharge restricted shall be operated with the air intake and/or discharge adjusted sufficiently to cause a maximum wattage input to the appliance.

36.1.11.1 added February 21, 2003

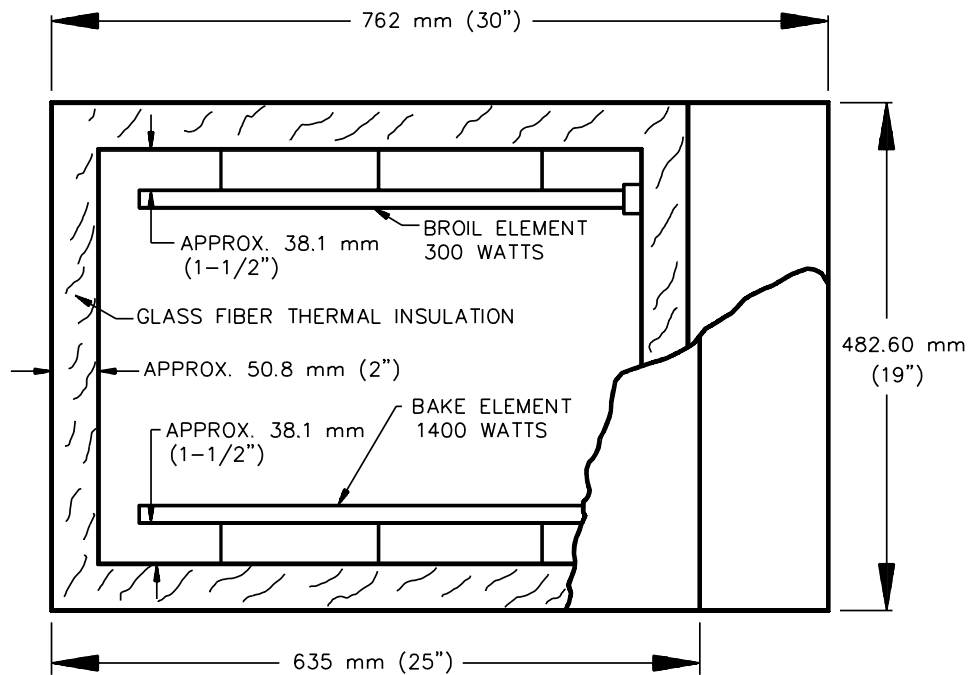
36.1.12 For fans rated 12 Amps or less, and that employ wiring terminals for field wiring connections, the Temperature Test is to be conducted with supply wiring sized for the ampacity of the fan. When the fan is rated more than 12 Amps, the fan is to be tested with supply wiring sized 125 percent of the rating of the fan.

### 36.2 Fans for use over an eye-level range oven

36.2.1 The temperature test for a fan intended for use over an eye-level range oven is to be conducted with the appliance mounted above a heat source as described in 36.2.2 and illustrated in Figure 36.1, in accordance with the manufacturer's instructions. The test is to be conducted with the appliance and heat source in a 2-sided-right side and rear-alcove of 9.525-mm (3/8-inch) thick plywood. The sides of the alcove are to be painted black and are to extend at least 609.6 mm (2 feet) beyond the outermost edges of the assembly. The appliance and heat source are to be as close to the side and back of the alcove as their configuration permits. The test is to be conducted first with the fan on and with only the bake element energized with the thermostat set to give a temperature of 246°C (475°F) with the door of the heat source closed. The test is then repeated with the heat source set for broiling and the door open 101.60 mm (4 inches). Both of these tests are then to be repeated with the fan off.

36.2.2 The heat source illustrated in Figure 36.1 is to be constructed of sheet metal having an average thickness of 0.81 mm (0.032 inch). The thermal insulation is to weigh 16.02 kilograms per cubic meter (1 pound per cubic feet). The heat source is to be approximately 381 mm (15 inches) deep, front to back, including the 25.4-mm (1-inch) thick door. The door is to be hinged on the left side and may be closed or opened as much as 101.60 mm (4 inches). The elements are to consist of coiled resistance wire embedded in fused magnesium oxide completely enclosed in nickel-alloy stainless steel. The heat from the source is to be controlled with a thermostat in which the bulb and capillary tube are located at the top of the heat source, toward the side.

**Figure 36.1**  
Heat source for temperature tests of fans for use over an eye-level range oven



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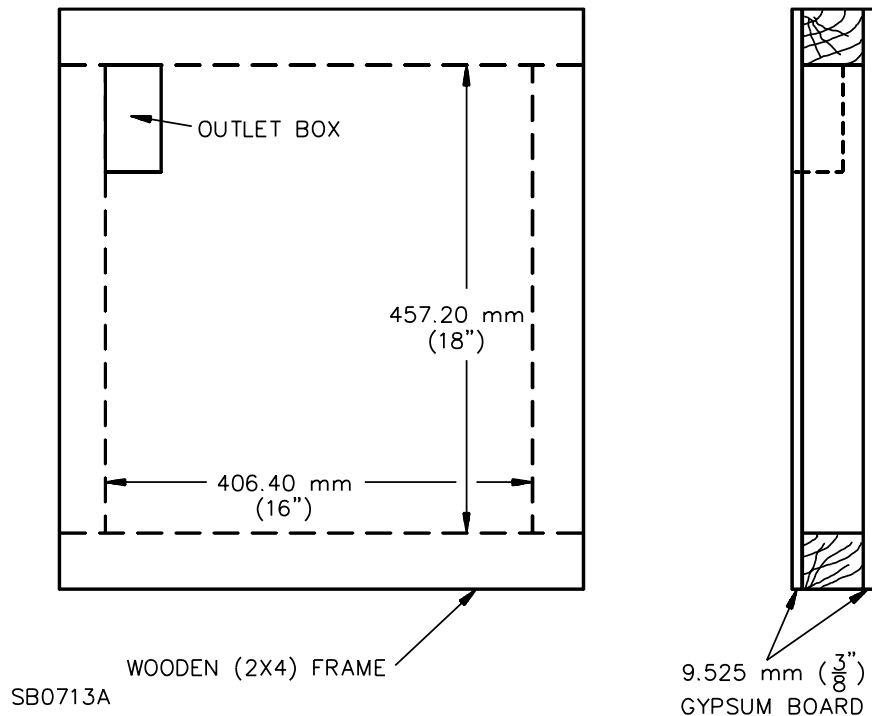
### 36.3 Controllers

36.3.1 For the temperature test, a separate controller – that is, a controller that is not a physical part of the appliance – that is intended for installation in a wall is to be mounted as follows. The controller is to be secured inside its own enclosure, if provided. Otherwise, it is to be installed inside the smallest standard flush-type outlet box that accommodates it, and the box is to be mounted in a simulated wall section as illustrated in Figure 36.2.

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**Figure 36.2**  
**Method of mounting outlet box**



### 37 Dielectric Voltage Withstand Test

37.1 An appliance shall withstand for 1 minute without breakdown the application of a 60-hertz essentially sinusoidal potential of the value indicated in 37.2 between the following:

- Uninsulated live metal parts and the enclosure. A non-conductive enclosure is to be wrapped in conductive foil.
- Terminals of opposite polarity.
- Uninsulated live metal parts and accessible dead metal parts.
- Uninsulated live metal parts and grounding contacts of grounding type receptacles.
- Primary and isolated secondary circuits.

37.2 The test potential referenced in 37.1 is to be as follows:

- One thousand volts for an appliance employing a motor rated 373 watts (1/2 horsepower output) or less and rated 250 volts or less. See 24.4.
- One thousand volts plus twice the rated voltage for an appliance employing a motor rated more than 373 watts (1/2 horsepower output) or more than 250 volts. See 24.4.
- Five hundred volts for an appliance operating at 50 volts or less. See 24.4.

37.3 Capacitors connected across-the-line or line-to-ground shall withstand a DC dielectric potential of 1414 volts plus 2.828 times the maximum rated supply voltage, without breakdown for 1 minute, between the terminals of the capacitor, and between the terminals and foil wrapped around the case of the capacitor. The test shall be conducted with the capacitor at normal operating temperature.

37.3 revised February 21, 2003

37.4 To determine whether an appliance complies with the requirements in 37.1, it is to be tested using a 500-volt-ampere or larger capacity transformer, the output voltage of which can be varied. The applied potential is to be increased from zero to the required test value and is to be held at that level for 1 minute. The increase in applied potential is to be at a substantially uniform rate as rapid as is consistent with correct indication of its value by a voltmeter.

*Exception: When the output of the test equipment transformer is less than 500 volt-amperes, the equipment shall include a voltmeter in the output circuit to indicate the test potential directly.*

37.5 The test equipment for conducting the dielectric voltage-withstand test is to be adjusted for sensitivity such that when a resistor of 120,000 ohms is connected across the output, the test equipment does not indicate unacceptable performance for any output voltage less than the specified test voltage, and the test equipment does indicate unacceptable performance for any output voltage equal to or greater than the specified test value. The resistance of the calibrating resistor is to be adjusted as close to 120,000 ohms as instrument accuracy can provide, and not more than 120,000 ohms.

*Exception No. 1: The sensitivity of the test equipment shall not be reduced, and a lower value of calibrating resistance shall not be used, unless testing an appliance intended to be permanently wired.*

*Exception No. 2: The sensitivity of the test equipment shall not be increased, and a higher value of calibrating resistance shall not be used, unless agreeable to those concerned.*

37.6 An appliance employing a reversible shaded-pole motor shall withstand for 1 minute the application of a 60-hertz essentially sinusoidal potential:

- a) Between the stator winding and the shading coils; or
- b) Between the shading coils and the stator core, with the appliance at the temperature reached in intended use.

The value of the test potential is to be as specified in 37.2.

## 38 Water Spray Test

### 38.1 General

38.1.1 The following appliances shall comply with the applicable water spray test requirements as specified in this section:

- a) Any appliance intended for installation in a window opening (See 63.7 and 63.8);
- b) A roof ventilator;
- c) An attic fan;

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*Exception: When an attic fan has instructions that comply with 64A.8, the fan is not required to be subjected to the tests described in this section.*

d) A wall-insert fan, other than a wall-insert fan intended for use over a bathtub or shower and tested in accordance with Section 142, Performance;

*Exception: When a wall-insert fan is intended for commercial or industrial use and is marked in accordance with 62.5.4 and 62.5.6, or when the fan is intended for mounting in an interior wall only and complies with 62.5.5, the fan is not required to be subjected to the tests described in this section.*

e) A through-wall fan;

f) Any appliance that is intended for outdoor use or in any location that includes direct contact with water or rain;

g) A nonresidential cord-connected fan that is not marked in accordance with 63.5, and that is not intended to be fastened in place;

h) A dryer type fan; and

*Exception: When a dryer type fan, intended for indoor use only, already complies with 156.1, the water spray test is not required.*

i) A damp location fan for use in cooking areas.

*Exception: When it is obvious from the construction or installation that an appliance would exclude the water spray, the water spray test is not required to be conducted.*

38.1.1 revised December 23, 2003

38.1.2 Compliance with the water spray test shall be determined by:

a) A visual inspection to determine that there is no wetting of uninsulated live parts or film-coated wire – other than motor windings – and no accumulation of water in the wiring compartment or channel. The accumulation of water droplets shall only be acceptable when the fan complies with the tests in (b) and (c). A drain hole may be provided to reduce the accumulation of water above a level that results in the wetting of an electrical part or wiring compartment.

b) A leakage current test for 120 volt cord connected appliances (see 38.4.1 – 38.4.6) or an insulation resistance test for all other appliances (see 38.5.1).

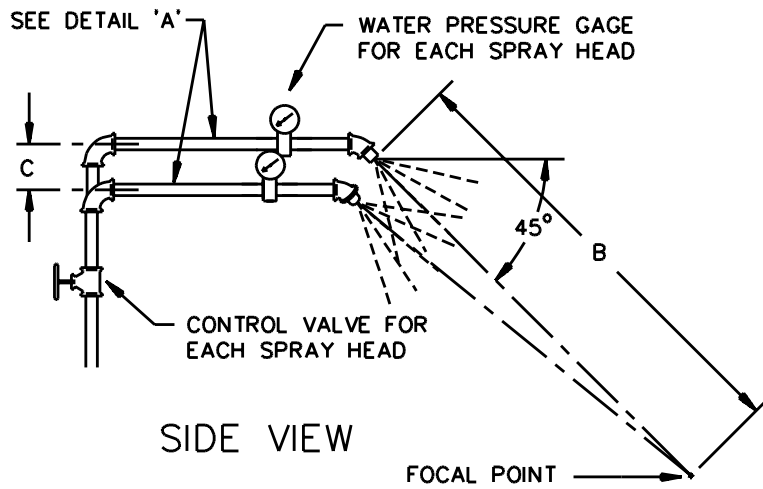
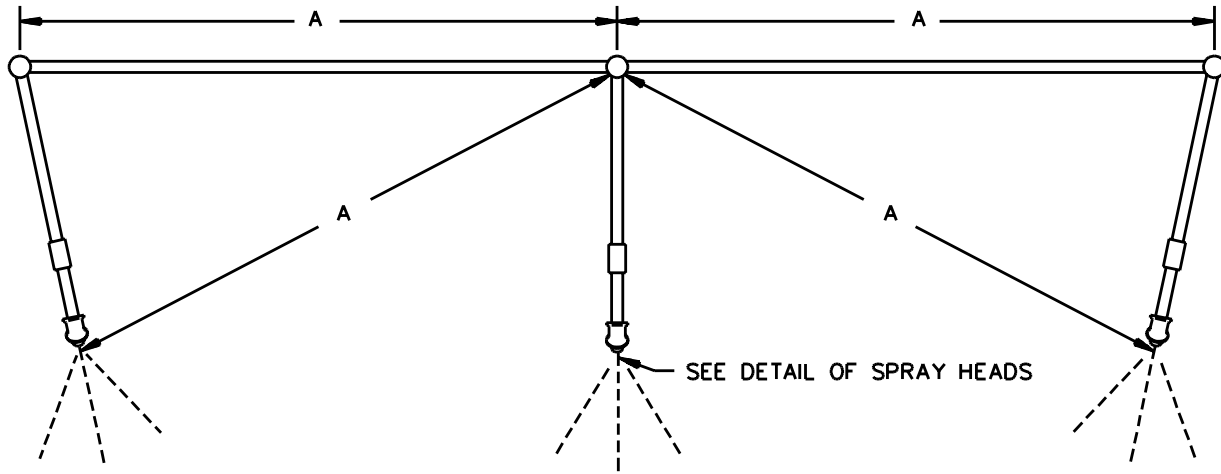
c) A dielectric voltage withstand test (see 38.6.1).

## 38.2 Test preparation

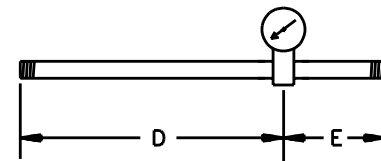
38.2.1 The water spray test apparatus is to consist of three spray heads mounted in a water supply pipe rack as shown in Figure 38.1. Spray heads are to be constructed in accordance with the details shown in Figure 38.2. The water pressure for all tests is to be maintained at 34.48 kPa (5 psi) at each spray head. The appliance shall be positioned in the focal area of the spray heads of the rain test apparatus so that the greatest quantity of water is likely to enter the enclosure of the appliance. The spray is to be vertical toward the louvers or other openings nearest current-carrying parts.

38.2.1 revised December 23, 2003

Figure 38.1  
Spray head pipe rack  
PLAN VIEW



PIEZOMETER ASSEMBLY  
DETAIL 'A'



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

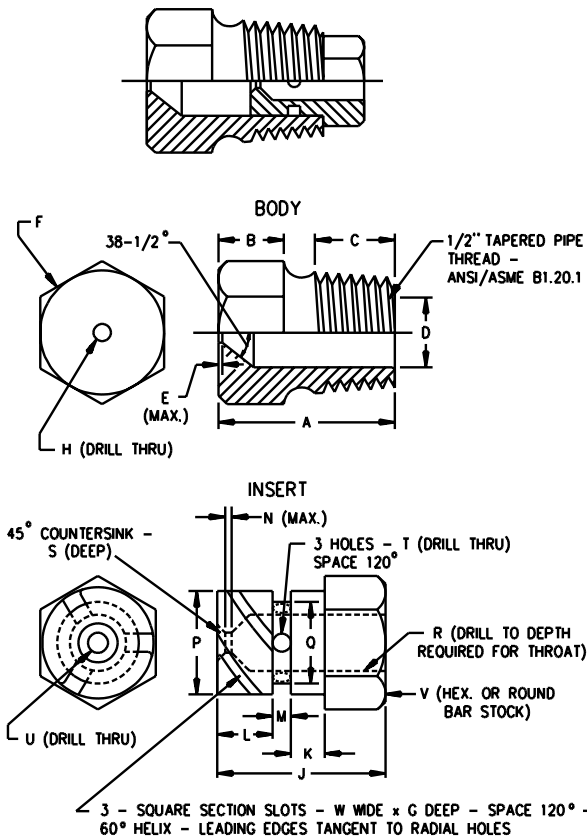
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**Figure 38.2**  
**Spray head assembly**

ASSEMBLY<sup>a</sup>



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

<sup>a</sup> Nylon Rain-Test Spray Heads are available from Underwriters Laboratories

<sup>b</sup> ANSI B94.11M Drill Size

<sup>c</sup> Optional - To serve as a wrench grip.

RT100F

38.2.2 Deleted December 23, 2003

### 38.3 Procedure

38.3.1 The appliance is to be mounted in accordance with the installation instructions. For items of installation not covered by the instructions, the most severe method of test installation is to be used.

38.3.2 The appliance is to operate during the exposure when it:

- a) Is intended to draw air in rather than expel it; or
- b) Has louvers that open only when the appliance is operating.

Other appliances are not to operate during the water spray.

38.3.3 The appliance is to be subjected to a water spray for 4 hours in the direction most likely to cause water to enter.

38.3.4 A box fan that is marked in accordance with 63.7 is to be subjected to a water spray for 2 hours in the direction most likely to cause water to enter. The fan is to be energized for 1 hour and then de-energized for 1 hour during the water spray.

38.3.5 Before conducting a leakage current measurement with the circuit in Figure 38.3, the appliance is to be disconnected from the receptacle. It is to be determined by closing S1, utilizing both positions of S2, and observing the leakage currents at the meter, that the stray leakage currents are negligible.

### 38.4 120 volt cord-connected appliances

38.4.1 The water spray test is to be conducted with the switch in the "on" position. For a multispeed appliance, the "on" position of the switch is to be the low-speed setting.

38.4.2 The leakage current is to be measured using the test methods and equipment described in 32.2 – 32.5, except that the circuit shown in Figure 38.3 is to be used. The leakage current is to be measured with switches S1 and S2 in all possible positions.

38.4.3 During exposure to the water spray described in 38.2.1, the leakage current is to be monitored using both positions of S2. The leakage current shall be no more than 2.5 milliamperes.

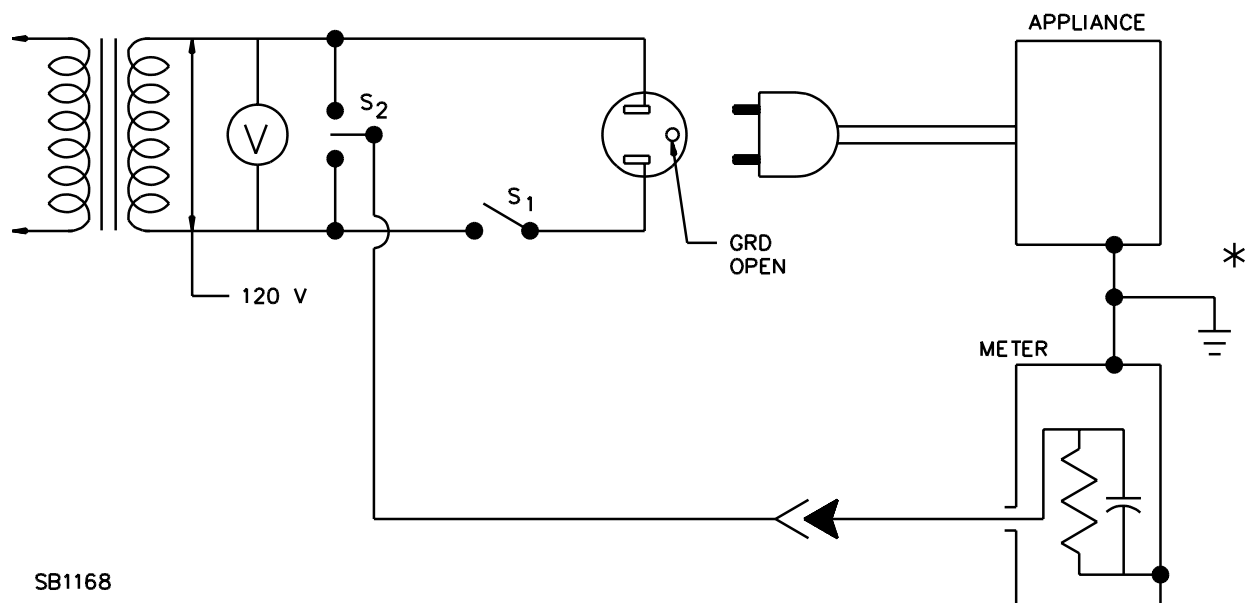
38.4.4 Immediately upon cessation of the water spray, the appliance is to be turned off by opening switch S1 unless it was in the open position during the exposure to the water. The leakage current shall be no more than 2.5 milliamperes.

38.4.5 After the 30-minute monitoring period, the leakage current is to be measured with switch S1 open and using both positions of switch S2. The leakage current shall be no more than 0.5 milliampere.

38.4.6 Immediately after each of the leakage current measurements, a dielectric voltage withstand test is to be conducted as described in 38.6.1.

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**Figure 38.3**  
Leakage current measurement circuit for the water spray test



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### 38.5 Other than 120 volt cord connected appliances

38.5.1 Immediately after the water spray test, the insulation resistance measured between live parts and interconnected dead metal parts of an appliance shall be 50,000 ohms or more. After the insulation resistance measurement, the appliance shall comply with the dielectric voltage withstand test described in 38.6.1.

### 38.6 All appliances

38.6.1 Within 1 minute of cessation of the water spray and also 30 minutes after cessation of the water spray, a dielectric voltage withstand test shall be conducted in accordance with Section 37, Dielectric Voltage Withstand Test, except that the duration of the applied potential is to be 15 seconds for the test conducted within 1 minute of cessation of the water spray test.

## 39 Hosedown Test

39.1 When required by 62.1.9, the hosedown test shall be conducted on a fan.

39.2 At the conclusion of the test described in 39.3 – 39.5, a fan shall have no standing water inside the enclosure and there shall be no water on uninsulated live parts or on film-coated wire, other than motor windings.

39.3 For a permanently installed fan that is connected to conduit during installation, a conduit is to be installed on the enclosure to equalize internal and external pressures as required, but it is not to serve as a drain. No sealing compound other than that normally provided by the manufacturer is to be used. The enclosure interior is to be dry.

39.4 The enclosure and its external mechanisms are then to be sprayed by water from a hose having a 25.4-mm (1-inch) inside diameter nozzle that delivers at least 246 L (65 gallons) of water per minute. The water stream is to be directed at the fan from a distance of 3 – 3.7 m (10 – 12 feet) and is to be moved along the enclosure or surface at a minimum rate of 1.6 cm/sec (4 inches per second).

39.5 For an enclosure having a test length – height plus width plus depth dimension – of 1.9 m (75 inches) or less, the duration of the water stream contact with the enclosure is to be 5 minutes. For an enclosure having a test length exceeding 1.9 m (75 inches), the duration of water stream contact in minutes is to be 2.6 times the test length measured in meters (the test length measured in inches divided by 15).

#### 40 Locked Rotor Test

40.1 An impedance-protected motor used in a wall-insert fan, ceiling-insert fan, a fan intended for use in cooking areas, or a fan in which the motor is subjected to conditions such as restricted ventilation or proximity to an external source of heat, shall comply with the requirements in 40.5 and 40.6.

40.2 For fans rated 12 Amps or less, and that employ wiring terminals for field wiring connections, the Locked Rotor Test is to be conducted with supply wiring sized for the ampacity of the fan. When the fan is rated more than 12 Amps, the fan is to be tested with supply wiring sized 125 percent of the rating of the fan.

40.3 The fan is to be installed or placed in its intended position with the rotor of the fan motor locked and energized as described in the Locked-Rotor Temperature Test in UL 2111 , the Standard for Overheating Protection for Motors. The temperature is to be determined after thermal equilibrium is attained.

40.4 In determining compliance with the requirements specified in 40.3, motor temperature readings are to be taken as follows:

- a) The temperature is to be measured by means of thermocouples applied directly to the actual conductor material or the integrally applied conductor insulation. Thermocouples shall be placed under the coil wrap, when provided; or
- b) The temperature is to be measured by use of the change-in-resistance method.
- c) In the instance where the motor is totally enclosed and the temperature can not be determined by the method in either 40.4(a) or (b), the temperature is to be measured by thermocouples placed on the enclosure.

40.4 revised September 24, 2001

40.5 Under locked-rotor conditions:

- a) The stabilized temperature of an impedance-protected motor shall not exceed the temperature obtained when the motor was tested in the open in accordance with the Locked-Rotor Temperature Test in UL 2111 , the Standard for Overheating Protection for Motors; or
- b) The motor shall comply with the requirements in 40.6, Exception No. 2 to 20.1(a), or the Exception to 20.1(b).

40.6 When the stabilized temperature of the impedance-protected motor installed in the fan exceeds the temperature of the motor tested in the open in accordance with UL 2111, the Standard for Overheating Protection for Motors or if the motor was never so tested, the rotor is to remain locked for 18 days under the conditions specified for the Locked-Rotor Temperature Test in UL 2111, except the motor is to be installed in the fan as specified in 40.3. During the initial 72 hours, the motor temperature shall not exceed the applicable temperature limits specified in UL 2111, or 200°C (392°F) for impedance-protected Type F fan motors. During and after the 18-day period, the motor shall comply with the Locked-Rotor Temperature Test requirements in UL 2111.

40.7 Under locked rotor conditions, the temperature of a thermally protected motor shall not exceed the requirements in UL 2111, the Standard for Overheating Protection for Motors.

## 41 Humidity Conditioning Test

### 41.1 Deleted December 23, 2003

41.2 A sample of the appliance is to be heated to a temperature just above 34°C (93°F) to reduce the likelihood of condensation of moisture during conditioning. The heated sample is then to be placed in the humidity chamber and conditioned for 48 hours in air having a relative humidity of 88 ±2 percent and a temperature of 32 ±2°C (90 ±4°F). Following the conditioning:

- a) A cord-connected appliance rated for a nominal 240-volt supply or less is to be tested in the unenergized condition as specified in 32.6(a). The sample is then to be energized and tested as specified in 32.6(b) and (c). The test is to be discontinued when the leakage current stabilizes or decreases. The leakage current shall not be more than the applicable value in 32.1.
- b) An appliance other than as mentioned in (a) is to have an insulation resistance of 50,000 ohms or more between live parts and exposed dead metal parts.
- c) An appliance shall comply with the dielectric voltage withstand requirements in 37.1.

41.2 revised December 23, 2003

41.3 Insulation resistance is to be measured by means of a high-resistance voltmeter using a 250-volt, direct-current circuit.

## 42 Strain Relief Test

42.1 The strain relief means provided on a flexible cord shall withstand for 1 minute without displacement a direct pull of 155.68 N (35 pounds) applied to the cord with the connections within the appliance disconnected. The strain relief is not acceptable when, at the point of disconnection of the conductors, there is such movement of the cord as to indicate that stress on the connections have resulted.

*Exception: The strain relief means provided in a through cord switch shall be in accordance with the requirements of 42.3.*

42.1.1 The strain relief means provided on a flexible cord shall withstand for 1 minute without displacement a torque as shown in Table 42.1 in either direction between the cord and the enclosure with the connections within the appliance disconnected. The strain relief is not acceptable when, at the point of disconnection of the conductors, there is such movement of the cord as to indicate that stress on the connections have resulted.

*Exception: The strain relief means provided in a through-cord switch shall be in accordance with the requirement in 42.3.*

Added 42.1.1 effective September 24, 2003

**Table 42.1**  
**Torque requirements**

Added Table 42.1 effective September 24, 2003

Weight of appliance, W kg (pounds)	Torque N•m
$W < 1.0$ (2.2)	0.10
$1.0$ (2.2) $\leq W \leq 4.0$ (8.8)	0.25
$W > 4.0$ (8.8)	0.35

42.2 A 16-kg (35-pound) weight is to be suspended from the cord and supported by the appliance so that the strain-relief means can be stressed from any angle the construction of the appliance permits.

42.3 The strain relief means provided in a through cord switch shall withstand for 1 minute a direct pull of 133.44 N (30 pounds). The strain relief is not acceptable when a conductor is detached from a terminal or an uninsulated conductor of the cord is exposed.

42.4 For the construction mentioned in 14.2.3, six samples of the clamp that have been secured to the cord in the intended manner are to be used. Three samples are to be subjected to the dielectric voltage withstand test specified in Section 37, Dielectric Voltage Withstand Test, and shall then comply with the strain-relief test specified in 42.1 in the as-received condition. Three samples shall comply with the requirements specified in 42.1 after being subjected to the following procedures:

- a) The samples are to be placed for 168 hours in a forced-draft air-circulating oven maintained at a temperature of 70°C (158°F) or 10°C (50°F) higher than the temperature recorded on the clamp during the Temperature Test, Section 36, whichever is greater.
- b) The samples are then to be subjected to the dielectric voltage withstand test specified in Section 37, Dielectric Voltage Withstand Test, with the value of the applied potential based on the rating of the appliance. The potential is to be applied between conductors, and the potential is also to be applied between the clamp and all conductors spliced together.



- c) The conditioned samples then are to be cooled at room temperature.

### 43 Unguarded Impeller Tests

43.1 An impeller of a portable fan not required to be guarded shall not break, crack, or chip when operated for 1 hour connected to a supply voltage of 130 percent of the rated supply voltage. The test is to be conducted before and after conditioning as described in 43.2.

43.1 revised December 23, 2003

43.2 An impeller not required to be guarded is to be placed in an air-circulating oven maintained at 70°C (158°F) for 7 hours. After removal, it is to be tested as described in Section 43, Unguarded Impeller Tests; Section 47, Impact Test on Guards; and Section 52, Drop Test. As a result of the testing, the impeller shall not break.

43.3 A motor-driven impeller not required to be guarded shall be energy absorbent to the extent that a 3.2 mm (1/8 inch) diameter dry hardwood dowel does not break when thrust into a rotating blade. The fan is to be fixed in place and energized so that the impeller rotates at intended speed. The dowel is to be supported on a stable, stationary flat surface perpendicular to the plane of rotation. The surface is to have a straight edge located approximately 9.5 mm (3/8 inch) from the fan blade. The dowel is then to be suddenly thrust and retained by hand along an axis perpendicular to the plane of impeller rotation into the blade. This procedure is to be repeated at different points on the impeller (blade and hub) with the impeller rotating at all intended speeds and from in front of and behind the impeller in order to include the most severe condition.

### 44 Push Back Relief Test

44.1 With reference to 14.2.4, a cord-connected fan shall be tested in accordance with 44.2 without occurrence of any of the following conditions:

- a) Mechanical damage to the supply cord or lead;
- b) Exposure of the supply cord or lead to a temperature higher than that for which it is rated;
- c) Reduction of spacings (such as to a metal strain-relief clamp) below the minimum required values; or
- d) Damage to internal connections or components.

44.2 The supply cord or lead is to be held 25 mm (1 inch) from the point where the cord or lead emerges from the product and is then to be pushed back into the product. When a removable bushing which extends further than 25 mm (1 inch) is present, it is to be removed prior to the test. When the bushing is an integral part of the cord, the test is to be carried out by holding the bushing. The cord or lead is to be pushed back into the product in 25-mm (1-inch) increments until the cord buckles or the force to push the cord into the product exceeds 27 N (6 pounds-force). The supply cord or lead within the product is to be manipulated to determine compliance with 44.1.

## 45 Tests of Switches and Controls

### 45.1 Overload

45.1.1 A switch or other device that controls a motor and that has not been previously investigated for its suitability of controlling a motor shall perform acceptably when subjected to an overload test consisting of 50 cycles of operation, making and breaking the locked-rotor current of the motor. As a result of the test, there shall be no electrical or mechanical breakdown of the device. The fuse in the grounding connection shall not open.

*Exception: This requirement does not apply to a switch or other device interlocked so that it does not have to break the locked-rotor current of the motor.*

45.1.1 revised December 23, 2003

45.1.2 In a test to determine whether a switch or other control device complies with the requirements in 45.1.1, the appliance is to be connected to a grounded supply circuit of rated frequency and maximum rated voltage in accordance with 36.1.8, with the rotor of the motor locked in position. During the test, exposed dead metal parts of the appliance are to be connected to ground through a 3 ampere plug fuse, and the connection is to be such that any single-pole, current-rupturing device is connected in the ungrounded conductor of the supply circuit. If the appliance is intended for use on direct current, or on direct current as well as on alternating current, the exposed dead metal parts are to be connected so as to be positive with respect to a single-pole, current-rupturing control device. The device is to be operated at a maximum rate of 10 cycles per minute, except that a faster rate of operation is to be employed only when agreeable to all concerned.

### 45.2 Reversing

45.2.1 A motor-reversing switch shall withstand a test consisting of 1000 cycles of operation as described in 45.2.2. There shall be no electrical or mechanical breakdown of the switch, nor pitting or burning of the contacts that impairs intended operation.

*Exception: This requirement does not apply to a reversing switch that reverses the direction of rotation by changing the connections between shading coils that are insulated from the main windings.*

45.2.2 To determine whether a switch complies with the requirements in 45.2.1, the appliance is to be connected to a circuit of maximum rated voltage. Each cycle of operation is to consist of throwing the switch to the position in which the fan blades rotate in one direction, allowing the blades to come to full operating speed in that direction, then – without pause in any intermediate "off" position unless the switch does not function otherwise – throwing the switch to the position in which the rotation of the blades is reversed, allowing the rotation to attain normal operating speed in that direction, and then reversing the direction of rotation again by throwing the switch to the initial "on" position.

## 46 Static Load Test For Mounting Means

46.1 When subjected to the test specified in 46.2, a cord-connected wall- or ceiling-surface mounted or direct plug-in appliance shall comply with the following:

- a) The security of the attachment of the appliance to the wall shall not be adversely affected;
- b) There shall be no evidence of a risk of fire or electric shock;
- c) The insulation resistance between live and dead-metal parts shall not be less than 50,000 ohms; and
- d) The appliance shall withstand for 1 minute without breakdown the application of a 60-hertz essentially sinusoidal potential of 1000 volts between live and dead-metal parts.

Revised 46.1 effective February 21, 2005

46.2 An appliance as mentioned in 46.1 is to be mounted in the intended manner and subjected to a static load equal to three times the weight of the appliance, for 1 minute. The load is to be applied so as to transmit the maximum amount of stress to the mounting means. An appliance that is wall or ceiling surface mounted as mentioned in 46.1 is to be mounted in accordance with the installation instructions provided by the manufacturer on 3/8-inch-thick plasterboard (dry wall) on nominal 2 by 4-inch wood studs/joists spaced on 24 inch (609 mm) centers. The mounting parts are to be used as specified in the instructions, and the securing screws are to be located between the studs/joists and secured in the plasterboard.

Revised 46.2 effective December 23, 2005

46.3 After installation, the appliance is to be subjected to a static load. The load is to be applied so as to transmit the maximum amount of stress to the mounting means and is to be increased during a 5 to 10 second interval, until a load equal to the weight of the product plus a force of three times the weight of the product, but not less than 10 pounds (45 N), is applied to the mounting system. The load is to be maintained for 1 minute.

Added 46.3 effective December 23, 2005

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## 47 Impact Test on Guards

47.1 A polymeric guard which is subject to impact, such as one on a portable fan, a window fan, a floor insert fan, a crawl space fan, or a wall insert fan installed less than 7 feet above the floor, the malfunction of which results in a risk of injury to persons, that is subjected to impact shall withstand the impact test described in 47.2 and 47.3.

47.1 revised February 21, 2003

47.2 An appliance is to be subjected to an impact of 6.67 N (1.5 foot-pounds) on any surface that is exposed to a blow during intended use. Only one impact is to be applied at a given point. The impact is to be produced by dropping a steel sphere, 50.8 mm (2 inches) in diameter and weighing approximately 0.54 kg (1.18 pounds), from a height of 381 mm (15 inches). For surfaces other than the top of an enclosure, the steel sphere is to be suspended by a cord and allowed to swing as a pendulum, dropping through a vertical distance of 381 mm. For the test on a freestanding fan, the fan is to stand in its intended operating position without restraint.

47.3 Following the impact test, the probe illustrated in Figure 8.1 is to be used to determine whether a portion of an impeller that presents a risk of injury to persons is exposed.

47.4 Deformation of a guard or detachment of a guard or portion of a guard during the impact test is acceptable if the part can readily be restored to its original shape or replaced in the intended manner. After restoration of the guard, the probe illustrated in Figure 8.1 shall not contact a portion of an impeller that can cause risk of injury to persons when inserted in any opening of the guard.

47.5 When the guard also serves as an enclosure, the guard shall be subjected to the impact test specified in 47.1 – 47.4 and shall withstand the impact without occurrence of any of the following:

- a) Making uninsulated live parts or film-coated wire accessible to contact by the probe specified in Table 9.1, applied as indicated in Section 9, Accessibility of Live Parts;
- b) Producing a condition that affects the mechanical performance of the equipment; or
- c) Producing a condition that increases the risk of electric shock.

47.6 With reference to 47.5(b), cracking or denting of the enclosure shall not affect the function of any safety controls or constructional features such as thermostats, overload protective devices, waterseals, or strain relief.

## 48 Static Force Test on Guards

48.1 When a 88.96-N (20-pound) force is applied for 1 minute over a 50.8-mm (2-inch) diameter area to any part of the guard of a portable fan or window fan, spacings to a moving part that presents a risk of injury to persons shall not be permanently reduced to the degree that the probe shown in Figure 8.1 contacts a portion of the moving part when inserted in any opening in the guard.

*Exception: When the 88.96-N force tips over a freestanding fan, the force to be employed is the value that gives the maximum deflection without tipover. The test is to be conducted with and without the fan operating and with any adjustments made to provide the greatest resistance to tipping.*

48.1 revised February 21, 2003

## 49 Impeller Test for Portable Fans

49.1 With reference to the requirement in 8.2.13, the following tests are to be conducted on non-metallic impellers of portable fans and window fans. A 6.35 mm (1/4 inch) diameter steel rod is to be pushed suddenly into the blade with the fan resting on the floor and operating at maximum speed and rated voltage. A test is to be made with the rod inserted near the hub, and a second sample is to be tested with the rod inserted 2/3 of the distance from the hub to the tip of the blade. The rod is to rest on the guard as it is inserted. A part of the blade is not to be thrown more than 1.52 m (5 feet) from the closest part of the base of the fan.

*Exception: When an opening is smaller than 6.35 mm (1/4 inch), use the largest standard diameter steel rod that physically fits.*

49.1 revised February 21, 2003

49.2 Relocated as 8.1.5 February 21, 2003

## 50 Impeller Ignition Test

50.1 The requirements in this Section are intended to investigate the risk of fire for fans as referenced in the Exception to 6.4.2(f).

50.2 A polymeric impeller that is located outside a thermally protected motor on a fan that does not comply with 6.4.2 and 6.4.2(a) – (e) of the Exception shall not ignite as a result of a locked rotor test conducted as described in 50.3.

*Exception: When the impeller ignites, the results meet the intent of the requirement only when the cheesecloth does not ignite and there is no emission of flame beyond the fan enclosure during the following test on three additional fans:*

- a) A double layer of cheesecloth is to completely cover each fan before the test; and
- b) The test described in 50.3 is to be repeated.

50.3 The motor thermal protector is to be shunted out of the motor winding so that the motor stays continually energized. The rotor is to be locked. The fan is to be positioned as intended in application and is to be energized in a room ambient temperature of 10 to 40°C (50 to 104°F) at the voltage indicated in Table 31.1. The fan is to be energized until ultimate results are observed, but no more than 18 days. This procedure is to be repeated on two additional fan samples.

50.4 The cheesecloth referenced in the Exception to 50.2 is to be bleached, 914.40 mm (36 inches) wide, 28.22 – 30.24 meters per kilogram (14 – 15 yards per pound), and having what is known to the trade as a count of 32 × 28 – that is, along the two directions parallel to the threads, there are 13 threads per centimeter in one direction and 11 threads per centimeter in the other (32 threads per inch in one direction and 28 threads in the other).

## 51 Component Breakdown Test

51.1 As required by 27.1, a fan shall be subjected to the Component Breakdown Test as specified in 51.2 – 51.12.

51.2 With reference to 51.1, a risk of fire or electric shock is determined to exist when any of the following occur:

- a) Glowing, charring, or flaming of the cheesecloth or tissue paper as specified in 51.6;
- b) Opening of the 3 Amp fuse specified in 51.7;
- c) Emission of flame, sparks, or molten metal from the enclosure;
- d) Creation of any openings in the enclosure that results in accessibility of live parts, when judged in accordance with Accessibility of Live Parts, Section 9; and
- e) Loss of structural integrity to a degree that the equipment collapses or experiences displacement of parts that leads to short-circuiting or grounding of live parts.

51.3 The circuit between any two terminals of a device is to be opened or shorted. Only one of the simulated fault conditions is to be imposed at a time. For a multi-terminal device, only two terminals are to be short-circuited at a time. Simulated circuits are not prohibited from being used, but when the tests performed on simulated circuits indicate damage to other parts of the fan to the extent that the safety of the fan is affected, the tests shall be repeated on the fan.

51.4 Each test is to be conducted on a separate sample unless it is agreeable to those concerned that more than one test be conducted on the same sample.

51.5 A part of the fan that is removed during routine operation or maintenance is to be omitted when it results in a more severe test, and the part is not:

- a) Required for the functioning of the equipment; and
- b) Exposed to view during intended operation.

*Exception:* The part is not required to be removed during testing when it can only be removed by the use of a tool.

51.6 During these tests, the sample is to be placed on a softwood surface covered with white tissue paper, and a single layer of cheesecloth is to be draped loosely over the entire enclosure.

*Exception No. 1:* Fans not having bottom openings are not required to be placed on a softwood surface covered with white tissue paper.

*Exception No. 2:* When it is impractical to drape the entire enclosure, cheesecloth is to be placed only over all ventilating openings.

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51.7 During each test, exposed dead-metal parts of the sample are to be connected to earth ground through a 3 Amp nontime-delay fuse.

51.8 The supply circuit is to have branch circuit overcurrent protection, the size of which equals 125 percent of the input current rating (20-ampere minimum). When this value does not correspond with the standard rating of a fuse or a circuit breaker, the next higher standard device rating shall be used. The test voltage and frequency are to be adjusted to the maximum rated voltage of the fan.

*Exception: When a marking on the fan or the manufacturer's literature indicates the use of branch circuit protection exceeding 125 percent of the input current, such protection shall be used.*

51.9 A fuse that is replaced during routine maintenance is to be defeated unless marked in accordance with 63.11. A fuse that is soldered in place, or is located such that it is accessible only to qualified service personnel, and marked in accordance with 63.11, and any other overcurrent protective device not subject to replacement during routine maintenance is to be left in the circuit.

51.10 Each abnormal condition is to be conducted for 7 hours or until one or more of the following results are observed:

- a) A risk of fire or electric shock develops (see 51.2);
- b) The branch-circuit fuse opens;
- c) The supplementary protective device opens;
- d) A minimum of one hour elapses, circuit conditions stabilize, and there is no further evidence of overheating of parts.

51.11 The overheating of parts referred to in 51.10(e) is to be detected by an indicator such as an odor, smoke, discoloration, cracking of materials, charring, flaming, glowing, arcing, changes in circuit current through the applied fault, or any similar phenomenon.

51.12 When a fault condition is terminated by the opening of a circuit component, the test is to be conducted two more times using new components for each test.

## PERFORMANCE – PORTABLE APPLIANCES

### 52 Drop Test

52.1 A desk fan and a box fan shall withstand, with the fan operating at maximum speed, the drop test described in 52.2.

52.2 Each of three samples of a fan is to be dropped through a distance of 914.40 mm (3 feet) to strike a hardwood surface. Each sample is to be dropped three times. Three samples shall be employed for the test; however, if the manufacturer so elects, fewer samples may be used in accordance with Figure 52.1. As a result of the drop test, the probe illustrated in Figure 8.1 shall not be able to contact a portion of a blade or blower wheel that presents a risk of injury to persons when inserted in any opening in the guard.

52.2 revised December 23, 2003

**Figure 52.1**  
**Procedure for drop tests**

Each series consists of three drops on each sample as applicable

Figure 52.1 added December 23, 2003

Series Number	Sample Number											
	1	2	3	1	2	3	1	2	3	1	2	3
1	↓ A	N	N	↓ A	N	N	↓ A	N	N	↓ A	N	N
2	↓ A	N	N	↓ A	N	N	↓ U	↓ A	N	↓ U	↓ A	N
3	↓ A	N	N	↓ U	↓ A	N	↓ A	N		↓ U	↓ A	

Arrows indicate sequence of test procedure  
 A – Acceptable results from drop  
 U – Unacceptable results from drop  
 N – No test necessary

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52.3 The hardwood surface mentioned in 52.2 is to consist of a layer of 19-mm (3/4-inch) thick tongue-and-groove oak flooring mounted on two layers of 19-mm (3/4-inch) thick plywood. The assembly is to rest on a concrete floor during the test.

52.4 All samples are to be supported on a surface 914.40 mm (3 feet) above the hardwood surface. Each sample is to be dislodged from the supporting surface by a sudden pull applied to the power-supply cord in a plane parallel to the supporting surface and twice by being pushed by a force parallel to the mounting surface applied to the top of the sample, which is to be placed at the edge of the supporting surface. The sample is to be oriented differently for each test.

52.5 Deformation of a guard or detachment of a guard or portion of a guard during the drop test is acceptable when the part (including ribs of a desk fan) can readily be restored to its original shape or a detached guard can be readily replaced in the intended manner. After restoration of the guard, the probe illustrated in Figure 8.1 shall not contact a portion of a blade or blower wheel that presents a risk of injury to persons when inserted in any opening in the guard.

52.6 A part of the blade shall not be thrown more than 1.52 m (5 feet) from the closest part of the base of the fan.

52.6 added February 21, 2003

### 53 Security of Handle Test

53.1 A handle used to support or carry a fan shall withstand a force of four times the weight of the fan without breakage of the handle, its securing means, or that portion of the enclosure to which the handle is attached.

53.2 To determine if a handle complies with the requirements in 53.1, the force is to be started at zero and gradually increased so that the force specified in 53.1 is attained in 5 to 10 seconds and maintained for 1 minute. When the handle is 76.20 mm (3 inches) or more in width, the force is to be uniformly distributed over a 76.20-mm width at the center of the handle without clamping. When the width is less than 76.20 mm, the force is to be distributed over the entire handle. When more than one handle is furnished on a fan and the fan cannot be carried by only one handle, the force is to be distributed between the handles. The distribution of forces is to be determined by measuring the percentage of the fan weight sustained by each handle with the fan in the intended carrying position. When a fan is furnished with more than one handle and can be carried by only one handle, each handle is to sustain the total force.

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## 54 Stability Test

54.1 A cord-connected freestanding appliance shall not tip over when placed on a plane inclined 10 degrees from the horizontal.

54.2 In addition to the requirement in 54.1, a cord-connected freestanding appliance that is 1.68 m (66 inches) high or more and that also weighs 11.34 kg (25 pounds) or more shall not tip over when placed as intended on a horizontal surface and subjected to a force of 44.48 N (10 pounds) applied horizontally at a point farthest from the horizontal surface up to a maximum of 1.52 m (5 feet).

54.2.1 In addition to the requirements in 54.1, a cord connected freestanding appliance that is 2.1 m (6.9 ft) high or more shall not tip over when placed as intended on a horizontal surface and subjected to a force of 20 pounds applied horizontally at a height of 1.6 m (62 inches).

54.2.1 added February 21, 2003

54.3 During the tests described in 54.1, 54.2, and 54.2.1, the appliance is to be prevented from sliding along the supporting surface and is to be adjusted and operated in any intended manner so that it is most likely to tip over. The test procedure is to include such items as:

- a) Positioning or removal of casters or feet that do not require a tool for removal;
- b) Operating the fan at maximum speed and then evaluating it in the "off" position;
- c) Adjusting the fan into any intended position; and
- d) Fixing an oscillating type fan at any point in the oscillating cycle of movement.

54.3 revised February 21, 2003

## 55 Hassock Fan Load Test

55.1 A hassock fan shall sustain a 1779 N (400 pound) load uniformly distributed over the top of the fan for 1 minute, without breakage or cracking of the enclosure or guard, after which the probe illustrated in Figure 8.1 shall not contact a portion of the impeller that presents a risk of injury to persons when inserted through any opening in the guard or enclosure.

## PERFORMANCE – PERMANENTLY CONNECTED APPLIANCES

### 56 Installation Test

56.1 An appliance intended for permanent connection to a power supply shall be subjected to an installation test in which the appliance is assembled and installed in accordance with the manufacturer's instructions. The appliance shall function in the intended manner and shall comply with the applicable requirements in Sections 31 – 51.

### 57 Tests for Fans for Unattended Areas

57.1 A fan for use in unattended areas shall comply with the tests described in Sections 139 and 140.

## MANUFACTURING AND PRODUCTION TESTS

### 58 Dielectric Voltage Withstand Test

58.1 Each appliance shall withstand without electrical breakdown, the application of potential as indicated in Table 58.1 and at a frequency within the range of 40 – 70 hertz, as follows:

- a) Between the primary wiring, including connected components, and accessible dead metal parts that are capable of becoming energized; and
- b) Between primary wiring and accessible low-voltage (42.4 volts peak or less) metal parts, including terminals.

*Exception No. 1: This requirement does not apply to an appliance that has no electrical components other than a motor that is acceptable for permanent connection to the supply source and complies with the requirements in the Standard for Electric Motors, UL 1004.*

*Exception No. 2: For component fans with accessible dead metal, the potential is to be applied between the input leads or terminals and dead metal parts. For component fans with no accessible dead metal, the dielectric voltage withstand test is not required.*

58.2 This test shall be conducted in accordance with either condition A or condition B of Table 58.1.

58.3 The appliance is to be in either a heated or unheated condition for the test.

58.4 The test is to be conducted when the appliance is fully assembled. It is not intended that the appliance be unwired, modified, or disassembled for the test.

*Exception No. 1: A part, such as a snap cover or a friction-fit knob that would interfere with performance of the test, is not required to be in place.*

*Exception No. 2: The test shall not be performed before final assembly unless the test represents a test on the completed appliance.*

*Exception No. 3: An appliance employing a solid-state component that is not relied upon to reduce the risk of electric shock and that is damaged by the dielectric potential may be tested before the component is electrically connected provided that a random sampling of each day's production is tested at the potential specified in Table 58.1. The circuitry may be rearranged for the purpose of the test to reduce the likelihood of solid-state component damage while retaining representative dielectric stress of the circuit.*

**Table 58.1**  
**Production-line test conditions**

Product rating	Condition A		Condition B	
	Potential, volts	Time, seconds	Potential, volts	Time, seconds
60 volts or less	500	60	600	1
250 volts or less with a motor rated 373 watts (1/2 hp) or less	1000	60	1200	1
250 volts or less with a motor rated more than 373 watts (1/2 hp)	$1000+2V^a$	60	$1200+2.4V^a$	1
251 – 600 volts	$1000+2V^b$	60	$1200+2.4V^b$	1
<sup>a</sup> 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. <sup>b</sup> Maximum marked voltage.				

58.5 The test equipment is to include a transformer having an essentially sinusoidal output, a means of indicating the test potential, an audible or visible 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.

58.6 When 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.

58.7 When the output of the test equipment transformer is 500 volt-amperes or larger, the test potential shall be indicated by any of the following:

- 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) In the case of equipment having a single test potential output, by a marking in a readily visible location to indicate the test potential. When marking is used without an indicating voltmeter, the equipment is to include a positive means, such as an indicator lamp, to indicate that the manually reset switch has been reset following a dielectric breakdown.

58.8 Test equipment other than that described in 58.5 – 58.7 shall be used only when found acceptable to accomplish the intended factory control.

58.9 During the test, the primary switch is to be in the "on" position, both sides of the primary circuit of the appliance 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 No. 1: A product (resistive, high-impedance windings, or the like) having circuitry not subject to excessive secondary-voltage buildup in case of electrical breakdown during the test may be tested:*

- a) *With a single-pole primary switch in the "off" position; or*
- b) *With only one side of the primary circuit connected to the test equipment when the primary switch is in the "on" position or when a primary switch is not used.*

*Exception No. 2: The primary switch is not required to be in the "on" position if the test means applies full test potential between primary wiring and dead metal parts with the switch not in the "on" position.*

## 59 Grounding Continuity Test

59.1 Each appliance that has a power-supply cord having a grounding conductor shall be tested to determine the grounding continuity between the grounding blade of the attachment plug and the accessible dead metal parts of the appliance that are capable of becoming energized.

*Exception: This requirement does not apply to an unassembled fan kit employing a 3-conductor cord.*

59.2 Only a single test is required to be conducted when the accessible metal selected is conductively connected by design to all other accessible metal.

59.3 Any indicating device, such as an ohmmeter, a battery and buzzer combination, or the like, is to be used to determine compliance with the grounding-continuity requirement in 59.1.

## 60 Polarization Test

60.1 As a routine production-line test, each appliance provided with a manually operated, line-connected, single-pole switch for appliance "on-off" operation; an Edison-base lampholder or an Edison-base fuseholder; or a receptacle shall be tested for electrical continuity between the grounded supply circuit conductor of the attachment plug (wide blade of 2-wire plug) and the part of the appliance that is intended to be connected to the grounded supply circuit conductor of the attachment plug. The polarity shall be determined either visually or through the use of an electrical test. Equivalently, polarity may be verified between the ungrounded supply circuit conductor of the attachment plug and the part of the appliance that is intended to be connected to the ungrounded conductor.

60.2 Any indicating device, such as an ohmmeter, a battery and buzzer combination, or the like, is to be used to determine compliance with the requirement in 60.1.

## RATING

### 61 Details

61.1 An appliance shall be rated in volts and, when intended for use on an alternating current supply, the frequency shall be expressed in one of the following terms: hertz (HZ), cycles-per-second, cps, cycles/second, or c/s.

61.2 An appliance shall also be rated in amperes.

*Exception: The appliance may be rated in watts or kilowatts if the overall full-load power factor is 0.80 or more or if the rating of a cord-connected appliance is 50 watts or less.*

61.3 When the appliance is intended for connection to a polyphase supply circuit, the electrical rating shall include the number of phases.



61.4 When an appliance is additionally marked with a horsepower rating, the rating shall not be less than the horsepower rating on the motor nameplate. When the appliance consists of multiple motors, or one or more motors and other loads, the rated horsepower, if provided, shall not be less than the equivalent horsepower of the combined loads, calculated in accordance with Section 430-110(C)(1) of the National Electrical Code, ANSI/NFPA 70-2002.

Added 61.4 effective December 23, 2005

## MARKING

### 62 General Markings

#### 62.1 General

62.1.1 An appliance shall be plainly and permanently marked where visible with:

- a) The manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product is identified – hereinafter referred to as the manufacturer's name;
- b) A distinctive catalog number or the equivalent;
- c) The electrical rating; and
- d) The date or other dating period of manufacture not exceeding any three consecutive months. See 62.1.2.

For a permanently-connected appliance, the marking shall be visible after installation.

62.1.2 With reference to 62.1.1(d), when the date of manufacture is abbreviated or is in a nationally accepted conventional code or in a code affirmed by the manufacturer, the code shall:

- a) Not repeat less than 10 years for a household appliance and less than 20 years for a commercial appliance; and
- b) Not require reference to the production records of the manufacturer to determine when the appliance was manufactured.

62.1.2.1 When a manufacturer produces the appliance at more than one factory, each appliance shall have a distinctive marking, to identify it as the product of a particular factory.

62.1.2.1 added December 23, 2003

62.1.3 An appliance that does not start and attain normal running speed when connected to a circuit protected by a fuse other than a time-delay fuse as described in 34.1 shall be plainly marked, "If connected to a circuit protected by fuses, use time-delay fuses with this appliance," or with an equivalent wording.

62.1.4 A fan, other than a ceiling insert fan/light combination, provided with a lampholder for an incandescent lamp shall be plainly and permanently marked to indicate the maximum wattage rating of the lamp to be used in the lampholder. The marking shall be legible and located so that it is readily visible after the fan has been installed.

62.1.5 When a manufacturer produces or assembles an appliance at more than one factory, each finished appliance shall have a distinctive marking, such as a code, by which it is identified as the product of a particular factory.

62.1.6 A room-to-room fan shall be marked with the following or equivalent wording: "Do not mount in a fire-rated wall."

62.1.7 Unless known to be acceptable for the application, a pressure-sensitive label that is required to be permanent shall comply with the applicable requirements in the Standard for Marking and Labeling Systems, UL 969.

62.1.8 An appliance employing a general use receptacle shall be marked with the rating of the receptacle. See 18.18.

62.1.8 effective December 3, 2000

62.1.9 When the fan is marked, or the manufacturer's instructions indicate, that the fan can be hosed down with water, the fan shall be subjected to the test in Section 39, Hosedown Test, and shall comply with the requirements in 135.2, 135.4.4, 135.5.1, 135.7.1, and 138.1.

62.1.10 A fan that complies with Exception No. 3 to 13.1.2 or Exception No. 2 to 8.3.1 shall be marked with the following or equivalent: "Suitable for commercial or industrial use only."

Revised 62.1.10 effective December 23, 2005

*62.1.11 Deleted February 21, 2003*

62.1.12 A fan that complies with Exception No. 6 to 13.1.2 shall be marked with the following or equivalent: "This fan shall not be installed behind a suspended floor/ceiling or a structural wall, ceiling, or floor."

Added 62.1.12 effective December 23, 2005

## 62.2 Motors

62.2.1 When an appliance employs a single motor as its only electric-energy-consuming component, the electrical rating given on the motor nameplate is not required to be shown elsewhere on the appliance when the nameplate is readily visible after the motor has been installed in the appliance.

62.2.2 When an appliance employs a dual-voltage motor, and when the motor nameplate provides the electrical rating of the appliance as specified in 62.2.1, the appliance shall be additionally marked – not necessarily in a permanent manner – or other suitable means shall be provided to indicate the voltage for which it is connected when shipped from the factory. When the appliance employs an attachment plug, instructions shall be provided to indicate the type of plug that should be used when the appliance is reconnected for the alternate voltage.

62.2.3 When the motor of a wall-insert fan or ceiling-insert fan is electrically connected to the fan by an attachment plug, both the housing and motor-blade assembly shall be marked with a catalog number, a model designation, or the equivalent regardless of whether the fan is completely assembled when shipped from the factory. Also:

- a) The motor-blade assembly shall be marked to positively identify the housing or housings with which it is suitable; or

b) The housing shall be marked to positively identify the motor-blade assembly or assemblies with which it is suitable.

62.2.4 The catalog number or equivalent designation mentioned in 62.1.1, marked on the motor-blade and on the housing, provides adequate marking for compliance with the requirement in 62.2.3. The catalog number or equivalent designation marked on the individual components is considered to comply with the requirement in 62.4.1.

62.2.5 A thermally protected Type F motor complying with the requirements in Exception No. 2 to 20.1(a) shall be marked "Thermally Protected F."

*Exception: When the motor is rated 100 watts (1/8 horsepower) or less, the marking may be abbreviated "T.P.F."*

62.2.6 An impedance-protected Type F motor complying with the requirements in the Exception to 20.1(b) shall be marked "Impedance Protected F."

*Exception: When the motor is rated 100 watts or less, the marking may be abbreviated "Z.P.F."*

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### 62.3 Controllers

62.3.1 A separate controller for an appliance, other than a general-use snap switch that is provided in accordance with the requirement in 22.6, shall be marked with:

- a) The manufacturer's name; and
- b) The catalog number or equivalent designation of the controller unless the marking specifically indicates, by means of the manufacturer's name and by means of a catalog designation or the equivalent, the appliance or appliances with which it is intended to be used.

Unless the intended method of interconnecting the appliance and the controller is obvious, adequate information concerning this interconnection shall be provided by means of a circuit diagram, terminal markings, or the like.

### 62.4 Shipping

62.4.1 If an appliance is not completely assembled when shipped from the factory, and is shipped from the factory in more than one carton, and if misassembly of components results in a risk of fire, electric shock, or injury to persons (see 10.6 and 10.7):

- a) A cross reference marking shall be indicated on each part packaged separately. This marking is not required to be permanent and shall be in the form of a tag or similar temporary marking.

*Exception: For small parts shipped in an envelope or other packaging, the marking may be on the package.*

- b) Each carton containing parts to complete the appliance shall be marked "For Use Only With (Manufacturer's name), Model(s) (Name of Appliance)," or equivalent wording. The carton containing the motor assembly shall be marked "To Complete This (Name of Appliance), Parts Are Shipped In A Separate Carton. Cartons Containing These Parts Are Marked To Indicate Suitability With This Model," or equivalent wording.

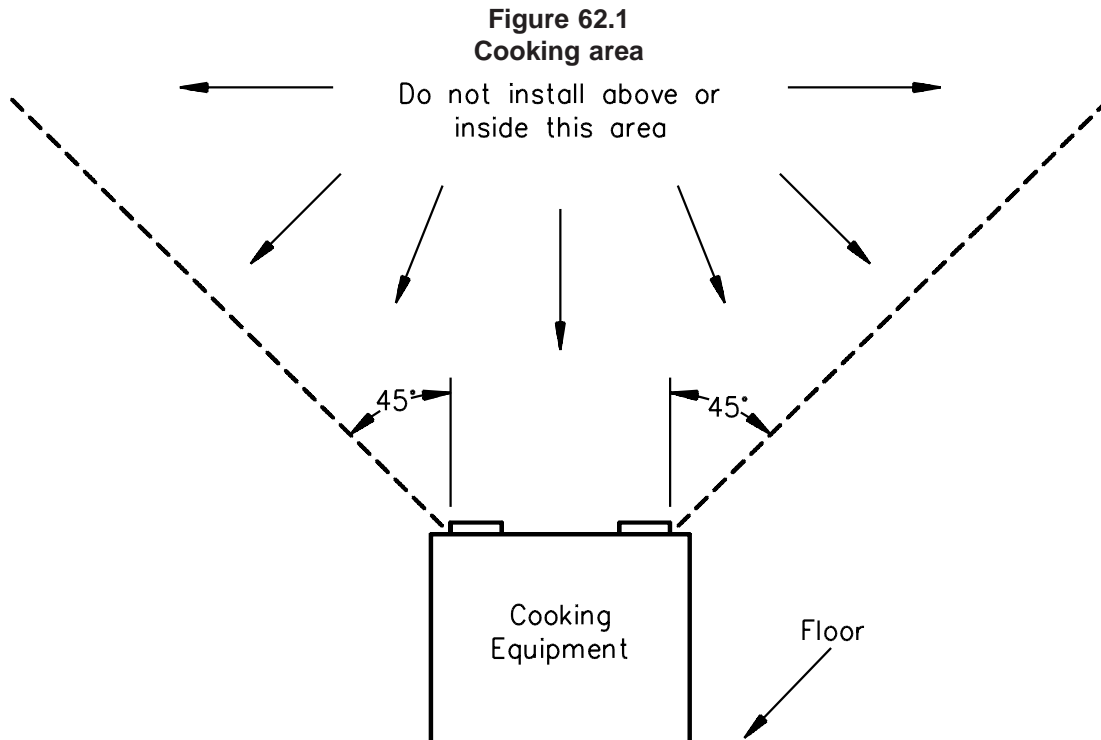
### 62.5 Wall- or ceiling-insert fans

62.5.1 A wall- or ceiling-insert fan that has been found to be suitable for use in a cooking area may be marked to indicate that fact. See 90.1.

62.5.2 A wall-insert fan or ceiling-insert fan that is not acceptable for use in a cooking area because the fan does not comply with the requirements in 16.2, 16.3, 91.1.1, 91.2.1, or 93.1 shall be marked legibly with any one of the following, or equivalent wording:

- a) "Do not install fan above or inside a 45-degree angle projected outwards from the cooking equipment element closest to the fan. See instruction sheet for clarification;" or
- b) "Not for use in cooking area – see installation instructions;" or
- c) "Not for Use in Kitchens."

When the wording from (a) or (b) is used, a figure equivalent to that illustrated in Figure 62.1 shall be included in the instruction sheet. See 16.5.



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*62.5.3 Deleted effective December 23, 2005*

62.5.4 Unless equipped with shutters or louvers, or unless it has been found to comply with the requirements in 38.1.1, a wall-insert fan intended for commercial or industrial use – see 38.1.1(d) – shall be marked "Install behind shutters for protection from rain" or with an equivalent wording located so that it will be readily visible after the fan has been installed as intended.

62.5.5 A wall-insert fan intended for mounting in an interior wall shall be permanently marked where the marking is readily visible after the fan has been installed as intended, "Install in interior wall" or with an equivalent wording.

*Exception: This marking is not required when it is obvious that the fan is intended to be so mounted.*

62.5.6 A wall-insert fan that is intended to comply with the requirements in the Exception to 38.1.1(d) shall be permanently marked in a location visible during installation with the following statement or the equivalent, "For Commercial or Industrial Use."

62.5.7 A fan described in (a) of Exception No. 2 to 8.3.3 shall be marked "Install Fan At Least 1.5 meters (5 Feet) Above The Floor" or with equivalent wording.

62.5.8 A wall or ceiling insert fan or ceiling insert fan/light combination that is provided with a polymeric housing shall be marked, "FOR USE IN NON FIRE RATED INSTALLATIONS ONLY." This marking shall be permanent in letters not less than 2.4 mm (3/32 inch) high, shall be located such that it is visible during installation, and shall be in a contrasting color from the material to which it is applied.

Added 62.5.8 effective June 23, 2005

62.5.9 A wall or ceiling insert fan or ceiling insert fan/light combination that is provided with a polymeric housing shall be marked, "FOR USE IN ONE- AND TWO-FAMILY DWELLINGS ONLY." This marking shall be permanent in letters not less than 2.4 mm (3/32 inch) high, shall be located such that it is visible during installation and inspection of wire connections, shall be located near the supply connections, and shall be in a contrasting color from the material to which it is applied.

Added 62.5.9 effective June 23, 2005

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## 62.6 Attic-mounted and roof-mounted fans

62.6.1 A fan described in 8.3.5 shall be marked "Install This Side Of The Fan Facing An Unoccupied Space" or with equivalent wording.

*Exception: This marking is not required to be provided on the fan when the information is included in the installation instructions.*

62.6.2 A fan described in 8.3.6(b) shall be marked "Attach Louvers Or Grilles When Installing The Fan" or with equivalent wording.

*Exception: This marking is not required to be provided on the fan when the information is included in the installation instructions.*

## 62.7 Wiring

62.7.1 When the wires in a terminal box or compartment intended for power-supply connections attain a temperature of more than 60°C (140°F) during the Temperature Test, Section 36, the appliance shall be marked with the following statement, or the equivalent, at or near the point where supply connections are made, and located so that it is readily visible during installation: "For supply connection, use wires suitable for at least \_\_\_C (\_\_\_F)." The temperature value to be used in the preceding statement shall be in accordance with Table 62.1.

**Table 62.1**  
**Outlet-box marking**

Temperature attained during test in terminal box or compartment	Temperature marking
61 – 75°C (142 – 167°F)	75°C (167°F)
76 – 90°C (169 – 194°F)	90°C (194°F)

62.7.2 If any point within a terminal box or wiring compartment of a permanently connected appliance in which field-installed conductors are intended to be connected – including such conductors themselves – attains a temperature more than 60°C (140°F) during the Temperature Test, Section 36, the appliance shall be marked in accordance with 62.7.3. The statement shall be legible and located so that it is clearly visible during installation and examination of the supply-wiring connections.

62.7.3 The marking mentioned in 62.7.2 shall be in accordance with Table 62.1 and the following:

- a) When all the conductors used in the test are the same size, the marking shall be "For supply connections use \_\_\_ AWG or larger wires suitable for at least \_\_\_ C (\_\_\_ F)" or with an equivalent statement.
- b) When the test was conducted with 14 AWG (2.1 mm<sup>2</sup>) conductors, the wire size marking is not required.

62.7.3 revised February 21, 2003

## 63 Cautionary Markings

63.1 A cautionary or warning marking intended to inform the user of a potential risk of fire, electrical shock, or injury to persons shall be prefixed by the signal word "CAUTION" or "WARNING." The signal word shall be more prominent than any which is intended to reduce the risk of injury, shall be permanent, in capital letters not less than 2.4 mm (3/32 inch) high, and shall be located on a part that cannot be:

- a) Removed without impairing the operation of the fan; or
- b) Left off the appliance without it being readily apparent.

63.1 revised February 21, 2003

63.2 A fan provided with an automatic-starting feature in accordance with 22.10 shall be provided with the following marking: "CAUTION" and the following or the equivalent, "Automatically Operated Device – To Reduce The Risk Of Injury Disconnect From Power Supply Before Servicing." The marking shall be visible to the user prior to the performance of intended maintenance or removing of any guard that exposes a moving part that presents a risk of injury to persons.

63.3 An exhaust fan shall be marked with the word "CAUTION" and the following or the equivalent: "To reduce risk of fire and to properly exhaust air, be sure to duct air outside – Do not vent exhaust air into spaces within walls or ceilings or into attics, crawl spaces, or garages." The marking shall be visible during installation.

*Exception No. 1: This marking does not apply to the following fan types:*

- a) *Ductless fans intended for use in cooking areas;*
- b) *Room-to-room fans;*
- c) *Bathroom ventilators; and*
- d) *Other non-kitchen type fans.*

*Exception No. 2: The required information may be included in the installation instructions instead of being marked on the fan if the instructions are packaged and shipped with the fan.*

63.4 Fans as specified in Exceptions No. 1 or No. 2 to 8.3.1 or Exception No. 1 to 8.3.3 or Exception No. 2 to 8.3.4 shall be marked with the word "CAUTION" and the following or equivalent wording: "To Reduce The Risk Of Injury To Persons, Install Fan At Least 2.1 m (7 Feet) Above The Floor."

63.4 revised February 21, 2003

63.5 A nonresidential cord-connected fan that is not subjected to the Water Spray Test (see 38.1.1) shall be marked in a readily visible location with the word "WARNING" and the following or equivalent wording: "To Reduce The Risk Of Electric Shock, Do Not Expose to Water or Rain."

63.6 *Deleted effective December 23, 2005*

63.7 A box fan that is subjected to the 2 hour water spray test in Section 38, Water Spray Test, shall be marked in a readily visible location with the word "WARNING" and the following or equivalent wording: "To Reduce The Risk Of Electric Shock And Injury To Persons, Do Not Use In A Window."

63.8 The individual shipping carton for a box fan not intended for window installation shall be labeled with the warning marking specified in 63.7. Also, the carton shall be free of any information that implies window mounting.

63.9 When required by 6.1.3, a fan having play value shall be marked with the word "WARNING" and with the following or the equivalent:

- a) "THIS IS A FAN – NOT A TOY!"; and

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b) "TO REDUCE THE RISK OF PERSONAL INJURY AND ELECTRIC SHOCK, IT SHOULD NOT BE PLAYED WITH OR PLACED WHERE SMALL CHILDREN CAN REACH IT."

63.10 An outdoor location fan employing a receptacle shall be marked "CAUTION: RISK OF ELECTRIC SHOCK, Do not use with extension cord near water or where water may accumulate. Keep fan at least 16 feet from pools and spas. Keep plugs and receptacles dry."

63.10 effective December 3, 2000

63.11 When required by 18.19, a fan shall be marked to indicate the type, ampere, and voltage rating of the replacement fuse. In addition, the portable fan shall be marked with the word "WARNING" and the following or equivalent: "For continued protection against risk of fire, replace only with same type and rating of fuse." These markings shall be located adjacent to the fuseholder so as to be visible during fuse replacement.

63.11 effective December 3, 2000

63.12 A portable fan employing a general use receptacle that is not subjected to the water spray test (see 38.1.1) shall be marked in a readily visible location with the word "WARNING" and the following or equivalent wording: "To reduce the risk of electric shock, do not expose to water or rain."

63.12 effective December 3, 2000

63.13 A portable fan employing a general use receptacle that is subjected to the water spray test (see 38.1.1) shall be marked in a location adjacent to the receptacle "Wet location only when cover closed."

63.13 effective December 3, 2000

## INSTRUCTIONS

### 64 Important Safety Instructions

64.1 Important safety instructions in an instruction sheet, manual, booklet, or the like, provided with an appliance shall be separated in format from other instructions, and shall appear before the operating instructions. The instructions shall be legible and shall include the words "READ AND SAVE THESE INSTRUCTIONS", which shall be more prominent than the general text used in the manual, booklet, or the like.

*Exception No. 1: The words "READ AND SAVE THESE INSTRUCTIONS" are not required to be included in the instructions for a fan intended only to be used as a component of another appliance.*

*Exception No. 2: The words "READ AND SAVE THESE INSTRUCTIONS" are not required to be included when the instructions do not include details regarding cleaning, periodic maintenance, or other servicing intended to be performed after installation of fan.*

64.2 When servicing or replacement of a component in an appliance requires the removal or disconnection of a safety device, the instructions shall include a statement to the effect that the safety device is to be reinstalled or remounted as previously installed.

64.3 An appliance having a 2-blade polarized plug shall have the following instructions: "This appliance has a polarized plug (one blade is wider than the other). To reduce the risk of electric shock, this plug is intended to fit in a polarized outlet only one way. If the plug does not fit fully in the outlet, reverse the plug. If it still does not fit, contact a qualified electrician. Do not attempt to defeat this safety feature."

64.4 The instruction manual shall:

- a) Include instructions pertaining to a risk of fire, electric shock, or injury to persons, for cleaning and user-maintenance, such as lubrication; and
- b) Warn the user to unplug or disconnect the appliance from the power supply before servicing.

64.5 The markings specified in 68.1 and 68.2 shall also appear in the important safety instructions.

*Exception: When the solid state speed control is an integral factory wired speed control, the marking of 68.2 is not required in the installation instructions.*

64.5 revised February 21, 2003

64.6 The instructions for a fan that has not been evaluated for operation with a solid state speed control as specified in 67.1.1 – 67.2.1 shall include the signal word "WARNING" and the following or the equivalent: "To Reduce The Risk Of Fire Or Electric Shock, Do Not Use This Fan With Any Solid-State Speed Control Device."

64.7 The important safety instructions for box fans not intended for window installation shall include the word "WARNING" and the following or equivalent wording: "To Reduce The Risk Of Electric Shock And Injury To Persons, Do Not Use In A Window."

64.8 The important safety instructions for a permanently-connected fan shall include, in addition to those items that apply to permanently-connected fans in 64.1 – 64.7, the following warnings and instructions verbatim and in the order shown:

WARNING – TO REDUCE THE RISK OF FIRE, ELECTRIC SHOCK, OR INJURY TO PERSONS, OBSERVE THE FOLLOWING:

- a) Use this unit only in the manner intended by the manufacturer. If you have questions, contact the manufacturer.
- b) Before servicing or cleaning unit, switch power off at service panel and lock the service disconnecting means to prevent power from being switched on accidentally. When the service disconnecting means cannot be locked, securely fasten a prominent warning device, such as a tag, to the service panel.

*Exception: The additional safety instructions do not apply to a ceiling-suspended fan.*

64.9 The important safety instructions for an exhaust type fan shall include the signal word "CAUTION" and the following statement verbatim: "For General Ventilating Use Only. Do Not Use To Exhaust Hazardous Or Explosive Materials And Vapors."

64.10 The important safety instructions for a whole-house fan or attic fan with an unguarded impeller shall include the signal word "CAUTION" and the following statement verbatim: "This unit has an unguarded impeller. Do Not Use In Locations Readily Accessible To People Or Animals."

64.11 Revised and relocated as 93B.1 effective February 21, 2005

Revised 64.11 effective February 21, 2005

64.12 Relocated as 93B.2 February 21, 2003

#### **64A Installation Instructions**

64A.1 Installation instructions shall be provided with an appliance intended to be permanently connected to the power supply, a cord-connected window, ceiling, or wall-mounted fan, and an appliance provided with keyhole mounting slots.

64A.2 Wiring instructions provided with an appliance shall not conflict with any requirement in this standard or in the National Electrical Code, ANSI/NFPA 70-1999.

64A.3 A small part not provided with the appliance for mounting shall be referenced in the installation instructions.

64A.4 An accessory for a permanently installed fan shall be provided with instructions detailing proper installation procedures.

64A.5 When the mounting hardware mentioned in 11.2.1 is not provided with a cord-connected wall-mounted fan, the instructions shall contain a description and an illustration of the hardware needed to mount the fan in place as intended.

64A.6 A wall-insert fan described in (b) of Exception No. 2 to 8.3.3 shall be provided with instructions that indicate that the fan is to be installed above a:

- a) Counter; or
- b) Major appliance, such as a dishwasher or range, that serves as a barrier.

64A.7 The instructions provided with those exhaust fans not described in Exception No. 1 to 63.3 shall indicate that the discharge air is to be directed to the building exterior.

64A.8 An attic fan that is intended to comply with the Exception to 38.1.1(c) shall be provided with instructions that indicate that the fan is to be mounted behind louvers or in a location where the entrance of drawn in water is unlikely.

64A.9 When an appliance is not completely assembled when shipped from the factory and is shipped from the factory in more than one carton, and when misassembly of components results in a risk of fire, electric shock, or injury to persons (see 10.6 and 10.7), the installation instructions shall include the word "WARNING" and the following or the equivalent: "To Reduce The Risk Of Fire, Electric Shock, And Injury To Persons, (Name of Appliance) Must Be Installed With (Name of Part(s)) That Are Marked (on their cartons) To Indicate The Suitability With This Model. Other (Name of Part(s)) Cannot Be Substituted."

64A.10 The installation instructions for a permanently-connected fan shall include, in addition to those items that apply to permanently-connected fans in 64A.1 – 64A.9, all of the following warnings and instructions verbatim and in the order shown and as applicable to the fan type:

**WARNING – TO REDUCE THE RISK OF FIRE, ELECTRIC SHOCK, OR INJURY TO PERSONS, OBSERVE THE FOLLOWING:**

- a) Installation work and electrical wiring must be done by qualified person(s) in accordance with all applicable codes and standards, including fire-rated construction.
- b) Sufficient air is needed for proper combustion and exhausting of gases through the flue (chimney) of fuel burning equipment to prevent back drafting. Follow the heating equipment manufacturer's guideline and safety standards such as those published by the National Fire Protection Association (NFPA), and the American Society for Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), and the local code authorities.
- c) When cutting or drilling into wall or ceiling, do not damage electrical wiring and other hidden utilities.
- d) Ducted fans must always be vented to the outdoors.
- e) If this unit is to be installed over a tub or shower, it must be marked as appropriate for the application and be connected to a GFCI (Ground Fault Circuit Interrupter) – protected branch circuit.
- f) NEVER place a switch where it can be reached from a tub or shower.

*Exception: The additional installation instructions do not apply to a ceiling-suspended fan.*



64A.11 Relocated as 93A.6 February 21, 2003

## PART 2 – SPECIFIC FAN TYPES

### FANS FOR USE WITH SOLID STATE SPEED CONTROLS

#### 65 General

65.1 In addition to the applicable requirements in Part 1 of this Standard, a fan for use with a solid-state speed control shall comply with the requirements in Sections 66 – 68. Also see 5.1.

#### 66 Construction

66.1 A motor in a fan that is marked for use with a separate solid-state speed control in accordance with 68.1 and 68.2, and a motor in a residential fan that is provided with an integral solid-state speed control, shall employ overload protection that complies with the tests described in Section 67.

66.2 A solid-state speed control shall comply with the applicable requirements in the Standard for Solid-State Fan Speed Controls, UL 1917, or the equivalent.

*Exception: The spacings of an integral factory wired component solid-state speed control shall comply with either UL 1917, the Standard for Solid-State Fan Speed Controls, or UL 244A, the Standard for Solid-State Controls for Appliances.*

66.2 revised December 23, 2003

66.3 A permanently connected fan employing a factory wired component solid-state speed control shall include a positive marked "off" position provided by an air-gap-type switch that complies with the applicable requirements in the Standard for General-Use Snap Switches, UL 20, or in the Standard for Special-Use Switches, UL 1054, or the equivalent.

*Exception No. 1: This requirement does not apply to a fan speed control that complies with UL 991, Tests for Safety-Related Controls Employing Solid-State Devices.*

*Exception No. 2: An air-gap-type switch is not required when the factory wired solid state speed control de-energizes all circuits that involve open circuit potentials in excess of 30 V ac (42.4 V peak), and where the continuous current flow through a 1500 ohm resistor connected across the potential exceeds 0.5 mA.*

Added 66.3 effective September 24, 2003

## 67 Performance

### 67.1 Temperature test

67.1.1 In addition to the condition described in 36.1.9, a fan that includes or that is intended for use with a solid-state speed control is to be operated under each of the following conditions:

- a) At the speed and rotation direction resulting in maximum motor temperatures. During this test the fan is to be connected to the load side of a triac. The triac is to be provided with associated circuitry allowing it to be triggered during each half-cycle of the ac input to the fan. Speed control is to be accomplished by varying the trigger points.
- b) Connected and tested as described in (a) with a 2-volt dc offset potential applied to the ac fan input voltage by a suitable method and with the integral solid-state speed control bypassed. The 2-volt dc offset potential is to be obtained by using a speed control device having routing diodes and dual triggering circuits to allow independent adjustment of the positive and negative 1/2 cycle triac triggering points. The triggering points are to be adjusted so that a 2-volt dc bias is measured on the switched ac output waveform. The dc bias may be measured by a dc volt meter having a frequency damped response in the range of 0 – 120 hertz. See Figure 67.1.
- c) With the fan connected to an ac supply modified to produce half-wave output. The supply is to be switched from sinusoidal to half-wave output after the fan is operating at maximum speed. This test is to be conducted in the rotation direction and speed control setting resulting in maximum motor temperatures. If after the supply is switched from sinusoidal to half-wave operation, the fan motor shaft does not continue to rotate in a manner that is a usable normal condition, the locked-rotor temperature requirements described in 67.1.2 shall be used instead of the maximum temperature rises specified in Table 36.1. See Figure 67.2.

67.1.2 When the fan motor shaft does not rotate or rotates in a manner not determined to be normal after the supply is switched from sinusoidal to half-wave operation as described in 67.1.1(c) or, the motor does not restart when operated from a half-wave source after the motor is de-energized, the motor shall comply with the applicable temperature requirements as follows:

- a) The temperature of an impedance-protected motor shall comply with the Locked-Rotor Temperature Test requirements in UL 2111 , the Standard for Overheating Protection for Motors.
- b) The temperature of a thermally-protected motor shall comply with the Locked-Rotor Temperature Test requirements in UL 2111 , the Standard for Overheating Protection for Motors, except:
  - 1) For a motor with an automatic reset type protective device, the temperature criteria shall not be applied during the initial cycle of the thermal protector operation and there shall be no emission of flame or molten metal, or
  - 2) For a motor with a non-replaceable thermal cutoff, the temperature criteria shall not be applied when the thermal cutoff opens within the first hour and there shall be no emission of flame or molten metal.

## 67.2 Abnormal operation test

67.2.1 A fan having a thermally protected motor shall comply with the requirements in the Locked-Rotor Endurance Test in UL 2111 , the Standard for Overheating Protection for Motors, and a fan having an impedance-protected fan motor shall comply with the requirements in the Locked-Rotor Temperature Test in UL 2111 , the Standard for Overheating Protection for Motors, except:

- a) No winding temperature requirements are applicable;
- b) The motor is to be installed in the fan, and the fan is to be installed as described for the Temperature Test in Section 36 of this Standard; and
- c) The duration of the test is for 15 days. The power supply is to be modified to provide half-wave output directly to the motor and bypassing the integral solid-state speed control.

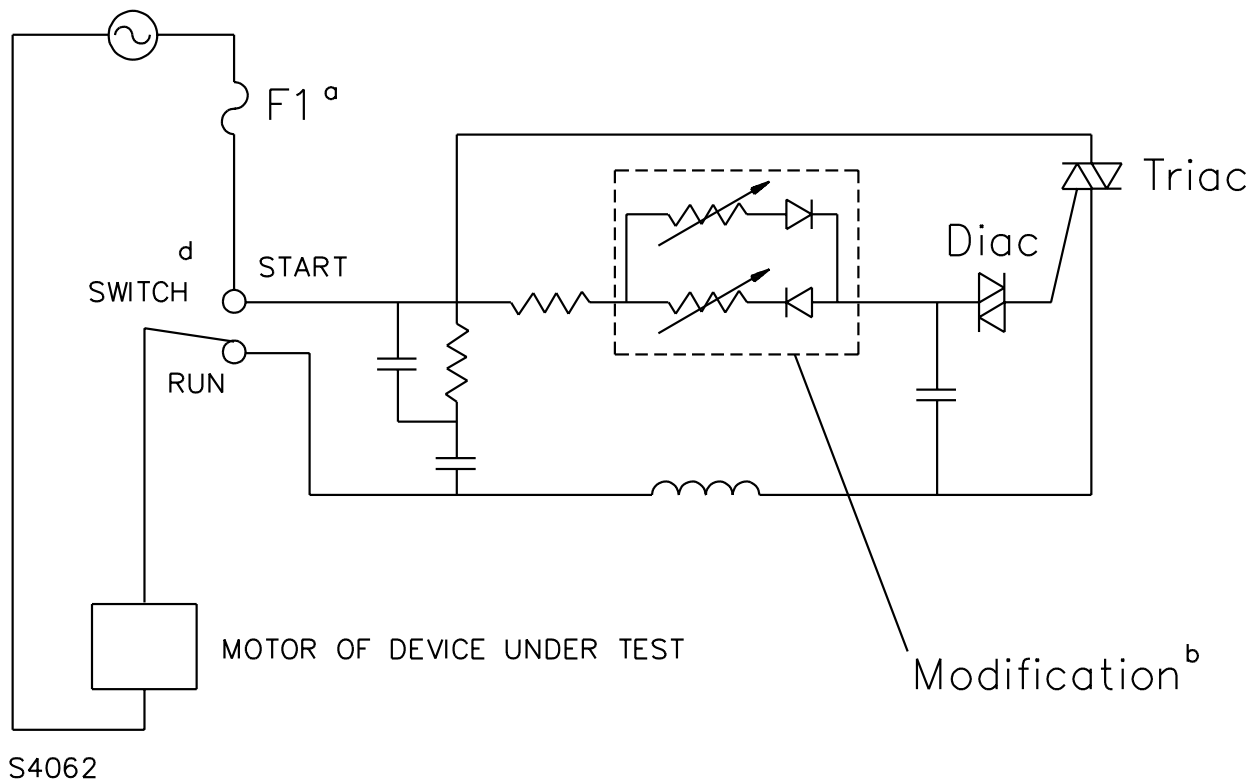
## 68 Marking

68.1 A fan that has been evaluated for compliance with 67.1.1 – 67.2.1 for use with a specific solid-state fan speed control that is not an integral component of the fan shall be permanently marked, "WARNING" and the following or the equivalent: "To Reduce The Risk Of Fire Or Electric Shock, This Fan Should Only Be Used With Fan Speed Control Part No.\_\_\_\_\_, Manufactured By\_\_\_\_\_." This marking shall be in a location readily visible both during and after installation. See 64.5.

68.2 A fan that operates with a solid-state speed control and complies with 67.1.1 and 67.2.1 may be marked with the following or the equivalent: "Suitable for use with solid-state speed controls." See 64.5.

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**Figure 67.1**  
2-volt DC offset test circuit<sup>c</sup>



Footnotes –

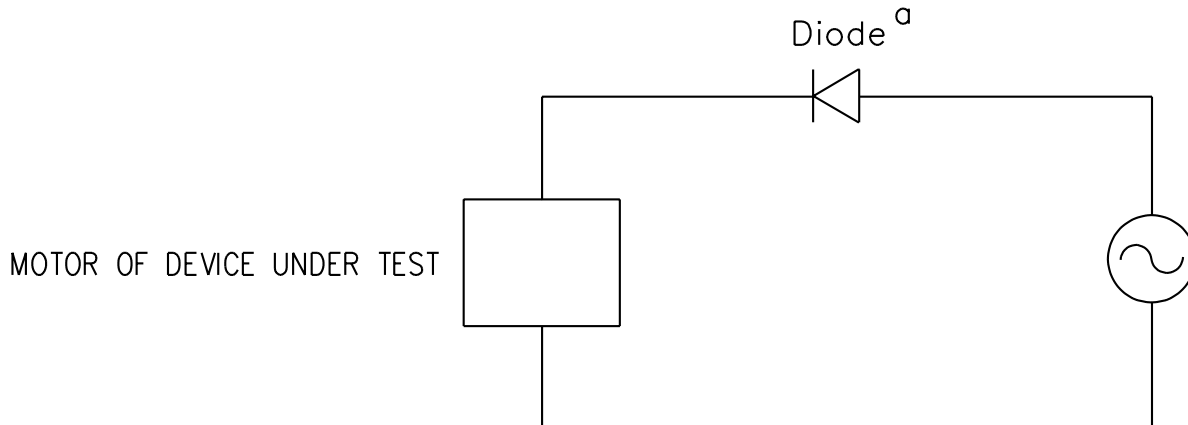
<sup>a</sup> The fuse is to protect the test circuit and is to be sized according to the rating of the standard triac module.

<sup>b</sup> The modification is made to a standard triac module such as a light dimmer or motor controller using two multi-turn potentiometers and two standard rectifier diodes each sized for the rating of the standard triac modules that are used to allow adjustment of the positive and negative portions of the sinusoidal waveform.

<sup>c</sup> Measurement of the test circuit is to be made with a meter having the capability to measure the dc components of the waveform.

<sup>d</sup> The switch allows starting of the device under test with the normal sinusoidal waveform ("Start" position) and then allows switching to the modified waveform ("Run" position).

**Figure 67.2**  
**Half-wave test circuit**



S4063

Footnote –

<sup>a</sup> A standard rectifier diode is used to produce the half-wave input to the motor of the device under test. The diode is to be sized for the rating of the device under test (at least twice the rating of the motor).

## CEILING-SUSPENDED FANS

### 69 General

69.1 In addition to the applicable requirements in Part 1 of this Standard, a ceiling-suspended fan shall comply with the requirements in Sections 70 – 73. Also see 5.1.

### 70 Construction

#### 70.1 Mounting means

70.1.1 A ceiling-suspended fan shall be provided with mounting means and instructions. See 64A.1. The mounting means shall comply with the static load test specified in Section 71.

70.1.2 Other than as noted in (a) and (b), the mounting means for a ceiling-suspended fan shall be independent of an outlet box and shall be secured directly to the building structure. See 73.2. A ceiling-suspended fan intended to be mounted directly to the building structure shall be marked in accordance with 72.5.

a) A ceiling-suspended fan intended to be mounted to an outlet box shall comply with the following:

- 1) The weight of the fan together with the intended combination of accessories installed, including possible loading as specified in 118.4;

- 2) The fan is marked for installation to an outlet box and is marked to instruct the installer to use the mounting screws provided with the outlet box (see 72.2);
  - 3) The installation instructions specify that the fan be mounted to an outlet box and that the mounting screws provided with the outlet box shall be used (see 73.6); and
  - 4) The fan mounting bracket has a maximum thickness of 7.9 mm (5/16 inch).
- b) A ceiling-suspended fan provided with two forms of mounting means, such that the fan is capable of being mounted to either an outlet box or directly to a structural framing member, shall comply with the following:
- 1) The weight of the fan together with the intended combination of accessories installed, including possible loading as specified in 118.4, does not exceed 16 kg (35 pounds);
  - 2) Both mounting means shall be tested in accordance with the static load test described in Section 71, Performance.
  - 3) The fan shall be marked in accordance with 72.6.

70.1.2 revised February 21, 2003

70.1.3 The mounting of a ceiling fan intended to be suspended by a single "J" hook shall be provided with:

- a) A means to reduce the likelihood of rotation and removal of the hook, such as a locking bar; or
- b) A short retention chain that would support the fan if the "J" hook were unscrewed.

The threads on the threaded portion of a "J" hook shall be a minimum of 50.8 mm (2 inches) long.

*Exception: This requirement does not apply to a unidirectional fan when its starting and operating torques tend to tighten the "J" hook.*

70.1.4 Downrods shall be fastened at each end by means that do not depend upon friction alone. Threaded fittings used for this purpose shall be fastened by an additional means, such as a through bolt, lockwasher and nut, or the like. A hardened setscrew that upon installation upsets the threads of a downrod is considered an additional means. An unthreaded downrod shall not be fastened solely by setscrews.

## 70.2 Fan blades

70.2.1 The blades of a ceiling-suspended fan shall be located at least 3.05 m (10 feet) above the floor when the fan is installed as intended.

*Exception: As an alternative to the 3.05 m requirement, the blades shall not be less than 2.1 m (7 feet) above the floor only when the maximum speed at the tip of the blades, the airflow, and the minimum edge thickness of the blades are as specified in Table 70.1.*

**Table 70.1**  
**Ceiling-suspended fans from 2.1 meters (7 feet) to less than 3.05 meters (10 feet) above floor**

Air flow	Maximum speed at tip of blades,		Minimum thickness of edges of blades,	
	m/s	(feet per minute)	mm	(inch)
Downward	16.3	(3200)	3.2	(1/8)
Downward	20.3	(4000)	4.8	(3/16)
Reversible	16.3	(3200)	4.8	(3/16)
Reversible	12.2	(2400)	3.2	(1/8)

70.2.2 All edges of the blades mentioned in 70.2.1 and Table 70.1 shall be smooth and well-rounded, with no projections, and have a smooth trailing surface.

70.2.3 The polymeric blades of a dry location ceiling-suspended fan shall comply with all the requirements specified in Section 77, except for the low temperature conditioning of 77.1.3 which is to be conducted at 0°C (32°F).

*70.2.4 Revised and relocated as 81.2.1 September 24, 2001*

## 70.3 Power supply connections

70.3.1 A cord-connected ceiling-suspended fan marked for commercial, industrial, or agricultural use in accordance with 72.3 shall be provided with a power supply cord in accordance with Table 14.1 and shall:

- a) Have three conductors;
- b) Be Type SJ or heavier terminating in an acceptable grounding type attachment plug;
- c) Have a length of 0.305 – 0.46 m (12 – 18 inches);
- d) Be permanently attached to the fan; and
- e) Comply with the requirements of 14.1.2 and 14.2.1 – 14.2.5.



## 70.4 Wiring

70.4.1 Wiring leads provided in a ceiling-suspended fan for supplying power to an optional light kit installed in the field shall not have exposed bare ends. See 72.4 and 86.1.

70.4.2 Wiring leads terminating in single or multiple connectors provided in a ceiling-suspended fan for supplying power to an optional light kit installed in the field shall be constructed such that the single or multiple connectors physically cannot be mated to each other to create a short circuit.

70.4.2 effective December 13, 2001

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## 70.5 Openings in canopy

70.5.1 An open hole in the fan canopy shall not exceed the dimension specified in Table 70.2.

**Table 70.2**  
**Maximum size of open holes**

Opening shape	Maximum area		Maximum Dimension	
	mm <sup>2</sup>	(inch <sup>2</sup> )	mm	(inch)
Slot <sup>a</sup>	967.7	1-1/2	9.5	3/8
Square	–		12.7	1/2
Round	–		12.7	1/2
Irregular	967.7	1-1/2	9.5	3/8

<sup>a</sup> A slot between two assembled parts that does not exceed 0.8 mm (1/32 inch) in width is not required to comply with the area limitation.

70.5.2 The total area of one or more open holes shall not be more than 15 percent of the area of the surface in which it is located.

## 71 Performance

### 71.1 Static load test

#### 71.1.1 Fans with other than ball-joint hanger means

71.1.1.1 The mounting means for a ceiling suspended fan having other than a ball-joint hanger means shall be tested as specified in 71.1.1.3. After the load is removed, the security of the mounting means to the building structure or outlet box and the security of the connection of the fan to the mounting means shall be as originally installed.

71.1.1.2 With reference to 70.1.3, for a fan intended to be suspended by a single "J" hook, the test specified in 71.1.1.3 shall be conducted:

- a) First with the fan installed as intended and supported by the "J" hook; and
- b) Second with the "J" hook removed and the fan suspended by the chain only.

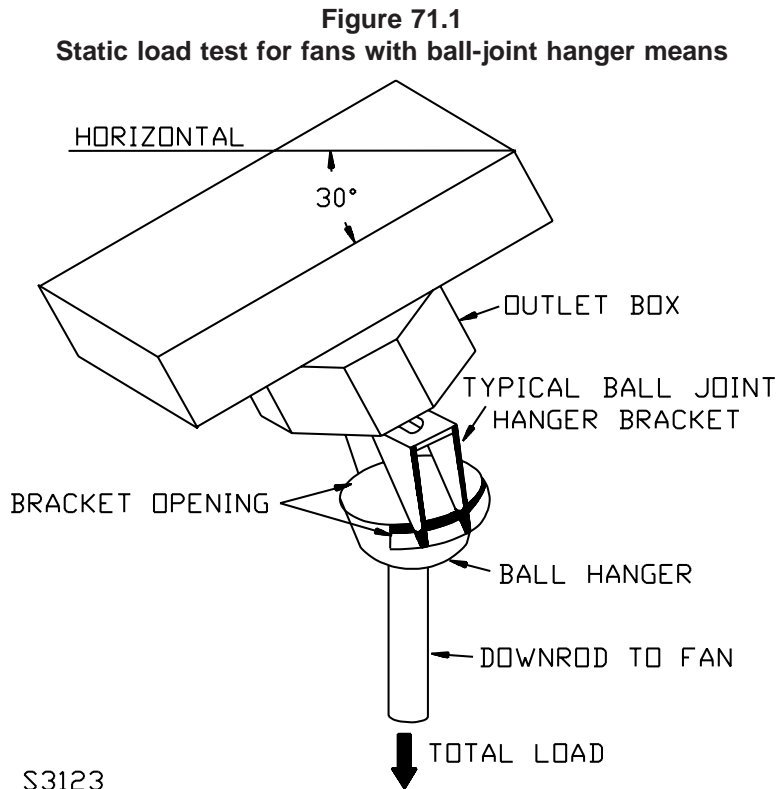
71.1.1.3 The mounting means of a fan is to be installed in accordance with the installation instructions provided by the manufacturer. The other parts of the fan are not to be installed. A static load of four times the maximum possible weight of the fan and accessories (including the considerations mentioned in 118.4) is to be gradually applied and then supported for one minute by the installed mounting means.

#### 71.1.2 Fans with ball-joint hanger means

71.1.2.1 After being tested as described in 71.1.2.2, a ball-joint hanger means shall comply with the requirements in 71.1.1.1. When a fan employs a polymeric ball-joint mounting means, the polymeric parts of the hanger are to be conditioned as described in 71.2.2.1 and 71.2.2.2 before testing in accordance with 71.1.2.2.

71.1.2.2 A mounting means for a fan provided with a ball-joint hanger means is to be mounted in accordance with the manufacturer's instructions using the mounting means provided with the fan. The mounting means is to be subjected to a static load of four times the weight of the fan and all accessories for 7 hours. The load is to be applied so as to transmit the maximum stress to the mounting means. Mounting angle A illustrated in Figure 71.1 is to be 30 degrees; however, the mounting angle may be less than 30 degrees, but not less than 10 degrees, if so recommended in the installation instructions. The load angle is to be in the direction of the hanger bracket opening. If the installation of a canopy could affect test results, the canopy is to be installed in accordance with the installation instructions.

71.1.2.2 revised February 21, 2003



## 71.2 Fans with polymeric mounting means

### 71.2.1 General

71.2.1.1 Three samples of a ball-joint hanger means incorporating polymeric material shall be installed on the down rods as intended for the ball hanger and shall be tested as described in 71.2.1.2.

71.2.1.2 The samples are to be subjected to the temperature conditioning test of 71.2.2. After the temperature conditioning test, one sample is to be subjected to the endurance test of 71.2.3, and one sample is to be subjected to the static load test of 71.1.2.

## 71.2.2 Temperature conditioning test

71.2.2.1 As a result of the conditioning described in 71.2.2.2, there shall be no softening, cracking, warping, or other deterioration that decreases the integrity of the polymeric mounting means.

71.2.2.2 Three samples of the polymeric mounting means are to be conditioned for seven hours at 0°C (32°F). For damp or outdoor location ceiling-suspended fans, low temperature conditioning is to be conducted at minus 35.0 ±1.0°C (minus 31 ±1.8°F). The same three samples are then to be conditioned for seven hours in an air-circulating oven maintained at a temperature of 70°C (158°F). The samples are to be cooled to room temperature.

## 71.2.3 Endurance test

71.2.3.1 After being tested as described in 71.2.3.2, the means used to prevent rotation or twisting between the fan assembly and the hanger assembly shall not be damaged such that it permits rotation or twisting between the assemblies.

71.2.3.2 The same sample of the ceiling-suspended fan, and a sample of the polymeric mounting means that has been conditioned in accordance with 71.2.2.2, are to be mounted in accordance with the manufacturer's instructions. The fan is to be connected to a 60-hertz electrical supply adjusted to the appropriate nominal test voltage specified in Table 31.1. The fan is then to be subjected to 1000 cycles of operation. For a reversible fan, each cycle of operation is to consist of throwing the switch in one direction, allowing the blade to reach full operating speed in that direction; then, without a pause, throwing the switch to the position in which rotation is reversed, allowing the blade to reach full operating speed in that direction. For a unidirectional fan, each cycle of operation is to consist of starting the fan, allowing the blade to reach full maximum operating speed, shutting off the fan, allowing the blade to come to a complete stop.

## 71.2A Polymeric blades

71.2A.1 Following the conditioning described in 71.2A.3 – 71.2A.6, the polymeric blade-bracket assembly, consisting of a blade attached to the blade brackets, of a ceiling-suspended fan intended for damp locations:

- a) Shall not show any signs of blade cracking including the area around the screwholes;
- b) Shall not result in the reduction of the minimum blade height allowed on the final installation due to blade warpage; and
- c) The specific range or ranges marked on the rangehood as indicated in 99.1.5.1 and 99.1.5.2.

*Exception: If the input values are within ±10 percent of the before-conditioning values determined in Section 36, the Temperature Test need not be conducted.*

Added 71.2A.1 effective February 21, 2005

71.2A.2 The polymeric fan blades in the as-received condition are to be installed on their corresponding brackets with the flathead screws tightened to a maximum torque of 2.82 N-m (25 lbf-in.).

Added 71.2A.2 effective February 21, 2005

71.2A.3 The polymeric blade with bracket assemblies then is to be conditioned at  $0 \pm 1.0^{\circ}\text{C}$  ( $32 \pm 1.8^{\circ}\text{F}$ ) for 7 hours. Following this conditioning, the assemblies are to be allowed to return to room temperature (a minimum of 4 hours).

Added 71.2A.3 effective February 21, 2005

71.2A.4 The assemblies are then to be conditioned at  $50.0 \pm 1.0^{\circ}\text{C}$  ( $122 \pm 1.8^{\circ}\text{F}$ ) at a relative humidity of 80 percent for 7 hours and allowed to return to room temperature (a minimum of 4 hours). See 71.2A.5. This sequence described in 71.2A.3 and 71.2A.4 constitutes one cycle.

Added 71.2A.4 effective February 21, 2005

71.2A.5 Immediately following the conditioning described in 71.2A.4, before allowing the samples to return to room temperature, the screws are to be tightened to the torque value applied in 77.1.2.

Added 71.2A.5 effective February 21, 2005

71.2A.6 The cycle described in 71.2A.3 and 71.2A.4 is to be repeated twice for a total of 3 cycles.

Added 71.2A.6 effective February 21, 2005

### 71.3 Fan blade brackets

#### 71.3.1 Static load test for ceiling-suspended fan blade brackets

71.3.1.1 A blade bracket to be used on a ceiling-suspended fan shall be subjected to the static load test described in 71.3.1.2. As a result of the load, the bracket shall have no cracks as determined by visual inspection with a 4-power magnifying glass.

71.3.1.2 The mounting feet of the blade bracket are to be fixed by a support, vise, or other securing means. The bracket is to be oriented as intended for actual use as illustrated in Figure 71.2. After securing the bracket mounting feet, a crossbar is to be secured across the top of the two outermost blade mounting holes. The load is to be suspended from the center of the crossbar for one minute as illustrated in Figure 71.2. The combined weight of the crossbar, load, and means of load suspension is to be in accordance with Table 71.1.

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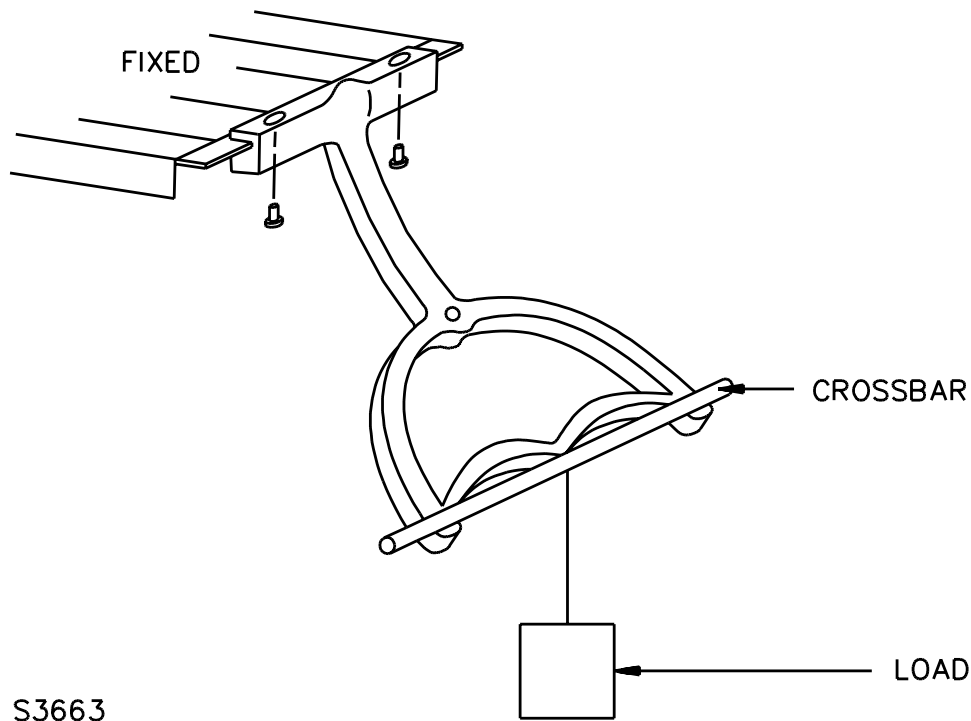
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**Table 71.1**  
**Static loads for blade brackets**

Diameter of ceiling fan <sup>a</sup>	Total static load on sample blade bracket <sup>b</sup>
Less than 1.14 m (45 inches)	9.07 kg (20 pounds)
1.14 m (45 inches) or greater	15.88 kg (35 pounds)

<sup>a</sup> Fan blade span.  
<sup>b</sup> Includes weight of crossbar and means of load suspension.

**Figure 71.2**  
**Static load test for fan blade brackets**



### 71.3.2 Dynamic load test for ceiling-suspended fan blade brackets

71.3.2.1 A blade bracket to be used on a ceiling-suspended fan shall be subjected to the dynamic load test described in 71.3.2.2 – 71.3.2.4. As a result of the test, the bracket shall have no cracks as determined by visual inspection with a 4-power magnifying glass.

71.3.2.2 The fan blades and blade brackets are to be installed on the test fan in accordance with the manufacturer's installation instructions. The fan blade length and fan speed are to be considered so as to test the fan and blade combinations that represent the most severe dynamic forces that are induced by the 10 gram (0.022 pounds) imbalance described in 71.3.2.3.

71.3.2.3 A 10 gram (0.022 pounds) flat weight is to be secured to the fan blade that will result in the most change in the vertical distance of the blade imbalance. The weight is to be secured to the fan blade at the outermost point from the center of the fan, but not on the edge of the fan blade.



71.3.2.4 The fan is to be operated at maximum normal speed rpm for 24 hours. A reversible fan is to be operated in the upward airflow direction.

## 72 Marking

72.1 A ceiling-suspended fan shall be marked where readily visible during installation of the fan with the word "CAUTION" and the following or the equivalent: "To Reduce The Risk Of Injury To Persons, Install Fan So That The Blade Is At Least 3.05 Meters (10 Feet) Above The Floor."

*Exception: A fan constructed in accordance with the Exception to 70.2.1 shall either be marked as 2.1 m (7 feet) or 3.05 m (10 feet).*

72.2 A ceiling-suspended fan which is intended to be supported solely by an outlet box in accordance with 70.1.2(a) shall be permanently marked with the word "WARNING" and the following or equivalent wording: "To Reduce The Risk Of Fire, Electric Shock, Or Personal Injury, Mount To Outlet Box Marked (a) And Use Mounting Screws Provided With The Outlet Box. Most Outlet Boxes Commonly Used For The Support of Luminaires Are Not Acceptable For Fan Support And May Need To Be Replaced. Consult A Qualified Electrician If In Doubt." This marking shall be readily visible during installation. The warning shall also be marked on the carton. See 72.7. Refer to Table 72.2 for appropriate outlet box marking.

72.2 revised February 21, 2003

72.3 A cord-connected ceiling-suspended fan as mentioned in 70.3.1 shall be marked with the following or the equivalent:

- a) Commercial or Industrial Fans are marked "For Commercial or Industrial Use Only," or Agricultural Fans are marked "For Use in Agricultural Buildings"; and
- b) "Do not use an extension cord with this fan."

72.4 When a ceiling-suspended fan having provision for installation of an optional, field-installed light kit has leads to be used in the installation, the leads shall be marked or identified as lamp supply leads.

*Exception: The leads are not required to be marked or identified when they are the only electrical parts exposed when installing the kit.*

72.5 For a ceiling-suspended fan intended to be mounted to the building structure, the mounting bracket shall be marked "WARNING – Support Directly From Building Structure." The marking shall be located on the downward facing side of the mounting bracket and may be on a non-permanent label such as a tag or any type of removable label. The warning shall also be marked on the carton. See 72.7.

72.6 For a ceiling-suspended fan provided with two forms of mounting means in accordance with 70.1.2(b), the mounting bracket shall be marked "WARNING – To Reduce The Risk Of Fire, Electric Shock, Or Personal Injury, Mount To Outlet Box Marked (a) And Use Mounting Screws Provided With The Outlet Box and/or Support Directly From Building Structure." The marking shall be located on the downward facing side of the mounting bracket and may be on a non-permanent label such as a tag or any type of removable label. The following or equivalent warning shall be marked on the carton: "WARNING – Risk Of Fire, Electric Shock, Or Personal Injury. The Fan In This Box May Be Either Directly Supported From A Structural Framing Member Of A Building And/Or May Be Mounted To An Outlet Box

Marked (a). Most Outlet Boxes Commonly Used For The Support of Luminaires May Not Be Acceptable For Fan Support And May Need To Be Replaced. Consult A Qualified Electrician If In Doubt." . Where (a) is the outlet box marking per Table 72.2.

72.6 revised February 21, 2003

72.6.1 When the maximum ampere rating for a permanently connected ceiling suspended fan is more than 50 percent of the rating of the branch circuit to which the ceiling suspended fan is intended to be connected, it shall be marked with the following or the equivalent: "Connect Only To A Dedicated Branch Circuit." It shall also be marked on the carton. See 72.7.

Added 72.6.1 effective February 21, 2005

72.7 A marking which is required to be located on a carton containing a ceiling-suspended fan shall:

- a) Be located on at least one outside surface other than the bottom. The outside surface of a carton for a ceiling-suspended fan is capable of being any side excluding the bottom or may be the top of the carton. When the top of the carton consists of two flaps, the marking is not prohibited from being located only on one flap and the smallest dimension of the carton panel is the size of the flap with the marking; and
- b) Appear in lettering not less than the height specified in Table 72.1. The minimum lettering height applies to the capital letters.

72.7 revised February 21, 2003

**Table 72.1**  
**Lettering height**

Table 72.1 revised February 21, 2003

Smallest dimension of the carton panel to be marked in mm (inches)		Minimum height of capital lettering in mm (inches)
More than	Less than or equal to	
0	152 (6)	3.2 (1/8)
152 (6)	254 (10)	4.8 (3/16)
254 (10)	–	6.4 (1/4)

**Table 72.2**  
**Outlet Box Marking**

Table 72.2 added February 21, 2003

Fan Weight	Required Marking
15.9 kg (≤ 35 lbs.)	"Acceptable for Fan Support"
22.7 kg (≤ 50 lbs.)	"Acceptable for Fan Support of 22.7 kg (50 lbs.) or less"
31.8 (≤ 70 lbs.)	"Acceptable for Fan Support of 31.8 kg (70 lbs.) or less"

### 73 Installation Instructions

73.1 The important safety instructions for ceiling-suspended fans shall include the word "WARNING" and the following or equivalent wording: "To Reduce The Risk Of Personal Injury, Do Not Bend The Blade Brackets When Installing The Brackets, Balancing The Blades, Or Cleaning The Fan. Do Not Insert Foreign Objects In Between Rotating Fan Blades."

73.2 The installation instructions for a ceiling-suspended fan shall indicate the method to be used for mounting the fan in accordance with 70.1.2.

73.3 For a ceiling-suspended fan that is intended to be secured to the ceiling by a single screw and is provided with a reversing switch, or has a starting torque that tends to unscrew its single mounting screw, the installation instructions shall indicate that:

- a) A lubricant should not be used on the single mounting screw; and
- b) The pilot hole should be drilled no larger than the minor diameter of the mounting screw threads, and at least 38 mm (1-1/2 inches) of the threaded part of the mounting screw should be secured into a structural wood joist to provide secure mounting.

73.4 The installation instructions for a ceiling-suspended fan intended to be mounted by a "J" hook shall warn against risk of fire, electric shock, or injury to persons that results from improper installation, and include instructions to attach the chain or locking bar required by 70.1.3.

73.5 Recommendations for the pilot hole for mounting screws shall be provided with the installation instructions. The instructions shall specify that a single "J" hook mounting shall have means to prevent rotation after assembly to the joist through the center of the ceiling box if it is employed with a reversible fan or a fan that operates in a manner that tends to loosen the screws. Reference to this information shall be in accordance with 73.3.

73.6 The installation instructions for a fan which is intended to be supported solely by an outlet box in accordance with 70.1.2(a) shall state "WARNING" and the following or equivalent wording: "To Reduce The Risk Of Fire, Electric Shock, Or Personal Injury, Mount To Outlet Box Marked (a) And Use Mounting Screws Provided With The Outlet Box." Where (a) is the outlet box marking per Table 72.2.

73.6 revised February 21, 2003

73.7 The installation instructions for a ceiling-suspended fan shall include the information in (a) – (g):

- a) A diagram showing the fan, intended mounting means, and ceiling outlet box with fan canopy covering the outlet box;
- b) A statement that the installation is to be in accordance with the National Electrical Code, ANSI/NFPA 70-1999 and local codes;
- c) A warning to make sure power is off before attempting installation;
- d) Instructions that after making the wire connections, the wires should be spread apart with the grounded conductor and the equipment-grounding conductor on one side of the outlet box and the ungrounded conductor on the other side of the outlet box;
- e) Instructions that the splices after being made should be turned upward and pushed carefully up into the outlet box;

- f) Instructions for supply connections: conductor of a fan identified as grounded conductor to be connected to a grounded conductor of power supply, conductor of fan identified as ungrounded conductor to be connected to an ungrounded conductor of power supply, conductor of fan identified for equipment grounding to be connected to an equipment-grounding conductor; and
- g) All instruction sheets shall indicate fan model designation or model series.

73.8 A ceiling-suspended fan which is intended to be supported solely by an outlet box shall have instructions to check that the outlet box is securely installed in place such that it is able to support at least the fan weight.

73.8 revised February 21, 2003

73.9 Swag kit, light kit, and external motor controller instructions shall not be included unless they are part of the kit that has been investigated for the purpose. Reference may be made in the fan instructions pertaining to proper light or controller accessories by model designation or that they are accessories that have been investigated and found acceptable for use with the fan and that instructions packed with such are to be followed during the installation of the accessory.

73.10 There shall be no illustration of a hanger bracket mounted directly to a ceiling joist, unless located within or over a ceiling outlet-box.

*Exception: This requirement does not apply to swag-connected fans and swag kits investigated for the purpose.*

73.11 There shall be no illustration of an equipment-grounding lead of a fan connected to a ceiling outlet-box.

73.12 All circuit diagrams shall indicate switching in the ungrounded circuit conductor.

73.13 Instructions shall not include illustrations of hanger assemblies that have not been investigated with the fan.

73.14 When a remote "on-off" wall switch is specified for fan control, instructions shall indicate that the switch used shall have been investigated and found acceptable for use as a general-use switch, as a speed control, or the like.

73.15 The installation instructions for a ceiling-suspended fan shall include the total weight of the fan plus any accessories packaged with the fan.

*Exception: The weight is not required to be in the instructions for ceiling-suspended fans that are mounted directly to the building structure.*

73.16 If an accessory is not packaged with the ceiling-suspended fan, the installation instructions for the accessory shall include the weight of the accessory.

## DAMP LOCATION CEILING-SUSPENDED FANS

### 74 General

74.1 In addition to the applicable requirements in Part 1 of this Standard, a ceiling-suspended fan that is intended for use in damp locations shall also comply with the requirements in Sections 69 – 73, and 136.3. Damp location ceiling-suspended fans are suitable for installation in interior locations protected from weather and subject to moderate degrees of moisture, such as some basements, barns, cold storage warehouses, and similar locations, and also partially protected locations such as under canopies, marquees, roofed open porches, and similar locations.

74.1 revised September 24, 2001

### 75 Construction – Protection Against Corrosion

75.1 All inside and outside surfaces of sheet steel or other mechanical parts of iron or steel shall be zinc coated, cadmium plated, enameled, painted, or provided with equivalent protection against corrosion on all surfaces.

*Exception: Punched holes and cut edges in ferrous material are not required to be protected against corrosion.*

75.2 Hinges, bolts, and fasteners made of ferrous materials shall be protected against corrosion as described in 75.1.

*Exception: Hinge pins are not required to be provided with protection against corrosion.*

75.3 Sheet steel or other metal that is painted to comply with 75.1 shall be properly cleaned of grease and the like prior to painting.

75.4 Welds in iron or steel (other than stainless steel) shall be painted or provided with equivalent protection against corrosion. Copper, aluminum, alloys of copper and aluminum, stainless steel, and similar materials having inherent resistance to atmospheric corrosion are not required to be provided with additional protection against corrosion.

75.5 Vitreous enamel may be used as the only protective coating for sheet steel having a thickness of 0.66 mm (0.026 inch) or more.

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## 76 Construction – Electrical

76.1 Nonabsorptive electrical insulation shall be used in the construction of electrical components where it is relied upon to provide electrical spacings or sole support of live electrical parts or as electrical insulation. Untreated fiber is an example of material that shall not be used; while treated cellulosic fiber, phenolic, urea, porcelain, and the like, are examples of acceptable nonabsorptive materials.

76.2 A screw shell in a screw shell type lampholder shall not be made of unplated aluminum.

## 76A Construction – Exposure to Sunlight (Ultraviolet Radiation)

76A.1 Polymeric enclosures and fan blades shall comply with the requirements in 136.3.

76A.1 added September 24, 2001

## 77 Performance

### 77.1 Polymeric blades

77.1.1 Following the conditioning described in 77.1.3 – 77.1.6, the polymeric blade-bracket assembly, consisting of a blade attached to the blade brackets, of a ceiling-suspended fan intended for damp locations:

- a) Shall not show any signs of blade cracking including the area around the screwholes;
- b) Shall not result in the reduction of the minimum blade height allowed on the final installation due to blade warpage; and
- c) Shall not result in unacceptable blade warpage as determined by compliance with the Temperature Test, Section 36, using the entire appliance with the conditioned blade-bracket assemblies installed.

*Exception: If the input values are within  $\pm 10$  percent of the before-conditioning values determined in Section 36, the Temperature Test need not be conducted.*

77.1.2 The polymeric fan blades in the as-received condition are to be installed on their corresponding brackets with the flathead screws tightened to a maximum torque of 2.82 N-m (25 lbf-in.).

77.1.3 The polymeric blade with bracket assemblies then is to be conditioned at minus  $35.0 \pm 1.0^\circ\text{C}$  (minus  $31 \pm 1.8^\circ\text{F}$ ) for 7 hours. Following this conditioning, the assemblies are to be allowed to return to room temperature (a minimum of 4 hours).

77.1.4 The assemblies are then to be conditioned at  $50.0 \pm 1.0^\circ\text{C}$  ( $122 \pm 1.8^\circ\text{F}$ ) at a relative humidity of 80 percent for 7 hours and allowed to return to room temperature (a minimum of 4 hours). See 77.1.5. This sequence described in 77.1.3 and 77.1.4 constitutes one cycle.

77.1.5 Immediately following the conditioning described in 77.1.4, before allowing the samples to return to room temperature, the screws are to be tightened to the torque value applied in 77.1.2.

77.1.6 The cycle described in 77.1.3 and 77.1.4 is to be repeated twice for a total of 3 cycles.

## **77.2 Polymeric ball-joint hanger means**

77.2.1 Low temperature conditioning is to be conducted at minus  $35.0 \pm 1.0^\circ\text{C}$  (minus  $31 \pm 1.8^\circ\text{F}$ ) for 7 hours for the polymeric ball investigation for damp location ceiling-suspended fans.

## **78 Marking**

78.1 A ceiling-suspended fan that complies with the requirements in Sections 74 – 77 and that is intended for use in damp locations shall be marked "Suitable For Use In Damp Locations".

## **79 Installation Instructions**

79.1 A damp location ceiling-suspended fan shall not be provided with any information either on the carton or with the appliance that implies or depicts an outdoor use.

79.2 A damp location ceiling-suspended fan that has provision for installation of a light kit and is marked in accordance with 78.1 shall also be provided with the installation instructions that state "Use Only With Light Kits Marked Suitable For Use In Damp Locations."

## **WET LOCATION CEILING-SUSPENDED FANS**

### **80 General**

80.1 In addition to the applicable requirements in Part 1 of this Standard, a ceiling-suspended fan that is intended for use in wet locations shall also comply with the requirements in Sections 69 – 73, Sections 76 – 79, 136.2 and 136.3. A wet location ceiling-suspended fan is suitable for installation in locations which are unprotected and exposed to weather.

80.1 revised September 24, 2001

### **81 Construction**

#### **81.1 Corrosion protection**

81.1.1 All inside and outside surfaces of a wet location ceiling-suspended fan shall comply with the outdoor corrosion protection requirements described in 135.2.1 – 135.2.5.

81.1 renumbered as 81.1.1 September 24, 2001



## 81.2 Fan blades

81.2.1 The polymeric blades of a wet location ceiling-suspended fan shall comply with:

- a) The requirements specified in Section 77; and
- b) 720 hours of exposure to ultraviolet radiation in accordance with the Ultraviolet Light Exposure Test (UV) in the Standard for Polymeric Materials – Use In Electrical Equipment Evaluations, UL 746C.

70.2.4 revised and relocated as 81.2.1 September 24, 2001

## 82 Performance

82.1 A wet location ceiling-suspended fan is to be assembled and mounted in accordance with the manufacturer's installation instructions. The fan is to be mounted to an outlet box acceptable for fan support. The outlet box is to be recessed and mounted to the "six-inch" side of a 4 by 6 wood beam. The outlet box is to be sealed such that no water enters the outlet box.

82.2 A wet location ceiling-suspended fan shall be subjected to the Water Spray Test of Section 38. The fan is to be subjected to the water spray for 4 hours in the direction most likely to cause water to enter. During the water spray, the fan is to be energized for 1 hour in the upward airflow direction, 1 hour in the downward airflow direction, and then de-energized for 2 hours. For ceiling-suspended fans which operate in only one airflow direction, the fan shall be energized for 2 hours and then de-energized for 2 hours during the water spray.

## 83 Marking

83.1 A ceiling-suspended fan that complies with the requirements in Sections 80 – 82 and that is intended for use in wet locations shall be marked where visible during installation with the following or equivalent: "Suitable for use in wet locations when installed in a GFCI protected branch circuit."

## 84 Installation Instructions

84.1 A wet location ceiling-suspended fan that has provisions for installation of a light kit and is marked in accordance with 83.1 shall also be provided with installation instructions that state "Use only with light kits marked 'Suitable for use in wet locations'."

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## CEILING-SUSPENDED FAN LIGHT KITS

### 85 General

85.1 In addition to the applicable requirements in Part 1 of this Standard, a ceiling-suspended fan light assembly shall comply with the requirements specified in Sections 86 – 89. Also see 5.1 and 5.4. The ceiling-suspended fan light kit shall also comply with the applicable requirements in the Standard for Luminaires, UL 1598.

85.1 revised February 21, 2003

### 86 Construction

86.1 A light kit shall be so constructed that when it is added to a ceiling-suspended fan, the combination does not create a risk of fire or electric shock. See 70.4.1.

86.2 The installation of a light kit shall be restricted to an arrangement that is accomplished mechanically by means of common household tools such as pliers or screwdrivers and electrically by means of plug-in connectors to receptacles provided on the appliance. However, an installation using splices with wire connectors such as wire nuts is not required to have plug-in connections to receptacles.

86.3 A light kit that is shipped disassembled or shipped separately from the fan shall be provided with all hardware, including wire connectors such as wire nuts, necessary to install the light to the fan.

86.4 The screw shell of each lampholder shall be provided with a lead identified for connection to the grounded conductor of the power supply. This lead shall be finished to show a white or gray color and shall be readily distinguishable from the other lead or leads. The supply leads shall have a minimum free length of 152.4 mm (6 inches). A shorter length shall only be used when longer leads increase the risk of fire, electric shock, or personal injury.

86.4 revised February 21, 2003

86.5 A switch provided for the control of a light kit having an incandescent lamp, and not integral with the lampholder, shall have a current rating at least the maximum current that it controls as determined in accordance with 22.5, and shall be a switch acceptable for the control of tungsten-filament lamps.

*Exception: This requirement does not apply to a switch rated at 3 amperes or more and used only for the control of a single candelabra-base lamp.*

86.6 For a light kit intended to be mounted to a fan having a power-supply cord, the fan shall have a 3-wire power-supply cord. One wire shall be the equipment grounding conductor.

86.7 A light kit intended for use in a damp location shall comply with the applicable requirements in Sections 74 – 79.

86.8 A light kit intended for use in a wet location shall comply with the applicable requirements in Sections 80 – 84.

## 87 Performance

87.1 As part of the investigation, a kit shall be trial-installed to determine that installation is feasible and that the instructions are detailed and correct.

87.2 With the fan installed in accordance with the manufacturer's installation instructions, the ceiling-suspended fan light kit shall comply with the requirements specified in the following tests: Continuity of Grounding Circuit Test, Section 33; Input Test, Section 35; Temperature Test, Section 36; Locked Rotor Test, Section 40; and Dielectric Voltage Withstand Test, Section 37.

87.3 With the fan installed in accordance with the manufacturer's installation instructions, the wet location ceiling-suspended fan light kit shall comply with the requirements specified in the following tests: Continuity of Grounding Circuit Test, Section 33; Input Test, Section 35; Temperature Test, Section 36; Locked Rotor Test, Section 40; Dielectric Voltage Withstand Test, Section 37; and Water Spray Test, Section 82.

## 88 Marking

88.1 When shipped separately from the fan, each light kit shall be marked with the organization responsible for the product and a distinctive catalog number or equivalent identification.

88.2 When shipped separately from the fan, the light kit shall be marked to indicate the combined electrical input rating of the fan and the light kit. The input marking may be included on the fan when the light kit is packaged with the fan. The marking on the fan, the light kit, or both may be in the form of a recommendation to add the lamp wattage to the fan to determine total input wattage. The marking may be indicated in terms of maximum lamp wattage included in the ratings of the fan.

88.3 A permanent marking shall be provided indicating the maximum lamp wattage to be used. This marking shall be visible during relamping.

*Exception: This marking is not required when the light kit complies with all test requirements with:*

- a) The maximum wattage lamp or lamps that fit in the diffuser or diffusers; and*
- b) The smallest commonly available diffuser or diffusers.*

88.4 When shipped separately from the fan, a light kit intended for use in a damp location shall be marked "Suitable For Use In Damp Locations".

88.5 When shipped separately from the fan, a light kit intended for use in a wet location shall be marked "Suitable for use in wet locations."

88.6 A light kit that is shipped separately from the fan shall be provided with a cautionary statement indicating which fan models are appropriate for use with the light kit. This cautionary statement shall be provided in one of the following forms:

- a) The light kit and the carton in which the light kit is sold shall be marked with the word "CAUTION" and the following or equivalent wording: "To Reduce The Risk Of Fire And Electric Shock, Install Light Kit Only On Ceiling-Suspended Fan Models Specified In The Installation Instructions Included In This Carton." The marking on the light kit shall be permanent and shall be visible during installation. (Also see 89.3.)

b) The light kit is marked with the word "CAUTION" and the following or equivalent wording: "To Reduce The Risk Of Fire And Electric Shock, This Light Kit Should Be Used Only With The Fan Models Specified Below:

Models \_\_\_\_\_ Manufactured By Company \_\_\_\_\_.

Models \_\_\_\_\_ Manufactured By Company \_\_\_\_\_."

The marking on the light kit shall be permanent and shall be visible during installation.

88.7 A light kit marked in accordance with 88.6(b) shall be provided with a carton marking that consists of the word "CAUTION" and the following or equivalent wording: "To Reduce The Risk Of Fire And Electric Shock, Install Light Kit Only On Ceiling-Suspended Fan Models Specified On The Light Kit." The fan light kit is not required to be provided with the installation instructions described in 89.3.

## 89 Installation Instructions

89.1 Installation instructions shall be packaged with a light kit which provide sufficient information to enable the light kit to be mounted and connected to the fan as intended.

89.2 The instructions shall include the word: "CAUTION" and the following or equivalent wording: "To Reduce The Risk Of Electric Shock, Disconnect The Electrical Supply Circuit To The Fan Before Installing Light Kit." The statement shall precede all others relating to the installation.

89.3 When a light kit is shipped separately from the fan as described in 88.6(a), the installation instructions packaged with the light kit shall include a statement consisting of the word "CAUTION" and the following or equivalent wording: "To Reduce The Risk Of Fire And Electric Shock, This Light Kit Should Be Used Only With The Fan Models Listed Below:

Models \_\_\_\_\_ Manufactured By Company \_\_\_\_\_.

Models \_\_\_\_\_ Manufactured By Company \_\_\_\_\_."

89.4 The installation instructions for a light kit shall include the weight of the light kit.

## FANS FOR USE IN COOKING AREAS

### 90 General

90.1 In addition to the requirements in Part 1 of this Standard, a fan that is intended for use in cooking areas shall comply with the requirements in Sections 91 – 93. Also see 5.1 and 5.3.

### 91 Construction

#### 91.1 Motor

91.1.1 The motor of a fan intended for use in a cooking area shall either:

- a) Be located so that it is not in the air stream; or
- b) Be constructed so that accumulation of grease on the motor windings does not occur – such as by use of a totally enclosed motor as specified in 2.3.8, or by encapsulation of the windings in a material that is resistant to grease; or
- c) Comply with the requirements in 92.1.1.

#### 91.2 Duct-connection fitting

91.2.1 The duct-connection fitting or adaptor for a fan for use in cooking areas shall be provided with the fan when the fitting:

- a) Is of unusual size or shape; and
- b) Must be installed so that the grease-laden air stream does not contact electrical parts.

#### 91.3 Enclosures and guards

91.3.1 A reusable metal filter is acceptable as a guard on the intake side of the fan.

91.3.2 The unobstructed distance to a part capable of causing injury to persons shall be not less than 25.4 mm (1 inch) for an opening on the intake side of a fan. When the unobstructed distance to such a part is 25.4 mm or more, the requirements of Table 8.1 apply.

*Exception: A part that is mounted less than 25.4 mm from the opening meets the intent of the requirement only when it cannot be contacted by the probe illustrated in Figure 8.2.*

91.3.3 Neither side of a fan for use in cooking areas is required to be guarded when:

- a) The manufacturer makes available a guard or reusable metal filter complying with the requirements in this Standard; or
- b) The fan is marked as specified in 93.2.

91.3.4 Non-metallic enclosures shall comply with the requirements in sub-section 6.3, Non-metallic enclosures, and Section 7, Flame Spread Requirements for Non-metallic Enclosures and Other Parts of Permanently Connected Equipment.

91.3.5 Non-metallic, including wood, parts other than the enclosure shall comply with the requirements in sub-section 6.4, Non-metallic parts other than enclosures, and Section 7, Flame Spread Requirements for Non-metallic Enclosures and Other Parts of Permanently Connected Equipment.

Revised 91.3.5 effective February 21, 2005

91.3.5A A non-metallic, including wood, part mounted less than 762 mm (30 inches) from the cooking surface, shall be completely separated from the cooking surface by a metal barrier.

*Exception: A part other than the enclosure complying with the requirements of 91.3.5 – 91.3.8 need not be completely separated from the cooking surface by a metal barrier.*

Added 91.3.5A effective February 21, 2005

91.3.6 Luminaire lenses shall have a flame spread rating of zero in accordance with UL 723, the Standard for Tests for Surface Burning Characteristics of Building Materials.

*Exception: Each luminaire lens rated HB or less flammable in the thickness in which it is used in the fan, and that does not form any part of the enclosure of an air handling compartment, is not required to have a flame spread rating of zero when the total area of all lenses is not more than 0.09 m<sup>2</sup>(1 square foot).*

91.3.6 revised February 21, 2003

91.3.7 The total volume of polymeric material for a grille, impeller, damper, and lenses that does not form any part of the enclosure of an air handling compartment, and which are all rated HB or less flammable in the thickness in which it is used in the fan, shall not exceed 295 cm<sup>3</sup>(18 cubic inches).

*Exception: The total volume of polymeric material is not limited when all parts have a flame spread rating of zero.*

91.3.8 The total volume of polymeric material for a grille, impeller, damper, and lenses that does not form any part of the enclosure of an air handling compartment, and which are all rated V-1 or less flammable in the thickness in which it is used in the fan, shall not exceed 1967 cm<sup>2</sup>(120 cubic inches).

*Exception: The total volume of polymeric material is not limited when all parts have a flame spread rating of zero.*

## 91.4 Receptacles

91.4.1 A convenience receptacle intended for general use shall not be provided on any fan in a cooking area.

## 91.5 Filters

91.5.1 A filter employed in a fan intended for use in cooking areas shall be either a Class 1 or Class 2 filter. See 29.3.

*Exception: A filter composed entirely of metal does not have to comply with this requirement.*

91.5.1 revised February 21, 2003

## 91.6 Cord-connected rangehoods

91.6.1 A cord-connected rangehood shall be limited to residential use only.

91.6.1 added September 24, 2001

91.6.2 A cord-connected rangehood shall be provided with a length of attached flexible cord and an attachment plug for connection to the supply circuit. The type of flexible cord shall be in accordance with 91.6.4, or shall have such properties that it is at least equally serviceable for the application. The length of attached cord shall be within the limits indicated in 91.6.5.

91.6.2 added September 24, 2001

91.6.3 The flexible cord shall be rated for use at a voltage not less than the rated voltage of the rangehood, and shall have an ampacity not less than the current rating of the rangehood. The blade configuration of the fittings shall be such that the rangehood can be connected to the proper supply source (voltage, phase, and the like).

91.6.3 added September 24, 2001

91.6.4 For cord-connected rangehoods, the cord type shall be one of the following: HS, HSO, HSJ, HSJO, S, SE, SO, SOO, ST, STO, STOO, SJ, SJO, SJOO, SJT, SJTO, or SJTOO.

91.6.4 added September 24, 2001

91.6.5 The length of a rangehood cord shall not be less than 3 ft (0.9 m) and shall not be more than 4 ft (1.22 m), and shall be measured external to the appliance and include the fittings, while excluding the blades on the attachment plug. The length of a detachable cord set is to be measured from the face of the rangehood plug to the face of the attachment plug, excluding the blades on the attachment plug.

91.6.5 added September 24, 2001

91.6.6 A rangehood intended for use with a detachable cord set shall have male pins that comply with Table 55.1 of UL 498 , Attachment Plugs and Receptacles. The general purpose configurations of Figures C1.1 – C1.38 of UL 1681 , Wiring Device Configurations, shall not be used.

91.6.6 added September 24, 2001

91.6.7 The female appliance coupler of the detachable power supply cord shall mate with the male inlet provided on the rangehood. The detachable cord set shall be shipped with the rangehood and shall comply with UL 817 , Cord Sets and Power-Supply Cords.

91.6.7 added September 24, 2001

91.6.8 The attachment plug of a power supply cord for a cord-connected rangehood shall be of the grounding type.

91.6.8 added September 24, 2001



91.6.9 A cord-connected rangehood rated 125 volts or 125/250 volts (3-wire) or less, and employing a lamp- or element-holder of the Edison screw-shell type, or a single-pole switch or overcurrent-protective device other than an automatic control without a marked "off" position shall have one terminal or lead identified for the connection of the grounded conductor of the supply circuit. The terminal or lead so identified shall be the one that is electrically connected to the screw shell of a lamp- or element-holder but to which shall not be connected a single-pole switch or single-pole overcurrent-protective device, other than an automatic control without a marked "off" position.

91.6.9 added September 24, 2001

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91.6.10 A flexible power supply cord for a cord-connected rangehood shall not be smaller than 18 AWG (0.82 mm<sup>2</sup>).

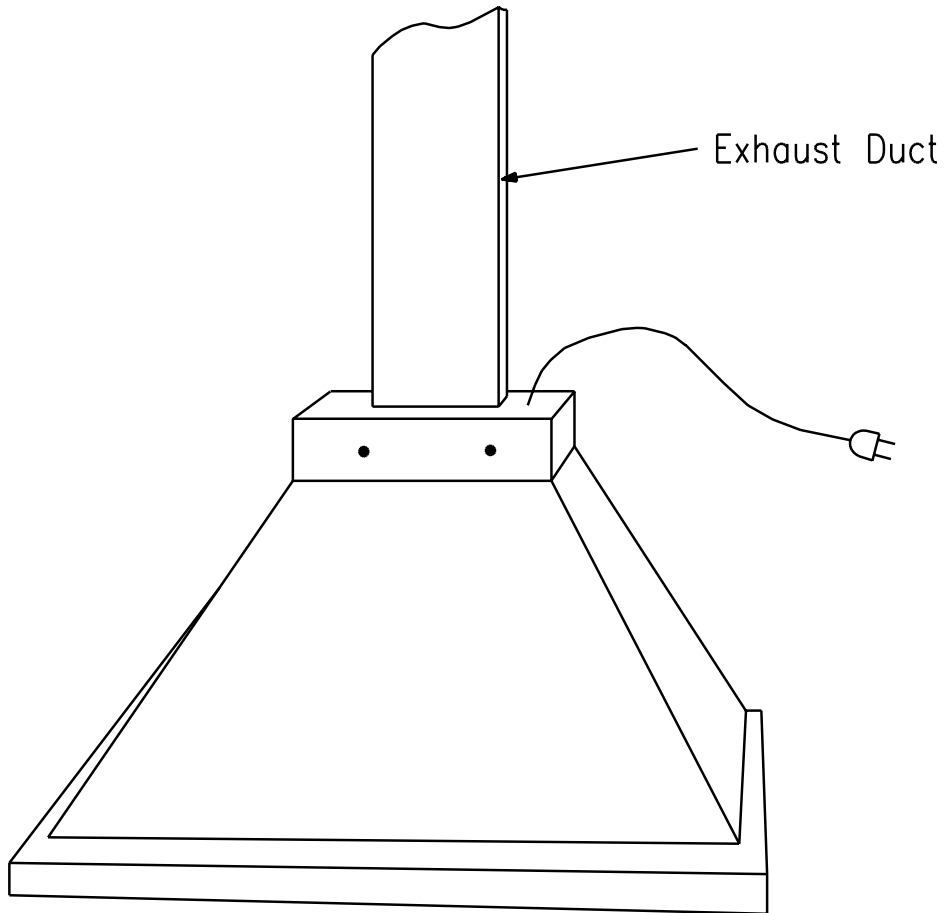
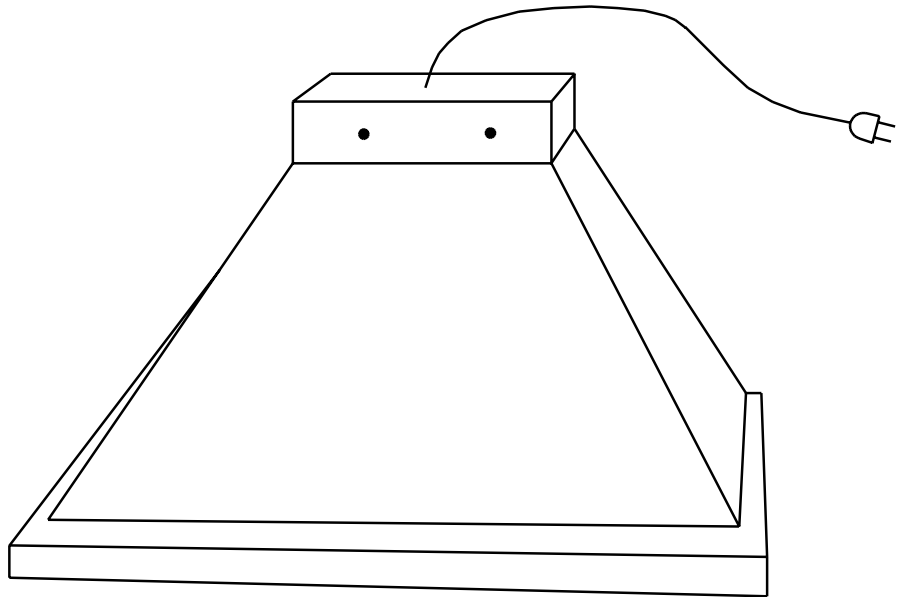
91.6.10 added September 24, 2001

91.6.11 A flexible power supply cord for a cord-connected rangehood shall vertically exit the top-most horizontal surface of the rangehood. See Figure 91.1.

91.6.11 added September 24, 2001

**Figure 91.1**  
**Rangehood with power supply cord exiting top-most vertical surface**

Figure 91.1 added September 24, 2001



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91.6.12 A cord-connected rangehood shall be tested in accordance with Section 32, Leakage Current Test; Section 33, Continuity of Grounding Circuit Test; Section 42, Strain Relief Test; and Section 44, Push Back Relief Test.

91.6.12 added September 24, 2001

91.6.13 A knot shall not be employed to provide strain relief for cord-connected rangehoods.

91.6.13 added September 24, 2001

## 91.7 Rangehood cord-connection kits

91.7.1 A rangehood cord-connection kit shall comply with the requirements in 91.7.2 – 91.7.8.

91.7.1 added September 24, 2001

91.7.2 For a rangehood cord-connection kit, the cord type shall be one of the following: HS, HSO, HSJ, HSJO, S, SE, SO, SOO, ST, STO, STOO, SJ, SJO, SJOO, SJT, SJTO, or SJTOO.

91.7.2 added September 24, 2001

91.7.3 A rangehood cord-connection kit shall be provided with strain relief.

91.7.3 added September 24, 2001

91.7.4 A knot shall not be employed to provide strain relief for rangehood cord-connection kits.

91.7.4 added September 24, 2001

91.7.5 A rangehood cord-connection kit that is provided with strain relief that complies with the component requirements in UL 635 , the Standard for Insulating Bushings, shall be factory installed on the cord and shall comply with Section 42, Strain Relief Test, Section 44, Push Back Relief Test, and the installation test of 92.6.1. Any other means shall comply with Section 42, Strain Relief Test, when installed in accordance with Section 93A, Installation Instructions for Rangehoods and Cord-Connection Kits.

*Exception No. 1: The strain relief is not required to be factory installed when the strain relief can be safely and reliably installed mechanically by means of common household tools such as pliers or screwdrivers.*

*Exception No. 2: The strain relief is not required to be factory installed when the tool(s) required for proper installation is provided with the rangehood cord-connection kit.*

91.7.5 added September 24, 2001

91.7.6 All component parts of the rangehood cord-connection kit shall be provided with the kit.

*Exception: Small parts commonly available for the mounting of the rangehood and the rangehood cord-connection kit are not required to be provided when the rangehood cord-connection kit instructions specify these parts for mounting.*

91.7.6 added September 24, 2001

91.7.7 As part of the investigation, a rangehood cord-connection kit shall be tested and trial-installed to determine that installation is feasible, that the instructions are detailed and correct, and that the use of the rangehood cord-connection kit does not introduce a risk of fire or injury to persons. See 92.6.1.

91.7.7 added September 24, 2001

91.7.8 The identified (neutral) lead of the power supply cord for a rangehood cord-connection kit shall be white, natural gray, or shall have three (3) continuous white stripes.

91.7.8 added September 24, 2001

## 91.8 Light assemblies

91.8.1 An appliance intended for use in a cooking area and employing a light shall comply with the applicable requirements of this standard and with the applicable requirements in the Standard for Luminaires, UL 1598.

91.8.1 added December 23, 2003

## 92 Performance

### 92.1 General

92.1.1 A motor as specified in 91.1.1 shall be subjected to the grease-conditioning test specified in 92.2.1. A motor employing an insulation system that has moisture-absorption characteristics is to be subjected to the tests specified in 92.3.1 and 92.4.1.

92.1.1 revised December 23, 2003

92.1.2 Any material with a moisture absorption value greater than 1.62 percent (see the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A, the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B, and the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C), and used as an insulating material between film-coated wires, between uninsulated live parts of opposite polarity, or between uninsulated live parts and dead or grounded metal parts shall comply with the tests specified in 92.3.1 and 92.4.1.

92.1.3 When a motor is tested as specified in 92.2 – 92.4:

- a) There shall be no noticeable change or deterioration of the motor insulation with respect to accessibility, mechanical strength, or the like;
- b) There shall be no dielectric breakdown or arc-over when subjected to the dielectric voltage-withstand test specified in 37.1, except that the potential is to be applied between current-carrying parts and aluminum foil wrapped tightly over the motor assembly; and
- c) The insulation resistance of the motor shall be no less than 50,000 ohms between live parts and interconnecting dead metal parts. Charring or discoloration of the insulation is acceptable unless the insulation flakes or rubs off when rubbed with thumb or finger pressure.

## 92.1A Temperature test for rangehoods

92.1A.1 Household rangehood fans or fans intended for use over an eye-level oven shall not reach a temperature at any point sufficiently high to cause deterioration of any materials used or to exceed temperature rises specified in Table 36.1 when tested as described in 92.1A.2 – 92.1A.5.

Added 92.1A.1 effective February 21, 2005

92.1A.2 Household canopy or hood type fans, intended for use over an eye-level oven, shall be tested with the specified (marked on nameplate) cooking unit, or shall be tested with a heating unit as follows:

- a) The fan unit shall be mounted and operating as intended above a representative heat source having a 3300 W broil (upper) element and a 3000 W bake (lower) element controlled by a thermostat and a door that may be closed or held open 10 cm (3.9 inch), and with the oven venting through one of the rear elements or the back splash;
- b) The test shall be conducted in a wooden alcove with the back and one side extending 1.8 m (5.9 feet) above the floor;
- c) The fan temperature test shall be conducted with the heat source set for a “bake” temperature of 232°C (445°F) and the oven door closed until steady temperatures are reached in the fan unit; and
- d) The test shall be continued with the “broil” setting, and the door opened 10 cm, until steady temperatures are again obtained in the fan unit.

Added 92.1A.2 effective February 21, 2005

92.1A.3 Household range-hood fans, intended for use over a built-in surface unit, or free-standing range, shall be tested with the specified (marked on nameplate) cooking unit, or shall be tested with the heating unit described in 92.1A.2, which also has three 1250 W surface elements and one 2100 W surface element, as follows:

- a) The fan unit shall be mounted and operated with the marked clearance above the cooking surface;
- b) The test shall be conducted in the wooden alcove described in 92.1A.4; and
- c) The cooking unit shall be operated under the conditions specified in 92.1A.2 and 92.1A.5.

Added 92.1A.3 effective February 21, 2005

92.1A.4 The cooking unit referred to in 92.1A.3 shall be located in an alcove formed by three surfaces of 9.5 mm (0.37 inch) fir plywood painted a dull black color and placed in a vertical position to comply with the following:

- a) One surface shall extend from the floor to a height of 1.8 m (5.9 feet) at the back of the range and have a width at least equal to that of the range;
- b) One surface, on one side of the range, shall extend from the floor to a height of 1.8 m, and from the back to but not beyond the front of the range; and
- c) All surfaces shall be spaced 12.5 mm (0.5 inch) from the vertical sides of the range body; or in contact with projections on the range that extend 12.5 mm or more beyond the range body.

*Exception: An alcove is not required when testing rangehoods which are only intended for installation above a kitchen island's cooking unit as specified in the manufacturer's installation instructions.*

Added 92.1A.4 effective February 21, 2005

92.1A.5 The cooking unit referred to in 92.1A.3 shall be operated under the following conditions:

- a) Pans containing water placed on the surface heater elements shall:
  - 1) Be constructed of sheet steel at least 1.02 mm (0.04 inch) thick;
  - 2) Have flat bottoms and vertical sides with radius of curvature at the junction of sides and bottom not exceeding 9.5 mm (0.37 inch); and
  - 3) Have a bottom plane surface diameter not less than the diameter of the active part of the surface heater element on which the pan is placed and not more than 25 mm (1 inch) larger than that diameter.
- b) The depth of water shall be maintained at not less than 25 mm in each pan; sufficient water shall be used at the start of the test to maintain the minimum depth without addition; and
- c) Each surface heater element switch shall be turned to the position giving maximum temperature setting for 15 minutes, and then turned to a position giving a temperature setting nearest to half, until constant temperatures are reached.

Added 92.1A.5 effective February 21, 2005

## 92.2 Grease conditioning

92.2.1 Three samples of a motor are to be completely coated with a minimum 3.2-mm (1/8-inch) thick layer of lard and placed for 30 days in a forced-draft air-circulating oven maintained at a temperature of 150°C (302°F). At the end of the conditioning, each sample shall comply with the requirements in 92.1.3.

## 92.3 Oven and humidity conditioning

92.3.1 At the end of the second conditioning cycle specified below, each sample shall comply with the requirements specified in 92.1.3. Three samples of a motor shall be placed for 7 hours in a forced-draft air-circulating oven maintained at a temperature of 100°C (212°F). At the end of 7 hours, the samples are to be removed from the oven and conditioned for 48 hours in air having a relative humidity of 88 ±2 percent and a temperature of 32.0 ±2.0°C (89.6 ±3.6°F). The cycle is then to be repeated.



## 92.4 Grease and humidity conditioning

92.4.1 At the end of the conditioning period specified below, each sample shall comply with the requirements specified in 92.1.3. Three samples of a motor are to be conditioned for 48 hours in air having a relative humidity of  $88 \pm 2$  percent at a temperature of  $32.0 \pm 2.0^\circ\text{C}$  ( $89.6 \pm 3.6^\circ\text{F}$ ). After the humidity conditioning, each sample is to be subjected to the grease conditioning specified in 92.2.1.

92.4.2 A coil winding having insulating material that is affected by moisture shall have an insulation resistance of not less than 50,000 ohms between current-carrying parts and interconnected noncurrent-carrying parts after exposure for 48 hours to air having a relative humidity of  $88 \pm 2$  percent and a temperature of  $32 \pm 2^\circ\text{C}$  ( $90 \pm 4^\circ\text{F}$ ). See 92.4.1.

## 92.5 Tests for cord-connected rangehoods

92.5.1 Cord-connected rangehoods shall be tested in accordance with Section 32, Leakage Current Test; Section 33, Continuity of Grounding Circuit Test; Section 42, Strain Relief Test; and Section 44, Push Back Relief Test.

92.5.1 added September 24, 2001

## 92.6 Tests for rangehood cord-connection kits

92.6.1 A rangehood cord-connection kit is to be subjected to an installation test in which the kit is to be assembled and installed in accordance with the manufacturer's instructions. The rangehood shall function in the intended manner and shall comply with the tests in 92.6.2.

92.6.1 added September 24, 2001

92.6.2 A rangehood cord-connection kit shall be installed in accordance with the manufacturer's instructions and then tested in accordance with Section 32, Leakage Current Test; Section 33, Continuity of Grounding Circuit Test; Section 42, Strain Relief Test; and Section 44, Push Back Relief Test.

92.6.2 added September 24, 2001

## 92A Rating for Cord-Connected Rangehoods

92A.1 The maximum ampere rating for a cord-connected rangehood shall not be more than 50 percent of the rating of the branch circuit to which the rangehood is intended to be connected. For example, the rating shall not be more than 7.5 amperes for a 15-ampere branch circuit, or 10 amperes for a 20-ampere branch circuit.

*Exception: Where the rangehood is marked to indicate connection to an individual (dedicated) branch circuit, the maximum ampere rating shall not be more than 80 percent of the branch circuit rating based on Section 210-3, Rating, of the National Electrical Code, ANSI/NFPA 70-1999. See 93.5.*

92A.1 added September 24, 2001

### 93 Marking

93.1 A fan for use in cooking areas shall be provided with a permanent marking, in capital letters not less than 4.76 mm (3/16 inch) high for an eye-level fan and 6.35 mm (1/4 inch) high for all other fans. The marking shall be located so that it is readily visible after the fan has been installed as intended, and shall call attention to:

- a) The need for frequent cleaning of all grease from the fan and from all other grease-laden surfaces;
- b) The need for frequent removal and cleaning of any filter unit provided; and
- c) The need to exercise care when using cleaning agents or detergents.

93.1 revised February 21, 2003

93.2 A fan complying with the requirements of 91.3.3(b) shall be marked where readily visible during and after installation of the fan with the word "CAUTION" and the following or the equivalent: "To Reduce The Risk Of Injury To Persons, Install Fan So That The Blade Is At Least 2.1 Meters (7 Feet) Above The Floor."

93.3 A cord-connected rangehood and a rangehood cord-connection kit shall be plainly marked with the word "WARNING" and the following or the equivalent: "To provide protection against electric shock, connect to properly grounded outlets only." This marking is not prohibited from being in the form of a non-permanent cord tag.

93.3 added September 24, 2001

93.4 A rangehood cord-connection kit shall be marked with the manufacturer's name and a distinctive catalog number, or equivalent identification.

93.4 added September 24, 2001

93.5 When the maximum ampere rating for a cord-connected rangehood is more than 50 percent of the rating of the branch circuit to which the rangehood is intended to be connected, it shall be marked with the following or equivalent:

"Connect Only To A Dedicated Branch Circuit."

93.5 added September 24, 2001

93.6 Rangehoods shall be marked "For Residential Use Only" or the equivalent.

93.6 revised December 23, 2003

93.7 Rangehoods shall be marked with the minimum clearance distance above the cook surface.

Added 93.7 effective February 21, 2005

93.8 If the rangehood is not completely assembled when shipped from the factory, and is shipped from the factory in more the one carton, the following markings must be utilized:

- a) The rangehood shall be marked with the word "CAUTION" and the following wording "To reduce the risk of fire, install only with integral and remote blowers that are recommended for installation with this hood. See Manual Enclosed."

b) The remote or integral blower assembly must be marked "To Complete This Blower, The Hood Assembly Must Be Purchased Separately. See Hood Manual To Determine Suitability."

Added 93.8 effective February 21, 2005

### 93A Installation Instructions for Rangehoods and Rangehood Cord-Connection Kits

93A.0 The installation instructions for a rangehood intended for use with remote or integral blowers shall include the word "CAUTION" followed by the following or equivalent wording: "To Reduce The Risk Of Fire And Electric Shock, Install This Rangehood Only With Remote Blower Models Rated Maximum<sup>a</sup>(Current and/or Horsepower) Or Integral Blowers Manufactured by (Manufacturer's Name), Model(s) (Name of Appliance)." Note: <sup>a</sup> Maximum recommended remote blower rating.

*Exception: If the rangehood is not recommended for use with remote blowers the instruction can be amended to state: "CAUTION" followed by the following or equivalent wording: "To Reduce The Risk Of Fire And Electric Shock, Install This Rangehood Only With Integral Blowers Manufactured by (Manufacturer's Name), Model(s) (Name of Appliance)."*

Added 93A.0 effective February 21, 2005

93A.1 Installation instructions shall be provided with each cord-connected rangehood that describe the intended mounting and wiring of the cord-connected rangehood.

93A.1 added September 24, 2001

93A.2 Installation instructions shall be provided with each rangehood cord-connection kit that describe the intended mounting and wiring of the rangehood cord-connection kit.

93A.2 added September 24, 2001

93A.3 The installation instructions for a cord-connected rangehood and a rangehood cord-connection kit shall include the following. The word "WARNING" shall be in upper case letters.

#### "GROUNDING INSTRUCTIONS

This appliance must be grounded. In the event of an electrical short circuit, grounding reduces the risk of electric shock by providing an escape wire for the electric current. This appliance is equipped with a cord having a grounding wire with a grounding plug. The plug must be plugged into an outlet that is properly installed and grounded.

WARNING – Improper grounding can result in a risk of electric shock.

Consult a qualified electrician if the grounding instructions are not completely understood, or if doubt exists as to whether the appliance is properly grounded.

Do not use an extension cord. If the power supply cord is too short, have a qualified electrician install an outlet near the appliance."

93A.3 added September 24, 2001

93A.4 The installation instructions and packaging of a rangehood cord-connection kit shall include a statement consisting of the word "CAUTION" and the following or equivalent wording:

"To Reduce The Risk Of Fire And Electric Shock, This Rangehood Cord-Connection Kit Should Be Used Only With The Rangehood Models Listed Below:

[Brand Name]: Models \_\_\_\_\_.

[Brand Name]: Models \_\_\_\_\_.

93A.4 added September 24, 2001

93A.5 The rangehood installation instructions shall include the following or equivalent:

"Use only with rangehood cord-connection kits that have been investigated and found acceptable for use with this model rangehood."

Added 93A.5 effective September 24, 2003

93A.6 The installation instructions for a fan intended for use in cooking areas shall include, in addition to those items that apply to these products in 64A.1 – 64A.9 and the requirements specified in 64A.10, the signal word "WARNING" and the following statement verbatim: "TO REDUCE THE RISK OF FIRE, USE ONLY METAL DUCTWORK."

64A.11 relocated as 93A.6 February 21, 2003

### 93B Safety Instructions

93B.1 The important safety instructions for a fan intended for use in cooking areas shall include the following statements verbatim and in the order shown regarding the means for reducing the risk of a range top grease fire:

#### WARNING – TO REDUCE THE RISK OF A RANGE TOP GREASE FIRE:

- a) Never leave surface units unattended at high settings. Boilovers cause smoking and greasy spillovers that may ignite. Heat oils slowly on low or medium settings.
- b) Always turn hood ON when cooking at high heat or when flambeing food (i.e. Crepes Suzette, Cherries Jubilee, Peppercorn Beef Flambe').
- c) Clean ventilating fans frequently. Grease should not be allowed to accumulate on fan or filter.
- d) Use proper pan size. Always use cookware appropriate for the size of the surface element.

64.11 revised and relocated as 93B.1 effective February 21, 2005

93B.2 The important safety instructions for a fan intended for use in cooking areas, in addition to those mentioned in 93B.1, shall include the following statements verbatim and in the order shown regarding the steps to be taken in the event of a range top grease fire:

#### WARNING – TO REDUCE THE RISK OF INJURY TO PERSONS IN THE EVENT OF A RANGE TOP GREASE FIRE, OBSERVE THE FOLLOWING<sup>a</sup>:

- a) SMOTHER FLAMES with a close-fitting lid, cookie sheet, or metal tray, then turn off the burner. BE CAREFUL TO PREVENT BURNS. If the flames do not go out immediately, EVACUATE AND CALL THE FIRE DEPARTMENT.
- b) NEVER PICK UP A FLAMING PAN – You may be burned.
- c) DO NOT USE WATER, including wet dishcloths or towels – a violent steam explosion will result.
- d) Use an extinguisher ONLY if:
  - 1) You know you have a Class ABC extinguisher, and you already know how to operate it.
  - 2) The fire is small and contained in the area where it started.
  - 3) The fire department is being called.
  - 4) You can fight the fire with your back to an exit.

<sup>a</sup>Based on "Kitchen Firesafety Tips" published by NFPA.

64.12 relocated as 93B.2 February 21, 2003

## DAMP LOCATION FANS FOR USE IN COOKING AREAS

### 94 General

94.1 In addition to the applicable requirements in Part 1 of this Standard, a fan that is intended for use in a damp location cooking area shall comply with the requirements in Sections 38, 75, 76, 90 – 96, and 136.3.

94.2 A damp location fan for use in a cooking area shall be provided with means for permanent electrical connection to the power supply.

94.2 added September 24, 2001

## 95 Marking

95.1 A fan that complies with the requirements in Section 94 and that is intended for use in a damp location cooking area shall be marked where visible during installation with the following or equivalent: "Suitable for use in damp locations when installed in a GFCI protected branch circuit."

## 96 Instructions

96.1 When user servicing or cleaning operations are anticipated, the instructions shall indicate that the electrical supply source be disconnected prior to the beginning of any such servicing or cleaning operation.

96.2 A damp location fan shall not be provided with any information either on the carton or with the appliance that implies or depicts a wet location use.

## RANGEHOOD/REMOTE BLOWERS FOR USE IN COOKING AREAS

### 96A General

96A.1 In addition to the applicable requirements in Part 1 of this Standard, a roof mounted remote blower that is intended for use with a rangehood shall comply with the requirements in Sections 38, 92.1 – 92.4, 134 – 136.3, 139, and 140.

Added 96A.1 effective February 21, 2005

96A.2 In addition to the applicable requirements in Part 1 of this Standard, a non-roof mounted remote blower that is intended for use with a rangehood shall comply with 92.1 – 92.4, and Sections 139 and 140.

Added 96A.2 effective February 21, 2005

### 96B Construction

96B.1 A remote blower switch shall have a voltage, current, and horsepower rating not less than the maximum recommended remote blower rating.

Added 96B.1 effective February 21, 2005

96B.2 A remote blower solid state speed control or appliance control shall have a voltage and current rating not less than the maximum recommended remote blower rating.

Added 96B.2 effective February 21, 2005

## 96C Performance

96C.1 The temperature test for rangehoods for use with a remote blower is to be conducted without the remote blower. Blower control circuitry, such as solid state speed controls and switches, should be energized at maximum blower ratings.

Added 96C.1 effective February 21, 2005

## 96D Marking

96D.1 The rangehood shall be marked to indicate the combined electrical input rating of the rangehood and the maximum recommended remote blower rating.

Added 96D.1 effective February 21, 2005

96D.2 The rangehood shall be marked with the word "CAUTION" and the following wording: "To reduce the risk of fire, install only with integral and remote blowers that are recommended for installation with this hood. See Manual Enclosed."

Added 96D.2 effective February 21, 2005

96D.3 The remote blower assembly shall be marked "To Complete This Remote Blower, The Hood Assembly Must Be Purchased Separately. See Hood Manual To Determine Suitability."

Added 96D.3 effective February 21, 2005

## 96E Installation Instructions

96E.1 The installation instructions for a rangehood intended for use with remote or integral blowers shall include the word "CAUTION" followed by the following or equivalent wording: "To Reduce The Risk Of Fire And Electric Shock, Install This Rangehood Only With Remote Blower Models Rated Maximum<sup>(a)</sup>(Current and/or Horsepower) Or Integral Blowers Manufactured by (Manufacturer's Name), Model(s) (Name of Appliance)." Note: <sup>a</sup> Maximum recommended remote blower rating.

*Exception: If the rangehood is not recommended for use an integral blowers the instruction can be amended to state: "CAUTION" followed by the following or equivalent wording: "To Reduce The Risk Of Fire And Electric Shock, Install This Rangehood Only With Remote Blower Models Rated Maximum<sup>a</sup>(Current and/or Horsepower)."*

Added 96E.1 effective February 21, 2005

## VENTILATING-HOOD-FAN SHELVES

### 97 General

97.1 In addition to the applicable requirements in Part 1 of this Standard, a ventilating-hood-fan shelf shall comply with the requirements in Sections 98 – 102.

### 98 Construction

98.1 A single grounding type convenience receptacle intended for a microwave oven shall be provided on a ventilating-hood-fan shelf. The receptacle shall be mounted on a vertical surface, a horizontal surface above the microwave oven, or another area not susceptible to spills and accumulation of moisture and food matter. The receptacle shall be located where it is unlikely to be used when the microwave oven is unplugged.

*Exception: A convenience receptacle is not required when the installation instructions indicate that a duplex receptacle is to be installed near the ventilating-hood-fan shelf for connection of a microwave oven. See 102.5.*

98.1 revised February 21, 2003

98.2 When the electrical rating of a ventilating-hood-fan shelf exceeds 16 amperes, the receptacle circuit for a microwave oven shall have overcurrent protection rated not more than 20 amperes provided as part of the shelf to protect the microwave oven and the receptacle. The overcurrent protection shall be of a type acceptable for branch circuit protection.

98.3 A motor or power transformer in a ventilating-hood-fan shelf rated at more than 16 amperes shall be protected against short circuit and ground fault by an overcurrent device rated to protect the motor or power transformer in accordance with the National Electrical Code, ANSI/NFPA 70-1999. Such a device shall be provided as a part of the shelf unless it is determined that equivalent or better, lower current rated overcurrent protection is obtained from the branch circuit overcurrent protective device through which the shelf is supplied.

98.4 When a ventilating-hood-fan shelf includes a receptacle or a lampholder circuit, the shelf shall include a circuit breaker or fuse rated not more than 20 amperes to protect each of those circuits.

*Exception: Such a circuit breaker or fuse is not required when the ventilating-hood-fan shelf is connected in accordance with the National Electrical Code, ANSI/NFPA 70-1999, to a branch circuit rated 20 amperes or less.*

98.5 Each circuit breaker, fuse, or other overcurrent protection device in 98.3 and 98.4 shall be a type acceptable for branch-circuit protection of the ventilating-hood-fan shelf.

98.6 A motor having an inherent thermal protector that complies with the requirements for such devices complies with the requirements in 98.3 when the installed ventilating-hood-fan shelf is connected in series with a branch-circuit overcurrent protective device of the same type and has a current rating no more than that used during the tests on the motor protector combination.



98.7 An overcurrent protective device installed in a ventilating-hood-fan shelf shall not be connected in a grounded conductor unless the device opens all the supply conductors simultaneously.

## 99 Performance

### 99.1 Ventilating-hood-fan shelf temperature test

#### 99.1.1 General

99.1.1.1 A ventilating-hood-fan shelf intended for use with a microwave oven shall not reach a temperature at any point sufficiently high to cause a risk of fire, to cause deterioration of any material used, or to exceed the temperature rises specified in Table 36.1 when tested with the ventilating-hood-fan shelf installed above a range as described in 99.1.1.2 – 99.1.5.2. In addition, each microwave oven specified in the shelf marking shall not exceed the temperature rise limits specified in the Standard for Microwave Cooking Appliances, UL 923, when operated in conjunction with operation of the shelf and in accordance with the applicable temperature test requirements in UL 923.

99.1.1.2 A ventilating-hood-fan shelf and microwave oven are to be mounted together in accordance with the manufacturer's instructions above at least one of (or any combination of) the following:

- a) The standard test gas range described in 99.1.3.1 – 99.1.3.5.
- b) The standard test electric range described in 99.1.4.1 – 99.1.4.7.
- c) The specific range or ranges marked on the ventilating-hood-fan shelf. See 99.1.5.1 and 99.1.5.2.

99.1.1.3 The markings on the shelf determine which of the three options specified in 99.1.1.2 is chosen, as well as the width of the range heat source. When a standard range is chosen, the shelf is to be tested over the widest range recommended. When the widest recommended range is wider than the shelf, the shelf is also to be tested over a range of the same width as the shelf. Testing above the standard test gas range of a specified width qualifies a ventilating-hood-fan shelf for use above any electric, as well as gas, range of that width without the need for further testing.

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99.1.1.4 The test installation is to be as described in 99.1.2.1 – 99.1.2.3. The test is to be conducted in each of the applicable conditions specified in 99.1.1.5(a) – (e). Wall temperatures surrounding the gas or electric range are not required to be measured. All tests are to be continued until constant temperatures are attained.

99.1.1.5 The test is to be conducted in each of the following applicable conditions:

- a) Microwave oven, all range surface units, and the oven operating. The oven is to be set in the bake mode with the center of the oven maintained at an average temperature of 246°C (475°F).
- b) Microwave oven not operating, range surface units not operating, and the oven operating in the self-clean mode.
- c) The conditions specified in (a) and (b) with the ventilating-hood-fan shelf operating and not operating.

*Exception: The test is not required to be repeated with the fan not operating when:*

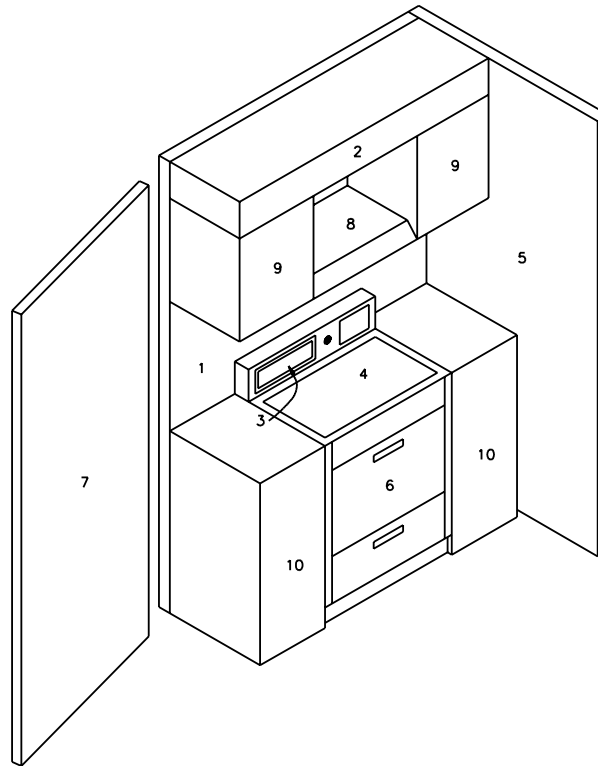
- 1) *The user cannot turn the fan "off" while the receptacle remains energized because of an automatic temperature control;*
  - 2) *The automatic temperature control withstands 100,000 cycles of intended operation without impaired performance while making and breaking the maximum rated current at rated voltage; and*
  - 3) *The control complies with the calibration requirements in the Standard for Limit Controls, UL 353, or the Standard for Temperature-Indicating and -Regulating Equipment, UL 873.*
- d) The conditions specified in (a) and (b) for each intended speed of the ventilating-hood-fan shelf.
  - e) The conditions specified in (a) and (b) in the duct position and ductless position when the fan is intended for such operation.

## 99.1.2 Test installation

99.1.2.1 The panels for the test enclosure and simulated cabinets described in 99.1.2.2 and Figure 99.1 are to consist of a single thickness of 9.52 mm (3/8 inch) plywood or other material of equivalent thermal conductivity. The inside surfaces of the enclosure and outside surfaces of the cabinets are to be painted dull black.

99.1.2.2 The walls of the enclosure are to extend at least to the top of the top building cabinet, and are to project at least 304.80 mm (12 inches) in front of the installed range or shelf. The enclosure is to be firmly assembled with 90 degree angles between the back and the side walls. The walls of the enclosure are to be located as close to the assembly as construction permits – a sliding fit. The side walls then are to be adjusted at the front until contact is established between the test enclosure and the front edges of the assembly at its widest point. See Figure 99.1.

**Figure 99.1**  
**Test enclosure for ventilating-hood-fan shelf over counter level range**



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1. Building back wall
2. Top building cabinet
3. Control panel
4. Cooking surface
5. Building side wall
6. Oven
7. Building side wall
8. Ventilating-hood-fan shelf
9. Upper side cabinet<sup>a</sup>
10. Lower side cabinet<sup>a</sup>

<sup>a</sup> Panels 9 and 10 are not normally used at the same time since the hood fan shelf width matches the range width. Panel 9 is to be used when the shelf width is less than the range width. Panel 10 is to be used when the shelf is more than the range width.

99.1.2.3 The ventilating-hood-fan shelf and range are to be installed in contact with the back wall with the shelf at the shelf manufacturer's minimum recommended height above the range top. A top building structure or cabinet is to be installed immediately above the ventilating-hood-fan shelf, or at the minimum clearance recommended by the ventilating-hood-fan shelf manufacturer to a cabinet, soffit, or the like. The top building cabinet is to be 304.80 mm (12 inches) high, a width sufficient to extend to the side walls of the test enclosure, and 330.20 mm (13 inches) deep, except that it may be of lesser depth if an integral cabinet stop is provided on the ventilating-hood-fan shelf, in which case the cabinet is to be of sufficient depth to extend to the top. When the ventilating-hood-fan shelf is narrower than the range, the fan shelf is to be centered over the range width, and upper side cabinets are to be installed on each side of the shelf to fill the spaces between the shelf sides, the test enclosure walls, and the top cabinet. The base surfaces of the upper side cabinets are to be at the same height above the range as the ventilating-hood-fan shelf base. When the ventilating-hood-fan shelf is wider than the range, the range is to be centered under the shelf width, and lower side cabinets are to be installed on each side of the range to fill the spaces between the range sides, the test enclosure walls, and the floor. The top surfaces of the lower side cabinets are to be at the same height as the range top. All cabinets are to have a solid front panel. See Figure 99.1.

### 99.1.3 Standard test gas range

99.1.3.1 The standard test gas range to be used is to have a self-cleaning oven and is to have surface burners rated 2.93 kW (10,000 Btu per hour) each and a broiler rated 4.10 kW (14,000 Btu per hour) when supplied with natural gas. A range 762 mm (30 inches) or less in width is to have four surface burners. A 914.40-mm (36-inch) wide range is to have five surface burners as described in Figure 99.2.

99.1.3.2 A stove plate is to be placed on each of the two front surface burners when a five burner range is used. When a four burner range is used, the front burner having the highest burner output is to be used. A pan of water is to cover each of the remaining surface burners.

99.1.3.3 The stove plate in 99.1.3.2 is to be circular, cast-iron or steel, 190.50 mm (7-1/2 inches) in diameter, and is to weigh approximately 1.36 kg (3 pounds). The plate is to be flat, but may be ribbed on one side to prevent warping, and it is to be free from rust and other foreign material.

99.1.3.4 The pans mentioned in 99.1.3.2 are to be of aluminum and are to have approximately vertical sides. The diameter of the bottom plane surface of each pan is to be 190.5 mm (7-1/2 inches).

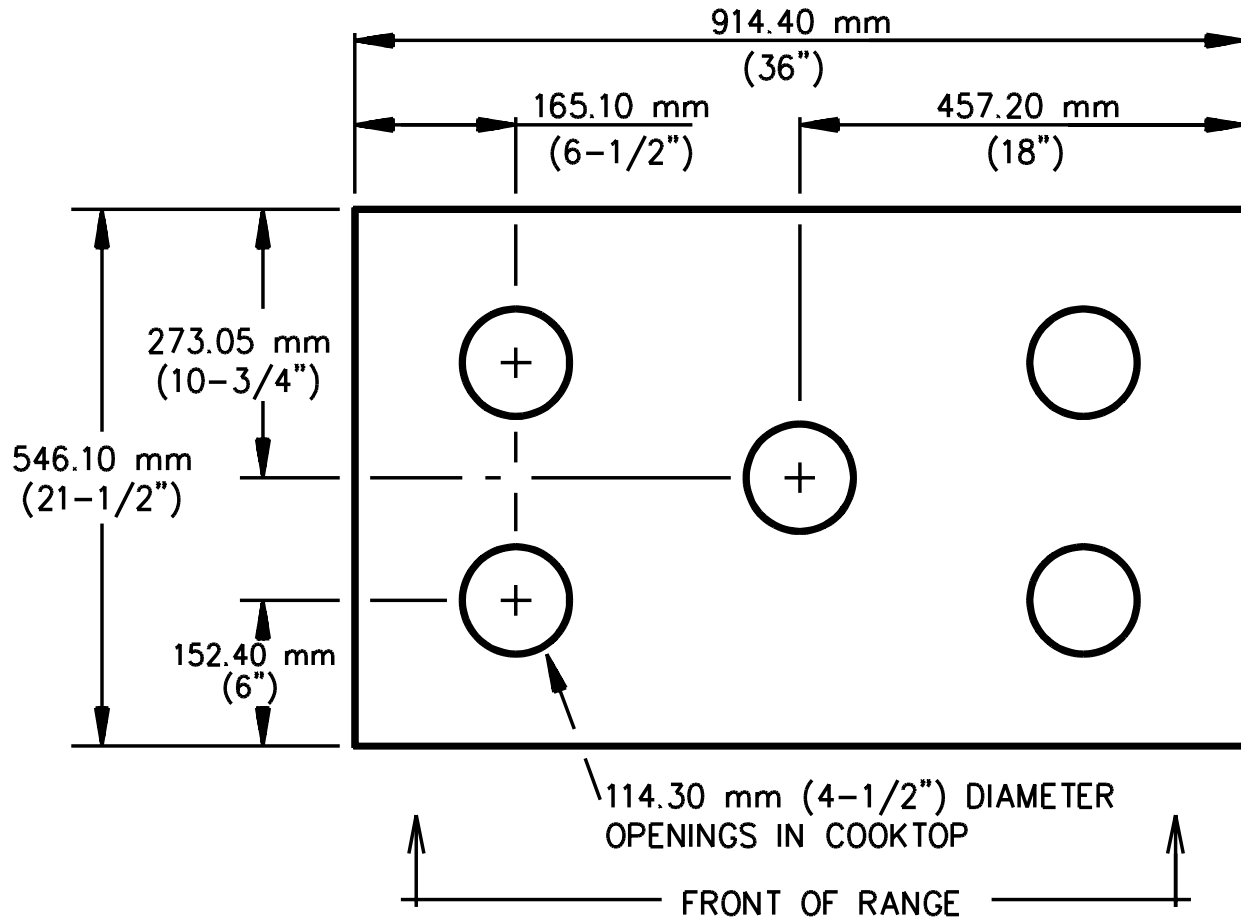
99.1.3.5 The controls for the surface burners covered with a stove plate are to be adjusted to result in a temperature of 246°C (475°F) at the center of the top surface of the stove plate. The control for each surface burner covered with a pan of water is to be adjusted at 888.68 W (3032 Btus per hour).

### 99.1.4 Standard test electric range

99.1.4.1 When a 762-mm (30-inch) wide or less standard test electric range is to be used, it is to have a self-cleaning oven and four surface elements. When a 914.40-mm (36-inch) wide standard test electric range is to be used, it is to have a self-cleaning oven, four surface elements, and a griddle.

99.1.4.2 The surface units are to consist of two, 152.40-mm (6-inch) diameter, 1200-watt minimum elements; two, 203.20-mm (8-inch) diameter, 2000-watt minimum elements; and, if applicable, a griddle. All elements are to be controlled by a cycling type control.

Figure 99.2  
Five-burner standard gas range (top view) (all dimensions nominal)



S3121A

NOTE - 63.5 mm (2-1/2") DIAMETER GAS ELEMENTS

99.1.4.3 A stove plate as described in 99.1.3.3, except that it is to be 266.70 mm (10-1/2 inches) in diameter and 3.18 kg (7 pounds) in weight, is to be placed on the front 2000 watt element. A pan of water is to be placed on each of the remaining elements. The pans are to be of aluminum and are to have approximately vertical sides. The diameter of the bottom plane surface of each pan is to be no less than the maximum diameter of the active part of the surface unit on which the pan is used, but no more than 25.4 mm (1 inch) larger than that diameter.

99.1.4.4 A control for the 2000 watt element covered with a stove plate is to be adjusted to result in a temperature of 246°C (475°F) at the center of the top surface of the stove plate. An automatic or cycling type control is to be set so that the average temperature at the center of the top surface of the stove plate is 246°C. When a control having a definite number of settings cannot be set to result in this average temperature, the surface unit is to be connected to an external power supply adjusted so that the temperature at the center of the top surface of the stove plate is 246°C.

99.1.4.5 The griddle of the 914.40-mm (36-inch) range is to be operated with its control set so that the temperature at the center of the griddle plate is closest to, but not less than, 246°C (475°F).

99.1.4.6 The control for each 1200-watt element is to be set so that the average power input is 650 watts. The control for the 2000-watt element on which a pan of water is placed is to be set so that the average power input is 833 watts.

99.1.4.7 The broil element is to be rated 3400 watts.

#### 99.1.5 Specific range

99.1.5.1 When a ventilating-hood-fan shelf is intended for use with a specific electric range or ranges, the range or ranges are to be operated as specified in the Standard for Household Electric Ranges, UL 858.

99.1.5.2 When a ventilating-hood-fan shelf is intended for use with a specific gas range or ranges, the range or ranges are to be operated using the stove plates and pans of water noted in 99.1.3.2 – 99.1.3.4. The control for the surface burner covered with a stove plate is to be adjusted to result in a temperature of 246°C (475°F) at the center of the top surface of the stove plate. The control for each burner covered with a pan of water is to be adjusted so that the power input to the burner is not less than:

- a) 50 percent of rated power input for a burner rated 1200.54 W (4096 Btu per hour) or less; or
- b) 400 watts plus 1/6 of the power rating of the burner in watts.

## 99.2 Strength of mounting test

99.2.1 During the test described in 99.2.2, the support brackets, hangers, and the like, for a ventilating-hood-fan shelf intended to support a microwave oven shall not deform, crack, break, bend, or the like, to the extent that a ventilating-hood-fan shelf or microwave oven would fall, and the shelf shall not pull out from the mounting surface.

99.2.2 The complete shelf unit is to be mounted in accordance with the manufacturer's instructions, using the brackets, hangers, and the like, that are provided with the shelf as shipped. A weight equal to four times the weight of the heaviest specified microwave oven is to be placed on the shelf for 1 hour. The weight is to be distributed evenly over the surface of the shelf provided for the microwave oven, with the center of gravity located directly above the center of the shelf surface provided for the microwave.

99.2.3 When specific wall constructions are described in the manufacturer's installation instructions, the ventilating-hood-fan shelf is to be tested with each construction.

99.2.4 When no construction is described or when the construction described does not represent expected wall constructions, then the test shall be conducted with wall constraints as follows:

a) A 9.5-mm (3/8-inch) thick trade size gypsum dry wall fastened to trade size 2 by 4 inch wood studs spaced on 406.40-mm (16-inch) centers is to be used as the support surface. The hardware is to be applied as specified in the instructions, and the mounting screws are to be positioned between the studs and secured into the gypsum dry wall. An adjustable product is to be adjusted to the position that gives the maximum projection from the wall. When the manufacturer's installation instructions indicate the mounting screws are to be secured into wood studs:

1) A shelf less than 812.80 mm (32 inches) wide is to be mounted on one side to a wood stud and on the other side to the dry wall, even when the instructions recommend securement to two studs.

2) A shelf at least 812.80 mm (32 inches) wide is to be mounted to a wood stud on each side.

b) A 12.7-mm (1/2-inch) thick trade size gypsum dry wall fastened to trade size 2 by 4 inch wood studs spaced on 609.60 mm (24 inch) centers is to be used as the support surface. The hardware is to be applied as specified in the instructions, and the mounting screws are to be positioned between the studs and secured into the gypsum dry wall. An adjustable product is to be adjusted to the position that gives the maximum projection from the wall. When the manufacturer's installation instructions indicate the mounting screws are to be secured into wood studs, then a shelf is to be mounted on the lightest side to a wood stud and on the other side to the dry wall, even if the instructions recommend securement to two studs.

### 99.3 Tipover test

99.3.1 A microwave oven installed as intended on a ventilating-hood-fan shelf shall not tip or move from the specified horizontal position during the test described in 99.3.2.

99.3.2 With a 23 kg (50 pound) weight attached to the outer edge of the open door of the microwave oven, the door is to be opened to the position that causes the greatest tendency to tip the oven. The weight is to be maintained for 1 hour.

### 100 Ratings

100.1 The current rating of a ventilating-hood-fan shelf shall include the rating of the maximum acceptable microwave oven load for the single receptacle provided as part of the shelf and intended for a microwave oven.

### 101 Marking

101.1 A ventilating-hood-fan shelf intended for use with a microwave oven shall be marked, in a location visible during installation of the microwave oven, with the following words or the equivalent, as applicable, "For use only with (manufacturer's name) (model number or numbers) microwave oven or ovens." The marking also shall be included on the shipping carton.



101.2 A ventilating-hood-fan shelf intended for use only with a specific gas or electric range or ranges shall be marked in a location visible during installation with the following words or the equivalent, as applicable, "For use only with (manufacturer's name) (model number or numbers) gas/electric range or ranges." The marking shall also be included on the shipping carton.

101.3 When a ventilating-hood-fan shelf is not intended for use only with a specific manufacturer's model range, it shall be marked to indicate the maximum width of the range over which it is intended to be used. When the shelf is intended to be used only with an electric range, it shall be marked with the following words or the equivalent, "Not for installation above gas cooking equipment." When the shelf is intended to be used above a gas or electric range, it shall be marked with the following words or the equivalent, as applicable, "Suitable for use above gas or electric cooking equipment." All markings shall be located so as to be visible during installation.

## 102 Installation Instructions

102.1 The installation instructions for a ventilating-hood-fan shelf intended for use with a microwave oven shall include the following or the equivalent, as applicable, "For use only with (manufacturer's name) (model number or numbers) microwave oven or ovens."

102.2 The installation instructions for a ventilating-hood fan shelf intended for use only with a specific gas or electric range shall include the following or the equivalent, as applicable, "For use only above (manufacturer's name) (model number or numbers) gas/electric range or ranges."

102.3 The installation instructions for a ventilating-hood fan shelf not intended for use only with specific manufacturer's model ranges shall indicate the maximum width of the range above which it is intended to be used. When the shelf is intended to be used only above an electric range, the following or the equivalent shall be included, "Not for installation above gas cooking equipment." When the shelf is intended to be used above a gas or electric range, the following words or the equivalent shall be included, "Suitable for installation above gas or electric cooking equipment."

102.4 Ventilating-hood-fan shelf installation instructions shall include the minimum recommended installation clearances between the ventilating-hood-fan shelf and:

- a) A cook surface; and
- b) A top cabinet, soffit, or the like.

102.5 The installation instructions for a ventilating-hood-fan shelf that does not employ a convenience receptacle in accordance with the Exception to 98.1 shall indicate that a duplex receptacle is to be installed near the ventilating-hood-fan shelf for connection of a microwave oven.

102.5 added February 21, 2003

## RECREATIONAL VEHICLE FANS

### 103 General

103.1 These requirements cover ventilating fans intended for permanent installation in recreational vehicles in accordance with Article 551 of the National Electrical Code, ANSI/NFPA 70-1999.

103.1.1 These requirements cover portable ventilating fans and portable ventilating fan/light combinations for use in recreational vehicles.

103.1.1 added February 21, 2003

103.2 A recreational vehicle fan rated 120 volts shall comply with the applicable requirements of Part 1 of this Standard. Requirements in Sections 104 – 107 for fans rated 24 volts or less supplement and amend the applicable requirements in Part 1.

103.3 Portable ventilating fan/light combinations shall comply with the applicable requirements of this standard and also with the applicable requirements in the Standard for Low-Voltage Lighting Fixtures for Use in Recreational Vehicles, UL 234.

103.3 added February 21, 2003

### 104 Construction

#### 104.1 Means of mounting

104.1.1 An acceptable means for permanent mounting shall be provided as determined by the Vibration Test, 105.6.1 – 105.6.4.

104.1.2 A mounting means other than bolts or screws shall be investigated to determine whether it is acceptable for the purpose. Keyhole slots for mounting screws may be provided when there is at least one round hole of appropriate size for accommodation of a permanent mounting screw.

#### 104.2 Diffusers and lenses

104.2.1 A diffuser or lens of a recreational vehicle fan shall be of a material specified in 91.3.4.

104.2.2 A diffuser, lens, or decorative part shall be securely positioned away from contact with any lamp or current-carrying part.

### 104.3 Supply connections – 24 volts or less

104.3.1 Wire leads shall be provided for connection to the source of supply.

104.3.2 The wire shall not be smaller than 18 AWG (0.82 mm<sup>2</sup>).

104.3.2 revised February 21, 2003

104.3.3 Wire leads shall also comply with the requirements in 13.4.9.

104.3.4 The terminals or pigtail leads shall be accessible for inspections through an access cover and the like without having to disassemble the fan, other than to remove a lens, diffuser, grill, or the like.

### 104.4 Wiring

104.4.1 Wire shall be stranded copper of an ampacity acceptable for the application when considered with respect to the conditions in 16.3.

104.4.2 Thermoplastic insulation on wires and rubber insulation on wires having a saturated braid shall not be less than 0.76 mm (0.030 inch) thick; neoprene insulation on wires shall be not less than 1.2 mm (3/64 inch) thick.

104.4.3 Each lead to an adjustable lampholder shall be of stranded wire and shall be of such length that adjustment of the lampholder does not transmit stress or cause damage to the lead or connection.

### 104.5 Electrical components

104.5.1 A lampholder may be a single- or double-contact bayonet-base or other type acceptable for the lamp base intended, and shall be marked in accordance with 107.2.

104.5.2 A motor shall be provided with overload protection in accordance with one of the following:

a) Thermal protection complying with the applicable requirements in UL 2111 , the Standard for Overheating Protection for Motors.

*Exception: A motor that has the impeller driven directly from its shaft need comply only with the requirements for protection during locked-rotor conditions.*

b) Impedance protection complying with the requirements in UL 2111 , the Standard for Overheating Protection for Motors. A fan in which the motor is subjected to conditions such as restricted ventilation, proximity to external source of heat, and the like, may require an additional investigation.

104.5.2 revised December 23, 2003

104.5.3 When a multispeed motor is provided with protection in accordance with the requirements in 104.5.2, the protection shall function acceptably to accomplish the intended result in each setting of the speed-control device.

104.5.4 With reference to 104.5.2, the protection shall comply with the requirements for the voltage rating marked on the motor (in series with the thermal protector during the short circuit test specified in UL 2111, the Standard for Overheating Protection for Motors), and the rating of the series fuse shall be not less than that specified in 107.1 and Table 107.1.

104.5.5 When a multispeed motor is not provided with protection in accordance with the requirements in this section, and when the protection with which the fan is provided upon installation does not function to protect the motor for one or more settings of the speed-control device, protection at each setting shall be provided as part of the fan.

104.5.6 A switch of 24 volts or less shall have current and voltage ratings in accordance with 104.5.7 and 104.5.8.

104.5.7 A switch of 24 volts or less used to control an incandescent lamp load shall have:

- a) A current rating for a tungsten filament load equal to or greater than the current measured during the Input Test described in 105.1.1; or
- b) If not rated for a tungsten filament load, a current rating at least 10 times the current measured during the Input Test.

*Exception: A switch of 24 volts or less that has been investigated and found to be acceptable for the intended use is not required to comply with the current rating requirements in (a) and (b).*

104.5.8 A switch of 24 volts or less in a fan intended for nominal 12 volt dc use shall be rated not less than 14 volts dc.

*Exception: A switch of 24 volts or less marked with the voltage rating "125 VT" is acceptable for controlling a tungsten load in a dc circuit when the current rating of the switch is not less than the load controlled.*

## **105 Performance**

### **105.1 Input test – 24 volts or less**

105.1.1 The current input of a recreational vehicle fan shall be not more than 110 percent of rated value when the appliance is operated under conditions of intended service and with the fan connected to a supply circuit of rated voltage in accordance with Table 105.1.

**Table 105.1**  
**Test potential (dc volts) to be applied**

Nominal circuit voltage	Voltage during input and temperature tests
6	7
12	14
24	28

### 105.2 Normal temperature test – 24 volts or less

105.2.1 When tested in accordance with Section 36, Temperature Test, and with the test voltages of Table 105.1, a recreational vehicle fan shall comply with the temperature rises specified in Table 36.1.

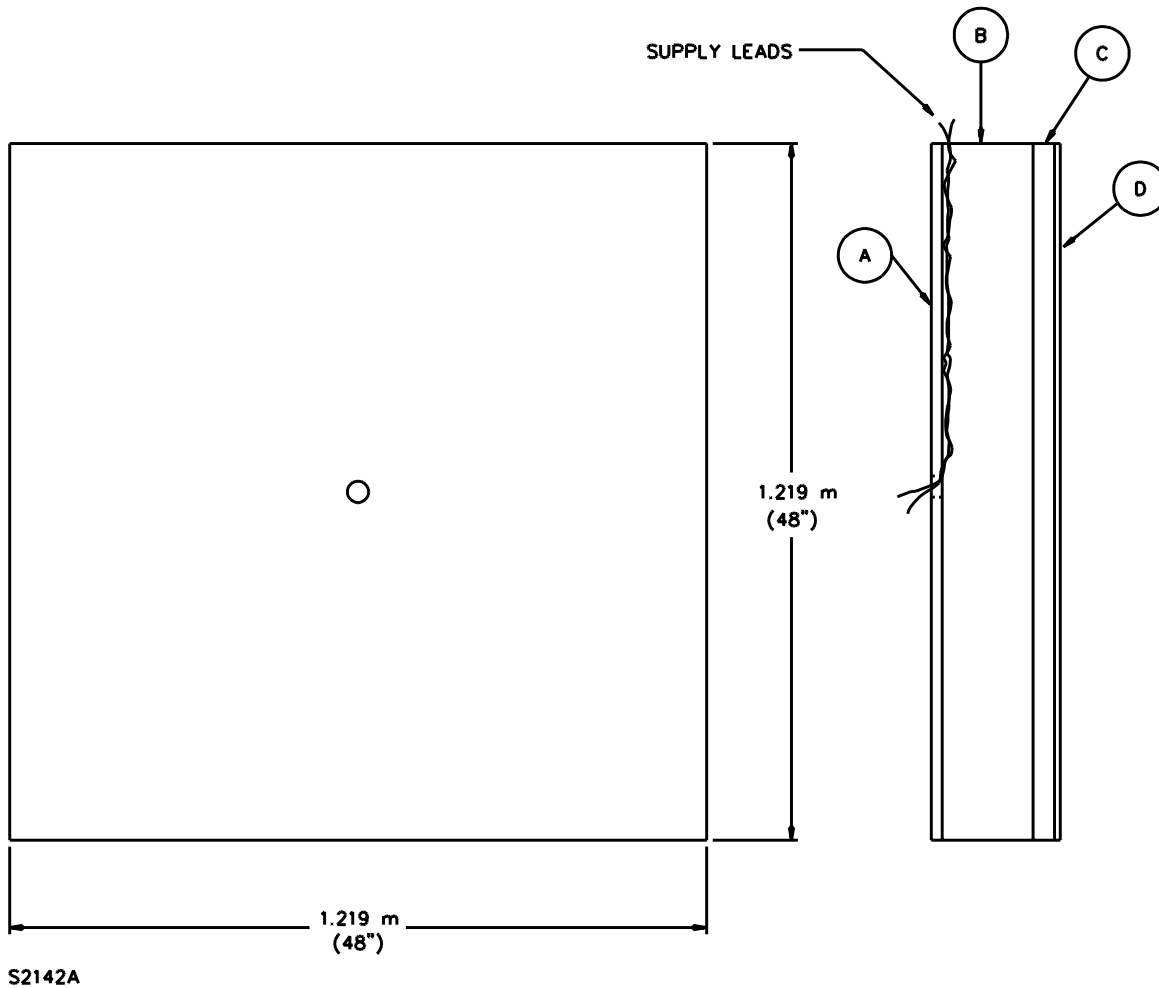
105.2.2 A fan is to be mounted to a ceiling or wall as intended by construction or in accordance with manufacturer's literature, as illustrated in Figure 105.1. If movement is possible, the fan is to be in the most severe position with respect to the enclosure and other parts of the appliance. However, if the fan is marked for a specific ceiling or wall mount structure different from that illustrated in Figure 105.1, it is to be mounted in that ceiling or wall in accordance with the manufacturer's installation instructions.

### 105.3 Dielectric voltage-withstand test – 24 volts or less

105.3.1 While in a heated condition, a recreational vehicle fan shall withstand for 1 minute without breakdown the application of a potential starting at zero and gradually increased to 500 volts direct current or 355 volts at 60 hertz and maintained at that level for 1 minute. The increase in applied potential is to be at a substantially uniform rate as rapid as is consistent with correct indication of its value by a voltmeter.

### Figure 105.1 Test ceiling

Figure 105.1 revised February 21, 2003



#### Materials:

A = Fiberboard, 6.35 mm (1/4 inch) thick.

B = Fiberglass thermal insulation, 50.8 mm (2 inches) thick.

C = Air space, 12.7 mm (1/2 inch).

D = Aluminum sheet, 0.508 mm (0.020 inch) thick.

#### Notes:

1. Supply connections to be made by two 14 AWG (2.1 mm<sup>2</sup>) leads, rated for at least 90°C (194°F), routed between thermal insulation and front panel to supply connection hole.
2. It may be necessary to cut appropriate size mounting hole for ceiling-mounted exhaust fans or wall fans.

#### 105.4 Abnormal operation test – 24 volts or less

105.4.1 The Normal Temperature Test, 105.2.1 and 105.2.2, shall be repeated with each of the test voltages as specified in Table 105.2, for 7 hours.

105.4.1 revised February 21, 2003

105.4.2 Following this test, the recreational vehicle fan shall comply with the Dielectric Voltage-Withstand Test, 105.3.1, and there shall be no indication of emission of flame or molten metal and no distortion of the material.

**Table 105.2**  
**Test voltage for abnormal operation test direct current**

Rated voltage	Minimum test voltage	Maximum test voltage
6	5.25	7.75
12	10.5	15.5
24	21.0	31.0

#### 105.5 Rain test – 24 volts or less

105.5.1 A recreational vehicle fan of the type specified in 38.1.1 shall be tested as specified in Section 38, Water Spray Tests. If the fan is to be operated during this test, the test voltages shall be in accordance with Table 105.1.

#### 105.6 Vibration test – 24 volts or less

105.6.1 A fan and its mounting means shall withstand vibration without mechanical breakdown that impairs its intended operation. The blower shall operate in its intended manner before and after the test.

105.6.2 The fan is to be secured to the vibration machine test fixture in its intended operating position in accordance with the manufacturer's installation instructions.

105.6.3 The fan is to be subjected to vibration in the horizontal, vertical, and lateral axis orientation for 4 hours in each axis at the resonant frequency of the sample. The resonant frequency is to be determined while varying the frequency from 0 to 60 hertz. The peak-to-peak amplitude is to be  $0.508 \pm 0.003$  mm ( $0.020 \pm 0.001$  inch). When two or more resonant conditions are found, the total test time is to be divided to permit testing at each resonant condition providing no test is maintained for less than 1 hour. When no resonant frequency is determined, the sample is to be tested at 55 hertz.

105.6.4 For these tests, peak-to-peak amplitude is defined as the maximum displacement of sinusoidal motion – total table displacement. Resonant frequency is defined as the maximum magnification of the applied vibration.

## 106 Manufacturing and Production Tests

### 106.1 Dielectric voltage-withstand test – 24 volts or less

106.1.1 As a routine production-line test, a recreational vehicle fan shall withstand an applied potential of 500 volts direct current or 355 volts at 60 hertz for 1 minute or 600 volts direct current or 425 volts at 60 hertz for 1 second without electrical breakdown. The potential is to be applied between live- and dead-metal parts. The test is to be conducted as specified in 58.3 – 58.7.

### 107 Marking

107.1 A recreational vehicle fan shall be marked to indicate the maximum fusing permitted that should not exceed the ampacity of the copper conductors in accordance with Table 107.1.

**Table 107.1**  
**Ampacity of conductors**

Wire size AWG (mm <sup>2</sup> ) <sup>a</sup>	Ampacity	Wire type
18 (0.82) or less	6	Stranded only
16 (1.3)	8	Stranded only
14 (2.1)	15	Stranded only
12 (3.3)	20	Stranded only

<sup>a</sup> Minimum wire size used in a fan.

107.2 The lamp trade number designation applicable to a low-voltage circuit (24 volts or less) shall be marked at a point where visible during relamping, in paint-stenciled, self-adhesive label, die-stamped or indelibly stamped capital lettering at least 1.59 mm (1/16 inch) high adjacent to each lampholder. The lamp number designation shall be expressed in the blank space in the following wording which shall include "CAUTION" and the following or equivalent: "To Reduce The Risk Of Fire, Use Lamp Trade Size \_\_\_\_\_."

107.2 revised February 21, 2003

## FANS FOR AGRICULTURAL BUILDINGS

### 108 General

108.1 A fan intended for use in a barn, a poultry house, a dairy barn, and the like, as specified in Article 547 of the National Electrical Code, ANSI/NFPA 70-1999, shall comply with the applicable requirements in Part 1 of this Standard and Sections 109 – 111. Also see 5.1.



## 109 Construction

109.1 An arcing part shall be enclosed in a corrosion-resistant enclosure having no openings and complying with the applicable outdoor use requirements specified in Section 135.

109.2 A totally enclosed motor described in 2.3.8 shall be used in a fan intended to be installed in the locations mentioned in 108.1.

109.3 Where flexibility of interconnecting wiring is required for the application, such as to permit fan adjustment, the wiring shall be installed in liquid-tight flexible metal or non-metallic conduit terminated with liquid-tight flexible metal or non-metallic conduit fittings.

109.3 revised February 21, 2003

109.4 A power supply cord shall be of the three-conductor hard usage type, minimum SJ or SJT. When the fan is intended to be used outdoors, the power supply cord shall be type SJW or SJTW.

109.5 An equipment-grounding terminal shall be provided. See 28.2.2.

## 110 Performance

110.1 The temperatures on an exposed surface shall not exceed a 60°C (140°F) rise in a 25°C (77°F) ambient temperature.

## 111 Marking

111.1 A fan intended to be used in a location mentioned in 108.1 shall be marked "For Use in Agricultural Buildings," or with an equivalent statement.

111.2 A ceiling-suspended agricultural fan that complies with 70.3.1 shall be marked with the following or equivalent: "Do Not Use An Extension Cord With This Fan."

111.3 A fan intended for use outdoors as specified in 109.4 shall be marked "Outdoor Use".

## CEILING INSERT FAN/LIGHT COMBINATIONS

### 112 General

112.1 These requirements cover two types of ceiling insert fan/light combinations, each referred to as a "unit" in Sections 112 – 116. These units, investigated and identified for installation in a cavity where they directly contact thermal insulation, include:

- a) A thermally protected Type IC ceiling insert fan/light combination; and
- b) An inherently protected Type IC ceiling insert fan/light combination constructed such that, even without a thermal protector, the unit limits temperatures at points in contact with insulation when overlamped in a manner equivalent to that of a thermally protected unit. Additionally, this unit does not depend on the fan motor to meet temperature limits.

112.2 A ceiling insert fan/light combination shall comply with the applicable requirements in Part 1 of this Standard and with the applicable requirements in Sections 113 – 116.

### 113 Construction

113.1 A thermally protected Type IC unit shall be provided with thermal protection that cycles the lamp circuit. The protector shall comply with the requirements for devices rated for control of incandescent lamps, as specified in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873.

113.2 A unit that relies on the fan motor for cooling during the Normal Temperature Test described in 114.1.1 – 114.1.11 shall have one of the following features:

- a) A thermostat as described in 113.3; or
- b) The fan and light factory-wired in parallel such that the connections are inaccessible during inspection and when making field wiring connections.

113.3 An automatic-reset overtemperature-protective device that is provided on a thermally protected Type IC unit to cycle the fan motor on and off, to regulate the temperatures during the Normal Temperature Test, shall comply with the Standard for Electrical Temperature-Indicating and -Regulating Equipment, UL 873, including the 100,000 cycle Endurance Test.

## 114 Performance

### 114.1 Normal temperature test

114.1.1 A ceiling insert fan/light combination is to be tested at the voltage described in 36.1.8 and with the lamp connected to a separate supply source to yield maximum marked lamp wattage. The test is to be conducted with the unit installed in a box filled with cellulosic insulation. The test is to be conducted at an ambient temperature of  $25 \pm 5^{\circ}\text{C}$  ( $77 \pm 9^{\circ}\text{F}$ ). The temperatures attained shall not exceed the values specified in Table 36.1.

114.1.2 During the test, a thermal protective device connected in the light circuit shall not cycle (nuisance trip). (See 113.2.)

114.1.3 A ceiling insert fan/light combination is to be mounted in a rectangular box built of 12.7-mm (1/2-inch) thick fir plywood, (a) – (d) grade. The plywood test box is to have dimensions such that each wall is 216 mm (8-1/2 inches) from the nearest point of the recessed housing, junction box, or incidental projection of the unit and the top edge of each wall is 216 mm above the height of the installed unit. The top of the box is to be open. The thickness of the surface of the box representing a ceiling is to be increased as necessary for a unit that is intended for thicker ceilings than 12.7 mm or that is adjustable to accommodate different ceiling thicknesses.

114.1.4 A hole is to be provided in the side of the box to permit an exhaust duct or hose of the size recommended in the installation instructions to exit the box. The hose is to be installed parallel to the bottom of the test box and is to be just long enough to reach through the hole. There are to be no bends in the exhaust duct or hose.

114.1.5 When a screen or shield is provided so that insulation does not contact the recessed housing, the plywood test box is to be spaced 216 mm (8-1/2 inches) from the screen or shield. The screen or shield is to be rigidly attached, and of sufficient strength to support the field-installed insulation and to withstand normal handling without reduction of intended spacings.

*Exception: The screen or shield is to be removed when it is not attached in a permanent manner such as with rivets, weldings, or a means that requires the use of tools.*

114.1.6 The interior space between the plywood box and the exterior surface of the recessed housing is to be filled with loose fill cellulosic insulation. The insulation is to be rated, conditioned, and placed as specified in 114.1.7 – 114.1.10.

114.1.7 The cellulosic insulation is to be rated for a thermal resistance of 3.75 – 3.85 R with a conditioned density of  $32.04 - 40.05 \text{ kg/m}^3$  (2.0 – 2.5 pounds per cubic foot).

114.1.8 The insulation is to be conditioned through a blowing or vacuum machine before being placed around the test fixture. The blowing or vacuum machine is to condition the insulation to the density specified in 114.1.7.

114.1.9 Insulation that has been conditioned through a blowing machine can be blown to allow it to fall into the test box around the unit or into a storage container. The insulation conditioned by a blowing machine into a storage container or by the vacuum machine into a storage container is to be placed in the test box around the unit by hand or scoop in a manner to minimize packing or settling.

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114.1.10 The insulation is to be placed into the space between the test box and unit in a uniform manner such that all areas surrounding the mounting brackets, incidental projections, and the like, are free of large air pockets or cavities. Small cavities such as 12.7-mm (1/2-inch) high spaces between the brackets and the test box are not required to be filled other than through natural filling as a result of placing the insulation around the area.

114.1.11 The test is to be conducted under each of the following conditions:

- a) Fan on – Light on
- b) Fan off – Light on

*Exception: The test is to be conducted only in the Fan on – Light on condition for a fan/light combination constructed in accordance with 113.2(b).*

## 114.2 Abnormal operation tests

### 114.2.1 Inherently protected – overlamping

114.2.1.1 An inherently protected unit connected to a supply as described in 114.1.1 and installed as described in 114.1.3 – 114.1.10 is to be operated with the largest type and wattage lamp that will physically fit into the unit with the trim and diffuser installed and positioned as intended. The test is to be conducted in the "fan off-light on" condition. The temperatures attained on parts of the unit in contact with combustible materials (for example, insulation, the test box, and unit support surfaces) after 7-1/2 hours of operation shall not exceed 90°C (194°F).

### 114.2.2 Thermally protected – overlamping

114.2.2.1 A thermally protected unit connected to a supply as described in 114.1.1 and installed as described in 114.1.3 – 114.1.10 is to be operated with a lamp as specified in Table 114.1, unless the lamp size and type cannot be physically accommodated in the lamp compartment with the trim and diffuser installed and positioned as intended. The test is to be conducted in the "fan off-light on" condition. For those units provided with a thermostat to cycle the fan motor on and off as described in 113.3, the test is to be conducted in the fan off – light on condition (with the thermostat permitted to cycle the fan) and then repeated with the fan motor out of the circuit. The temperatures attained on parts of the unit in contact with combustible materials (for example, insulation, the test box, and unit support surfaces) after 7-1/2 hours of operation shall not exceed those specified in 114.2.2.2.

**Table 114.1**  
**Lamp wattage to be used for overlamping test conditions**

Table 114.1 revised February 21, 2003

Arbitrary (Type A) <sup>a</sup>			
Lamp		Test lamp	
Rating	Size	Wattage	Size
40	A19	60	A19
60	A19	75	A19
75	A19	100	A19
100	A19	150	A21
150	A21	200	A23
200	A23	300	PS25

<sup>a</sup> If other than a Type A lamp is provided, the test lamp shall be as specified for the overlamping test for recessed fixtures in the Standard for Luminaires, UL 1598.

114.2.2.2 The supply voltage is to be adjusted to cause the lamp to operate at rated lamp wattage. The unit is to be operated until the thermal protector trips as follows:

- a) If the thermal protector operates within 3 hours, the lamp in the unit is to de-energize and temperatures attained on parts of the unit in contact with combustible materials (for example, insulation, the test box, and the unit surfaces) shall not exceed 160°C (320°F).
- b) If the thermal protector does not operate within 3 hours to de-energize the lamp in the unit, the unit is to continue to operate until the thermal protector operates or for a total of 7-1/2 hours from the start of the test, whichever occurs first. During this time the temperatures attained on parts of the unit in contact with combustible materials shall not exceed 90°C (194°F). If the thermal protector does not operate, the test is then to be reconducted with successively higher lamp wattages (unless the lamp size and type cannot be physically accommodated in the lamp compartment, thus ending the test) as specified in Table 114.1 until the protector operates as described in (a).

#### 114.2.3 Thermally protected – defeated fan motor

114.2.3.1 The tests described in 114.2.3.2 – 114.2.3.4 apply to units that rely on the fan motor for cooling during the Normal Temperature Test specified in 114.1.1 – 114.1.11.

114.2.3.2 The unit is to be connected to a supply as described in 114.1.1 and installed as described in 114.1.3 – 114.1.10 except that the fan motor is to be taken out of the circuit.

114.2.3.3 The unit is to be operated at the marked lamp wattage. The thermal protector shall operate within 3 hours, the lamp in the unit shall de-energize, and temperatures attained on parts of the unit in contact with combustible materials (for example, insulation, the test box, and the unit surfaces) shall not exceed 160°C (320°F).

114.2.3.4 The unit is then to be operated according to the underlamping test procedure outlined in Figure 114.1. The test is to be conducted at successively lower lamp wattages (Table 114.2) until one of the following conditions are met when using a lower than rated wattage lamp:

- a) The thermal protector operates within 3 hours and temperatures attained on parts of the unit in contact with combustible materials do not exceed 90°C (194°F).
- b) The thermal protector does not operate and temperatures attained on parts of the unit in contact with combustible materials do not exceed 90°C (194°F) after a test duration of 7-1/2 hours.

*Exception: When the protector operates at the rated lamp wattage before the housing and support temperatures exceed 90°C in 114.2.3.3, the underlamping procedure is not required to be conducted.*

**Table 114.2**  
**Lamp wattage to be used for underlamping test conditions**

Table 114.2 revised February 21, 2003

Arbitrary (Type A) <sup>a</sup>			
Lamp		Test lamp	
Rating	Size	Wattage	Size
200	A23	150	A21
150	A21	100	A19
100	A19	75	A19
75	A19	60	A19
60	A19	40	A19
40	A19	–	–

<sup>a</sup> When other than a Type A lamp is provided, the test lamp shall be as specified for the overlamping test for recessed fixtures in the Standard for Luminaires, UL 1598, except the rated and test lamps are to be taken in reverse order.

#### 114.2.4 Locked rotor

114.2.4.1 A ceiling insert fan/light combination, inherently protected or thermally protected, connected to a supply as described in 114.1.1 and installed as described in 114.1.3 – 114.1.10 is to be operated in the locked-rotor condition with the light on and with a lamp of the maximum rated wattage marked on the unit. There shall be no emission of flame or molten metal after 7-1/2 hours of operation. An impedance-protected motor shall also comply with the locked-rotor temperature requirements specified in 40.5.

## 115 Marking

115.1 A Type IC unit that complies with the requirements in 114.1.1 – 114.2.1.1 and 114.2.4.1 shall be marked where visible during and after installation "TYPE IC – INHERENTLY PROTECTED."

115.2 A Type IC unit that complies with the requirements in 114.1.1 – 114.1.11 and 114.2.2.1 – 114.2.4.1 shall be marked where visible during and after installation "TYPE IC – THERMALLY PROTECTED."

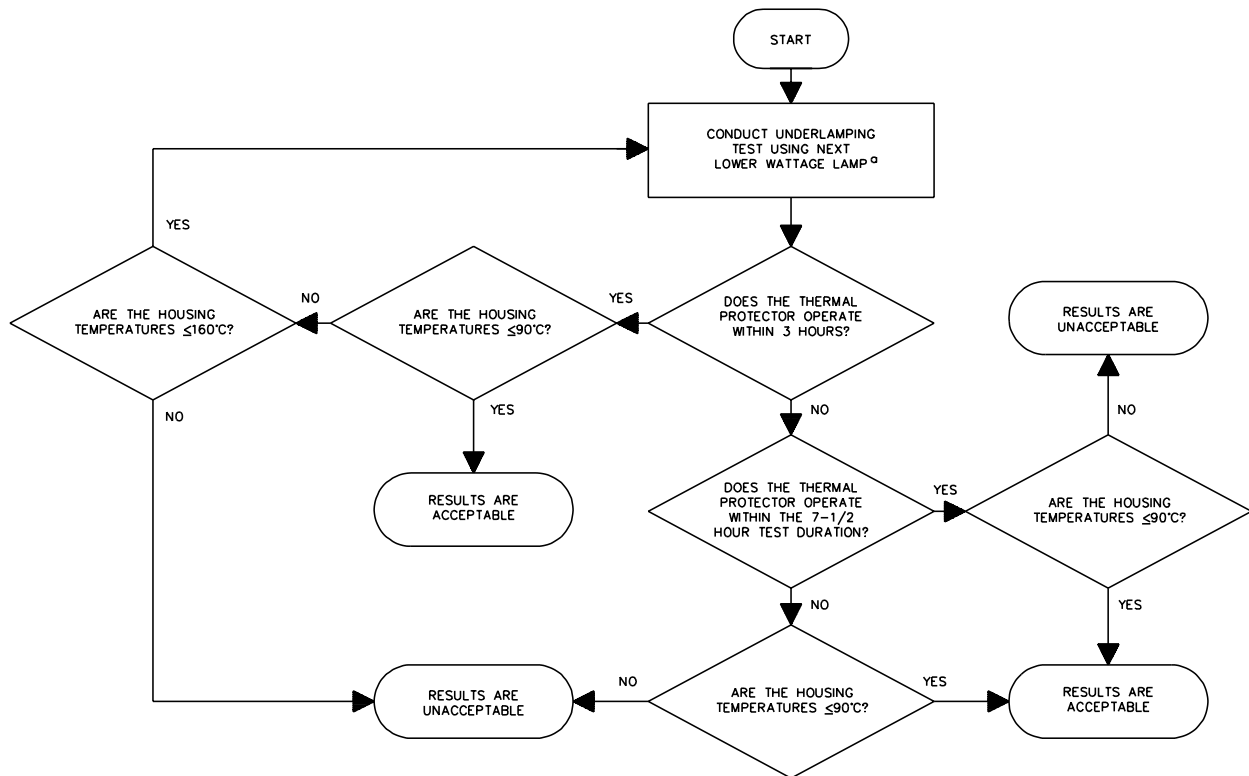
115.3 A thermally protected Type IC unit shall be marked at a point where visible during relamping "NOTICE – Blinking light may indicate: (improper lamp wattage or type, fan malfunction, or other condition causing overheating)." Conditions which result in the light blinking shall be stated in place of the phrase provided in parentheses.

115.4 A thermally protected Type IC unit provided with the device described in 113.3 to cycle the fan motor on and off to regulate the temperatures during the Normal Temperature Test shall be marked at a point where visible during relamping "NOTICE – Fan is intended to cycle when the light is on," or equivalent wording.

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**Figure 114.1**  
**Flow chart for underlamping test procedure**



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<sup>a</sup> In accordance with Table 114.2

115.5 A ceiling insert fan/light combination shall be marked where readily visible during relamping with "WARNING" and the following or equivalent wording: "(To Reduce The) Risk Of Fire, Use Only Type A Lamp(s), \_\_\_\_\_ Watts Maximum." The marked watts shall be no greater than the lamp wattage used in the normal temperature test described in Section 114. The use of the expressions in parentheses in the marking is optional.

*Exception: When other than a Type A lamp is provided, the lamp replacement marking shall be as described for recessed fixtures in the Standard for Luminaires, UL 1598.*

115.5 revised February 21, 2003

## 116 Operating and Installation Instructions

116.1 A ceiling insert fan/light combination with an automatic-reset overtemperature device as specified in 113.3 shall be provided with instructions that indicate that the fan is intended to cycle on and off to maintain normal operating temperatures.

## SWAG-MOUNTED CEILING-SUSPENDED FANS

### 117 General

117.1 A portable fan intended for suspension from the ceiling by a down rod and provided with a metal chain and a flexible cord for connection to a power supply shall comply with the applicable requirements in Part 1 of this Standard, the requirements of Sections 69 – 73, and with the requirements in Sections 118 – 120. When there is conflict between the requirements in Sections 118 – 120 and those in Part 1 and Sections 69 – 73, the requirements in Sections 118 – 120 shall apply to a swag fan.

### 118 Construction

118.1 The total length of chain shall be not less than 3.05 m (10 feet) nor more than 6.1 m (20 feet), and shall not support the fan.

118.2 The weight of a fan with any intended combination of accessories installed shall not exceed 23 kg (50 pounds).

118.3 The 23-kg (50-pound) weight limitation referred to in 118.2 shall be determined as specified in 118.4 for fans or accessories that are intended to support objects other than the fan or accessory.

118.4 With reference to the weight specification in 118.3, a fan or fan accessory that is provided with a bowl, a shelf, or a hook intended for the support of any object that is not part of the fan or fan accessory itself shall be investigated to determine the total possible weight of the installed fan, accessory, and anticipated additional loading. It is not possible to specify the conditions of possible loading of all constructions; however, the most severe conditions of anticipated use and abuse shall be considered – for example, a bowl is to be filled to capacity with dry sand and additionally filled with water.

118.5 The flexible power-supply cord of the fan shall:

- a) Extend not less than 0.305 m (1 foot) or more than 0.91 m (3 feet) beyond the end of the chain;
- b) Be not smaller than 18 AWG (0.82 mm<sup>2</sup>);

c) Have a temperature rating acceptable for the application, as determined for all fans by the maximum temperature achieved during the Temperature Test, Section 36; and

d) Be:

- 1) Type SPT-1 and provided with a separate jacket of nylon or the equivalent; or
- 2) Type SPT-2 or heavier cord.

118.5 revised February 21, 2003

118.6 When a metallic fan housing serves as the enclosure for internal wiring and splices, such wiring and splices shall be provided with supplementary insulation, rated for the temperature involved, or means shall be provided that keep the wiring from contacting the metal housing.

*Exception: This requirement does not apply to a fan provided with a cord employing an equipment-grounding conductor.*

118.7 The supplementary insulation mentioned in 118.6 may consist of woven-glass tape, close-fitting woven-glass sleeving, insulating tape or tubing not less than 0.25 mm (0.01 inch) thick.

118.8 Flexible cord that has had the outer jacket removed is regarded as internal wiring and is to be judged under the requirements in 118.6.

118.9 When a lampholder is provided, it shall have a body of insulating material.

*Exception: This requirement does not apply to a fan provided with a cord employing an equipment-grounding conductor.*

118.10 When the insulation body of a lampholder is provided with a metal nipple or tube fitting in an opening in the body wall, the inner end of the nipple or tube shall not extend inward beyond the inner surface of the lampholder body.

118.11 Polymeric insulating material used to separate dead metal parts of a lampholder or switch from a metal fan housing or chain support shall be acceptable for the temperature involved. An insulating material other than polymeric shall be investigated for the acceptability for the application.

118.12 The minimum spacings through air or over the surface between the dead metal parts of a lampholder or a switch and the metal of the fan housing or the chain support shall be not less than 1.2 mm (3/64 inch), except that a through-cord switch having exposed dead metal parts shall be located at least 38.1 mm (1-1/2 inches) from any part of the chain or metal fan housing.

*Exception: A through-cord switch having exposed dead metal parts may be located less than 38.1 mm from the metal of the fan housing or chain support when the fan is provided with a cord employing an equipment-grounding conductor.*

118.13 A swag-mounted ceiling-suspended fan shall include an equipment grounding conductor.

*Exception: A swag-mounted fan is not required to include an equipment grounding conductor when the fan is marked as specified in 119.1 and the installation instructions comply with 120.2.*

## 119 Marking

119.1 A swag-mounted fan that is not grounded shall be marked to indicate that it is not to be installed in a bathroom or kitchen.

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## 120 Installation Instructions

120.1 Installation instructions shall be provided with each fan and shall include the following:

- a) Clear instructions for the use of hardware provided;
- b) A statement that installation shall be on a joist and shall not be on a radiant-heating ceiling, nor accomplished by means of a toggle bolt; and
- c) A caution that hooks should engage the chain only and not the electric cord.

120.2 Installation instructions for a swag-mounted fan that is not grounded shall warn against mounting in a bathroom or kitchen. See 119.1.

## 121 Swag Kits

121.1 A fan to be used with a swag kit, and the swag kit, shall comply with the requirements in 117.1 – 120.1 and 121.2 – 121.6.

121.2 When strain relief is provided by the manufacturer, it shall be factory installed. Any other means such as tying a knot in a cord shall comply with the requirements specified in 121.4 and Section 42, Strain Relief.

121.3 All component parts of the swag kit shall be provided with the kit.

*Exception No. 1: Small parts commonly available for the mounting of the fan to be used with the swag kit are not required to be provided when instructions for intended mounting that refer to such parts are furnished in accordance with 120.1.*

*Exception No. 2: Parts such as a ceiling canopy that are provided and shipped with the fan are not required to be provided with the swag kit.*

121.4 As part of the investigation, a kit shall be tested and trial-installed to determine that installation is feasible, that the instructions are detailed and correct, and that the use of the kit does not introduce a risk of fire or injury to persons.

121.5 Each splice enclosure contained in the kit shall comply with the applicable enclosure requirements specified in Section 6, Frame and Enclosure.

121.6 A swag kit shall be marked to include the name of the manufacturer and the model number of the fan that is to be used with the swag kit.

## 122 Through-Cord In-Line Speed Controllers

### 122.1 General

122.1.1 An in-line speed controller provided with a ceiling-suspended cord-connected fan shall comply with the applicable requirements in Part 1 of the Standard, Sections 69 – 73, and the requirements specified in 122.2.1 – 122.4.2. The combination shall comply with the applicable requirements in Part 1 of the Standard and Sections 69 – 73.

## 122.2 Construction

122.2.1 A controller shall be provided with an enclosure that complies with the requirements for Frame and Enclosure, Section 6.

122.2.2 A controller shall be provided with an enclosure that has a mounting means consisting of a separate mounting bracket, an exposed ring hanger, or concealed keyhole slots for mounting on the wall. The mounting means shall comply with the following:

- a) A mounting bracket shall not contain any wiring or project more than 12.7 mm (1/2 inch) from the wall. A mounting bracket and the enclosure shall be constructed so that the speed controller cannot readily be permanently mounted to the mounting bracket or mounted directly to the wall without the use of the bracket.
- b) An exposed ring hanger shall have a diameter of at least 12.7 mm (1/2 inch).
- c) Concealed keyhole slots shall be located so that supporting screws and the like cannot damage the insulation on wiring or contact uninsulated live parts of the speed controller.

122.2.3 The controller shall be provided with the mounting means – such as brackets and screws – required to mount the controller in place as intended. Hardware shall be provided to route the cord connected between the controller and the fan along wall and ceiling surfaces. Such hardware shall:

- a) Be non-metallic;
- b) Be packaged with the controller; and
- c) Not encircle the cord.

Surfaces of the hardware that contact the installed cord shall be smooth.

122.2.4 A controller shall be rated for the load it controls. All internal current-carrying parts (switches, choke coils, solid state circuits, and the like) shall comply with the requirements for those components.

122.2.5 A controller shall be provided with a 1.5 – 3.05 m (5 – 10 foot) length of power-supply cord. The power-supply cord and the wiring from the controller to the fan shall be Type SP-2 or heavier, 18 AWG (0.82 mm<sup>2</sup>) or larger, and shall have a 4.6 – 6.1 m (15 – 20 foot) length.

122.2.5 revised February 21, 2003

122.2.6 Strain relief shall be provided for the power-supply cord where it enters the controller and for both ends of the wiring from the controller to the fan. The completed installation shall comply with the requirements for Strain Relief in Section 42.

122.2.7 The material of a controller part (such as an enclosure, frame, or guard), the breakage of which results in a risk of injury to persons, shall have properties that meet the demand of expected use conditions.

122.2.8 The requirement in 122.2.7 applies to those portions of a part adjacent to moving parts determined to involve a risk of injury to persons.

**122.3 Performance**

122.3.1 After a controller part as specified in 122.2.7 is subjected to the applicable impact test described in 122.3.2 – 122.3.4:

- a) The controller shall not be damaged so as to introduce a risk of injury;
- b) Parts of the controller capable of causing electric shock or risk of injury to persons shall not be exposed to unintentional contact, as determined by application of the accessibility probes as specified in the accessibility of live part requirements in Section 9;
- c) The controller shall remain intact with all parts in their original position; and
- d) The controller shall comply with the Dielectric Voltage-Withstand Test, Section 37.

122.3.2 A speed controller is to be dropped three times from a height of 1.5 m (5 feet) onto the hardwood surface described in 52.3. Each of the drops is to cause the controller to impact the surface at a different controller enclosure location.

122.3.3 Three samples are to be prepared for the test; however, depending on test results, fewer samples may be tested in accordance with Figure 122.1. The test result is acceptable upon completion of any one of the arrow paths represented. When any tested sample does not comply with 122.3.1 after its first series of three drops, the results of the test are unacceptable.

**Figure 122.1**  
**Impact test procedure**

Series Number	Sample Number											
	1	2	3	1	2	3	1	2	3			
1	↓ A	N	N	↓ A	N	N	↓ A	N	N	↓ A	N	N
2	↓ A	N	N	↓ A	N	N	↓ U	↘ A	N	↓ U	↘ A	N
3	↓ A	N	N	↓ U	↘ A	N	↓ A	N		↓ U	↘ A	

Arrows indicate sequence of test procedure

A – Acceptable results from drop

U – Unacceptable results from drop

N – No test necessary

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122.3.4 A product is to be subjected to the test with or without any attachment recommended by the manufacturer so as to result in the most severe test.

122.3.5 The controller shall remain in place and all parts remain intact and in their original position during the following test. The controller is to be mounted on nominal 9.52-mm (3/8-inch) thick wallboard in accordance with the instructions and mounting hardware provided. Each of the adjustment knobs provided is to be operated 50 times. Each operation is to cause the adjustment to go through its full range of settings when continuous or to each of its settings if a step control, and then back to the initial setting.

122.3.6 The controller shall be compatible with the motor it controls. Abnormal operation including open or shorted components shall not result in a motor exceeding the temperature limits in UL 2111, the Standard for Overheating Protection for Motors.

122.3.7 As part of the investigation, the controller is to be trial-installed and shall conform with the requirement in 121.4.

#### **122.4 Marking**

122.4.1 The controller shall be marked with a model or catalog number and it shall also be marked to identify the intended compatible fan model number(s) or the fan series number(s).

122.4.2 Installation instructions shall be provided with each in-line controller that describe the intended mounting and wiring of the controller. The instructions shall cover controller use with a swag-mounted fan in accordance with the requirements in Section 120, Installation Instructions.

### **FANS FOR USE IN WINDOWS**

#### **123 General**

123.1 In addition to the applicable requirements in Part 1 of this Standard, a fan intended for use in a window shall comply with the requirements in Section 124, Construction, and Section 125, Installation Instructions. These requirements also address box fans intended for use in windows. Also see 5.1.

#### **124 Construction**

124.1 When a fan for use in a window is provided with mounting hardware, the hardware shall retain the fan in position during and after installation in accordance with the manufacturer's installation instructions.

#### **125 Installation Instructions**

125.1 Detailed installation instructions with illustrations shall be provided with all box fans intended for installation in windows. The instructions shall also include the size of the window sashes and sills that are appropriate for that particular fan.

## TOILET-BOWL FANS

### 126 General

126.1 A toilet-bowl fan shall comply with the applicable requirements in Part 1 of this Standard and with the applicable requirements in Section 127.

### 127 Performance

#### 127.1 Water spray test

127.1.1 A toilet-bowl fan, when tested as described in 127.1.2 and 127.1.3, shall comply with the requirements in 38.5.1 and 38.6.1 for other than 120 V cord-connected units and in 38.4.2 – 38.4.6 and 38.6.1 for 120 V cord-connected units.

127.1.2 The stationary intake collar of a toilet-bowl fan is to be mounted to a frame intended to simulate the rim of a bathroom toilet-bowl. A toilet-bowl seat is then to be placed as intended over the simulated rim. A single sprinkler head employing the spray head illustrated in Figure 38.1 is to be located under the simulated toilet-bowl rim facing the intake collar. With the fan operating at rated voltage and the sprinkler adjusted to produce 34.48 kPa (5 psi) of water pressure, the intake opening is to be positioned so as to contact the top of the arc of the spray with the spray head in a 45 degree angle. The spray is to be maintained for 1 hour, using water having a resistivity of  $60 \pm 5$  ohm-cm.

127.1.3 The toilet-bowl fan is then to be installed as specified in 127.1.2, except that the spray head is to be located above the test assembly as illustrated in Figure 127.1. The toilet-bowl fan is to be exposed to four 1-minute applications of the water spray with a 1-minute interval between applications. The test water solution is to be as specified in 127.1.2.

#### 127.2 Overflow test

127.2.1 When tested as described in 127.2.3, the leakage current of a cord-connected toilet-bowl fan, measured in accordance with 38.4.2, shall not exceed:

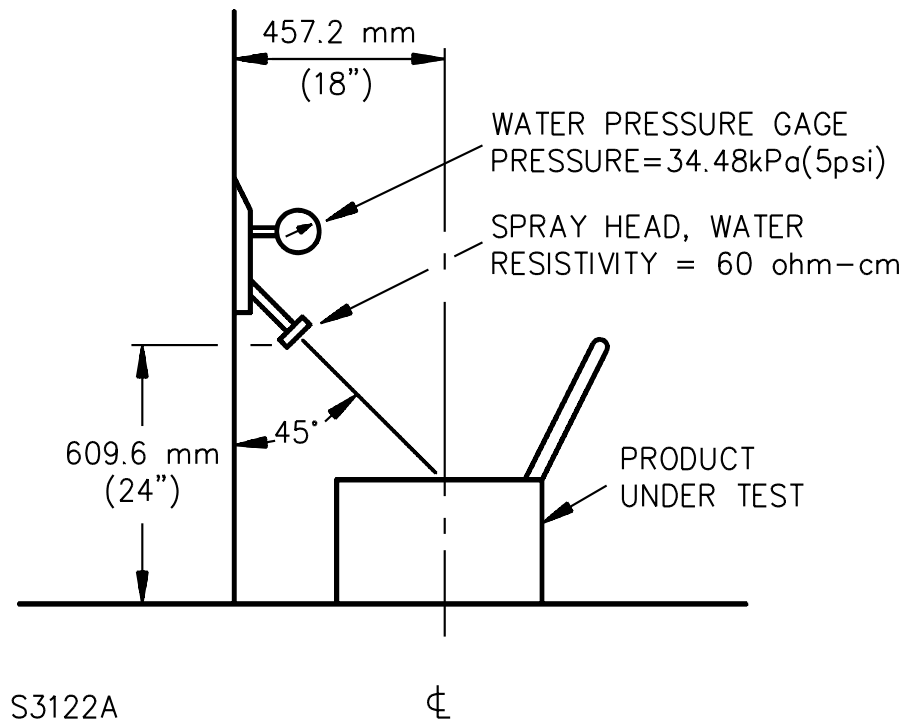
- a) 2.5 milliamperes during the 30 minutes of overflow;
- b) 2.5 milliamperes upon cessation of the overflow; and
- c) 0.5 milliamperes 30 minutes after cessation of the overflow.

Within one minute following the leakage current measurement 30 minutes after the cessation of the overflow, the fan shall be tested and shall comply with the Dielectric Voltage-Withstand Test of Section 37.

127.2.2 When tested as described in 127.2.3, the insulation resistance of a permanently installed toilet-bowl fan, measured upon cessation of the overflow, shall be a minimum of 50,000 ohms. Thirty minutes after cessation of the overflow, the fan shall comply with the Dielectric Voltage-Withstand Test of Section 37.

127.2.3 A toilet-bowl fan is to be mounted as intended on a test fixture to simulate a bathroom toilet-bowl. With the fan connected to rated voltage and operating in the intended manner, the toilet-bowl is to be allowed to overflow for a period of 30 minutes. At the beginning of overflow, the water resistivity is to be

**Figure 127.1**  
**Set-up for water spray test**



60  $\pm$ 5 ohm-cm. The resistivity of the water is to be increased in approximately equal increments to 3500  $\pm$ 300 ohm-cm in three 5-minute intervals, and the balance of the test conducted at the maximum water resistivity value.

### 127.3 Creep test

127.3.1 The requirements in 127.3.2 and 127.4.1 apply only to a thermoplastic enclosure to which a motor, a wiring compartment, or the like is secured by screws such that the material is under load.

127.3.2 Three samples of the enclosure are to be tested. Each screw is to be torqued to 6 pound-inches (0.678 N·m) and the samples are to be placed in an oven maintained at a temperature of 90  $\pm$ 2°C (194  $\pm$ 3.6°F) for a period of 300 hours. The samples are then to be removed from the oven and allowed to cool to room temperature of 23  $\pm$ 2°C (73.4  $\pm$ 3.6°F). The tightness of each screw is to be determined by measuring the torque required to just turn the screw clockwise (tightening). This torque value is to be no less than 0.339 N·m (3 lb-in).

### 127.4 Heat cycling test

127.4.1 Three samples of the enclosure are to be tested. Each screw is to be torqued to 0.678 N·m (6 lb-in) and the samples are to be placed in an oven maintained at a temperature of 90  $\pm$ 2°C (194  $\pm$ 3.6°F) for 4 hours, followed by 4 hours at a room temperature of 23  $\pm$ 2°C (73.3  $\pm$ 3.6°F). This cycling procedure is to be repeated for a total of 304 hours. The tightness of the screws is to be determined as described in 127.3.2. The torque value is to be no less than 0.339 N·m (3 lb-in).

### 127.5 Temperature cycling tests

127.5.1 Three samples of a toilet-bowl fan having a non-metallic enclosure are to be placed in an environmental chamber maintained at a temperature of  $90 \pm 2^{\circ}\text{C}$  ( $194 \pm 3.6^{\circ}\text{F}$ ) for 1 hour, followed by 1 hour at room ambient,  $23 \pm 2^{\circ}\text{C}$  ( $73.4 \pm 3.6^{\circ}\text{F}$ ), followed by 1 hour at  $0.0 \pm 2^{\circ}\text{C}$  ( $32 \pm 3.6^{\circ}\text{F}$ ). This procedure is to be repeated for a total of three cycles. At the end of this cycling, the non-metallic enclosure shall show no evidence of cracking or distortion or other condition that affects the integrity of the enclosure to the degree that mechanical protection is not afforded to internal parts of the fan.

### 127.6 Static load test

127.6.1 With the toilet-bowl fan mounted as intended to the toilet-bowl, a static load of 136 kg (300 pounds) is to be applied on the toilet-bowl seat and maintained for a period of 1 minute. The results are acceptable when:

- a) The fan remains secured as originally installed; and
- b) There is no breakage or cracking of the fan enclosure or other parts that increases the risk of fire, electric shock, or injury to persons.

## EVAPORATIVE COOLERS

### 128 General

128.1 An evaporative cooler that incorporates a heating element is investigated in accordance with the applicable requirements of this Standard and with the applicable requirements for electric space-heating equipment.

### 129 Construction

#### 129.1 Frame and enclosure

129.1.1 With reference to 9.4.1, the filter or filters of an evaporative cooler are to be removed – even if it is necessary to use tools to do so – when the appliance is being examined with reference to exposure of uninsulated live parts.

## 129.2 Motors and pumps

129.2.1 All required motors and pumps shall be provided with an evaporative cooler. They shall be factory installed, shipped in the same carton as the cooler, or shipped in a separate carton and marked as specified in 62.4.1. When a pump or motor is not factory installed, the installation instructions shall include statements specified in 64A.9. All motors and pumps intended to be installed in the field shall have provision for field wiring in accordance with the National Electrical Code, ANSI/NFPA 70-1999, or shall be provided with factory installed power supply cords for plug and receptacle connection.

129.2.1 effective December 13, 2001

129.2.2 Electrically operated pumps used to circulate water through the filter media of an evaporative cooler or to periodically drain mineral-laden water from the water storage reservoir shall comply with the requirements in the Standard for Motor Operated Water Pumps, UL 778.

*Exception No. 1: This requirement does not apply to cord-connected pumps that comply with the Exceptions in Section 162, Construction.*

*Exception No. 2: This requirement does not apply to permanently-connected pumps that comply with Exception No. 1, 4, 5, and 7 in Section 162, Construction.*

Added 129.2.2 effective February 21, 2005

129.2.3 An evaporative cooler employing one or more pumps intended to be protected by GFCI protection per 162.1 Exception No. 2 (b) shall provide appropriate GFCI receptacles as part of the cooler.

*Exception: An internal GFCI receptacle is not required when the evaporative cooler is plainly marked as required in 130A.1.*

Added 129.2.3 effective February 21, 2005

129.2.4 The electronic circuitry provided as part of a drain pump shall comply with the requirements in UL 244A, the Standard for Solid State Controls for Appliances.

129.2.4 added December 23, 2003

## 129.3 Filters

129.3.1 An evaporative cooler intended to be connected to a duct system that interconnects rooms or spaces within buildings for distributing the moist air shall use a Class 1 or Class 2 filter. The use of short ducts intended to bring moist air from the equipment, without connection to a duct system within the building, does not necessitate the use of a Class 1 or Class 2 filter.

## 129.4 Backflow prevention

129.4.1 An air gap shall be provided to prevent backflow from the storage reservoir of an evaporative cooler into a water supply system.

129.4.2 An air-gap fitting shall be constructed so that an unobstructed vertical distance of at least 25.4 mm (1 inch) or of two inlet-pipe inside diameters, whichever is greater, is permanently maintained through the free atmosphere between the lowest opening of the water-inlet device supplying water to the evaporative cooler and the flood-level rim of the reservoir receiving the water.

129.4.3 All parts of the potable water-supply assembly of an evaporative cooler that are in contact with the water, through the discharge terminal point of the air-gap fitting, shall be constructed of nontoxic and corrosion-resistant materials.

## 129.5 Wetting of live parts

129.5.1 The water reservoir in an evaporative cooler intended for connection to a plumbing system or a garden hose shall be constructed and located so that overflow will not wet insulated or uninsulated live parts or film coated wire, other than motor windings, and there shall be no accumulation of water inside the enclosure. An Overflow Test, 130.6, is to be conducted if it is not evident that the evaporative cooler complies with this requirement.

129.5.1 added December 23, 2003

129.5.2 An evaporative cooler with a manually filled water reservoir shall be constructed so that a liquid spill during any likely filling operation will not wet insulated or uninsulated live parts or film coated wire, other than motor windings, and there shall be no accumulation of water inside the enclosure. A Spill Test, 130.7, is to be conducted if it is not evident that the evaporative cooler complies with this requirement.

129.5.2 added December 23, 2003

## 130 Performance

### 130.1 Input test

130.1.1 The Input Test of Section 35 shall be conducted on an evaporative cooler:

- a) With the cooler dry; and
- b) When it is using water in the intended manner.

### 130.2 Temperature test

130.2.0 The Temperature Test of Section 36 shall be conducted on all evaporative coolers with the cooler dry.

130.2.0 added February 21, 2003

130.2.1 The Temperature Test of Section 36 shall also be conducted on an evaporative cooler employing a mechanical pump driven by the fan or blower motor when the cooler is using water in the intended manner.

130.2.1 revised February 21, 2003

### 130.3 Moisture resistance test

130.3.1 When tested under the conditions described in 130.3.2, an evaporative cooler in which the electrical insulation is exposed to the moisture-laden air shall comply with the following:

- a) A cord-connected appliance rated for a nominal 120-volt supply shall comply with the requirements in 32.1 in a repeat leakage current test, except that the test is to be discontinued when the leakage current stabilizes.
- b) An appliance, other than specified in (a), shall have an insulation resistance of 50,000 ohms or more between live parts and interconnected dead-metal parts.
- c) An appliance shall withstand without breakdown for 1 minute the application of a 60-hertz essentially sinusoidal potential of 1000 volts between live parts and interconnected dead-metal parts.

130.3.2 The evaporative cooler is to be operated for 24 hours in cycles of 15 minutes "on" and 45 minutes "off", with water circulating through it in the intended manner. Measurement of the insulation resistance or leakage current and the application of the test potential are to be made immediately upon conclusion of the final on cycle of the 24-hour period.

### 130.4 Stability test

130.4.1 An evaporative cooler shall not tip over when tested in accordance with the Stability Test in Section 54.

### 130.5 Ultraviolet light and water exposure

130.5.1 A polymeric material used for the enclosure of an evaporative cooler intended for outdoor installation shall comply with the ultraviolet light exposure requirements as specified in UL 746C, the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, including flammability, strength, and impact criteria.

130.5.1 added December 23, 2003

130.5.2 A polymeric material used for the enclosure of an evaporative cooler intended for outdoor installation shall comply with the water exposure and immersion requirements as specified in UL 746C, the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, including flammability, strength, impact, and dimensional change criteria.

130.5.2 added December 23, 2003

### 130.6 Overflow test

130.6.1 To determine whether failure to shut off the water supply manually or malfunction or breakdown of a float- or pressure-operated switch, timer switch, or the like will result in a risk of electric shock, the product will be conditioned as described in 130.6.2 and 130.6.3. Compliance with the overflow test shall be determined by:

- a) A visual inspection to determine that there is no wetting of uninsulated live parts or film-coated wire, other than motor windings, and no accumulation of water in an electrical enclosure. The accumulation of water droplets shall only be acceptable when the fan complies with the tests in (b) and (c). A drain hole may be provided to reduce the accumulation of water above a level that results in the wetting of an electrical part, or water in an electrical enclosure.
- b) A leakage current test for 120 volt cord connected appliances (see 38.4.1 – 38.4.6) or an insulation resistance test for all other appliances (see 38.5.1).
- c) A dielectric voltage withstand test (see 38.6.1).

130.6.1 added December 23, 2003

130.6.2 The product shall be connected to a water supply as intended.

- a) With any provided timer switch functioning as intended, a provided float- or pressure-operated fill switch shall be defeated and the product started. The fill shall be continued for an additional 15 minutes following the first evidence of overflow of the reservoir. If a timer switch is provided, it should be allowed to cycle as intended for the duration of the test and the test shall be continued for 7 hours.
- b) A timer switch, if provided, shall be defeated and the product started. If no automatic shutoff means is provided, the fill shall be continued for an additional 15 minutes following the first evidence of overflow of the reservoir. If a float- or pressure-operated switch is provided as an automatic shutoff means, actuation of the fill switch to terminate the fill will also terminate the test.
- c) If both a timer switch and a float- or pressure-operated fill switch are provided, the devices shall each be defeated independently as described above.



d) If the product is not provided with a timer or a float- or pressure-operated fill switch; that is, the water source is intended to be controlled manually, the product shall be started and the fill shall be continued for an additional 15 minutes following the first evidence of overflow of the reservoir.

130.6.2 added December 23, 2003

130.6.3 A rubber barrier or rim seal of a reservoir shall not be removed when a test is being conducted to simulate malfunction or breakdown of a timer switch or of a float- or pressure-operated switch.

130.6.3 added December 23, 2003

### 130.7 Spill test

130.7.1 When required by 129.5.2, the evaporative cooler is to be positioned as intended in use. The water reservoir is to be filled to capacity with water and then an additional four hundred-forty-four milliliters (15 oz) of water are to be poured into the reservoir at a rate of approximately 30 mL/s (1 oz per second).

130.7.1 added December 23, 2003

130.7.2 Compliance with 129.5.2 shall be determined within 30 minutes after the water is poured into the reservoir by:

a) A visual inspection to determine that there is no wetting of uninsulated live parts or film-coated wire, other than motor windings, and no accumulation of water in an electrical enclosure. The accumulation of water droplets shall only be acceptable when the fan complies with the tests in (b) and (c). A drain hole may be provided to reduce the accumulation of water above a level that results in the wetting of an electrical part, or water in an electrical enclosure.

b) A leakage current test for 120 volt cord connected appliances (see 38.4.1 – 38.4.6) or an insulation resistance test for all other appliances (see 38.5.1).

c) A dielectric voltage withstand test (see 38.6.1).

130.7.2 added December 23, 2003

### 130.8 Static loading test

130.8.1 A window-type or through-wall-type evaporative cooler shall withstand the test described in 130.8.2 – 130.8.4 without collapse of the cabinet, base, or the supporting means, and shall not fall out of the test window.

*Exception: Window-type or through-wall-type units protruding less than 10 inch (254 mm) from the building structure need not undergo this test.*

Added 130.8.1 effective December 23, 2005

130.8.2 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, including any brackets or bracing intended to support the rear edge of the unit. The water reservoir shall be filled with the maximum amount of water allowed by the construction of the unit. A load of 200 – 400 pounds-mass (90.5 – 181 kg) per Table 130.1 acting vertically downward shall be applied along the edge parallel with and farthest from the plane of the window.

*Exception: If the installation instructions indicate that the unit is intended only for through-wall application, a wall opening as specified by the installation instructions may be used in lieu of the simulated window frame.*

Added 130.8.2 effective December 23, 2005

130.8.3 The window shall be mounted in a 4-1/2 inch (114 mm) thick wall and 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. The sill shall extend 1/2 inch (12.7 mm) beyond the inside and outside surfaces of the wall.

Added 130.8.3 effective December 23, 2005

130.8.4 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.

Added 130.8.4 effective December 23, 2005

**Table 130.1**  
**Required Static Load**

Added Table 130.1 effective December 23, 2005

Protrusion From Building Structure		Static Load	
Inches	cm	pounds-mass	kg
≥ 10 and <12	≥ 25.4 and <30.5	200	90.5
≥ 12 and <14	≥ 30.5 and <35.6	220	99.6
≥ 14 and <16	≥ 35.6 and <40.6	240	108.6
≥ 16 and <18	≥ 40.6 and <45.7	260	117.7
≥ 18 and <20	≥ 45.7 and <50.8	280	126.7
≥ 20 and <22	≥ 50.8 and <55.9	300	135.8
≥ 22 and <24	≥ 55.9 and <61	320	144.8
≥ 24 and <26	≥ 61 and <66	340	153.9
≥ 26 and <28	≥ 66 and <71.1	360	162.9
≥ 28 and <30	≥ 71.1 and <76.2	380	172
≥ 30	≥ 76.2	400	181

### 130A Marking

130A.1 An evaporative cooler complying with the Exception to 129.2.3 shall be marked "CAUTION" and the following or the equivalent: "To Reduce The Risk Of Electric Shock, Connect Only To An Outlet Provided With A Ground Fault Circuit Interrupting Device."

130A.1 added February 21, 2003

130A.2 The marking in 130A.1 shall not be prohibited on evaporative coolers not otherwise required to be so marked.

130A.2 added February 21, 2003

## FLOOR INSERT FANS

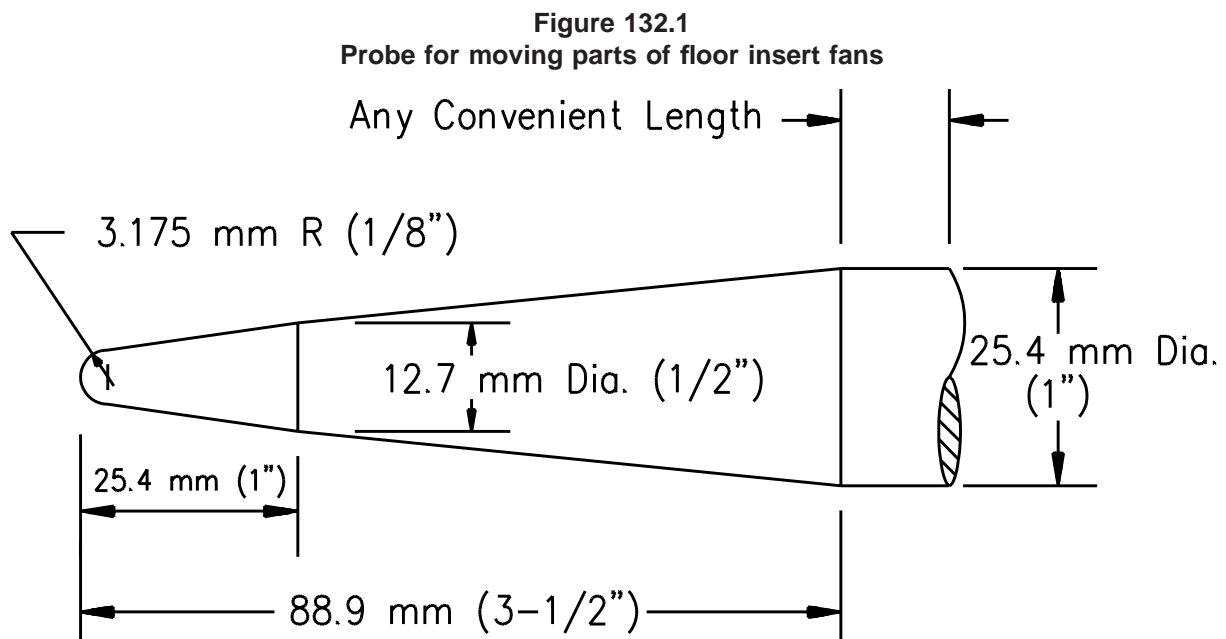
### 131 General

131.1 In addition to the applicable requirements in Part 1 of this Standard, a floor insert fan shall comply with the requirements in Sections 132 and 133. Also see 5.1.

### 132 Construction

#### 132.1 Moving parts

132.1.1 A moving part (blower wheel) of a floor insert fan that results in a risk of injury to persons shall be guarded so that the probe illustrated in Figure 132.1 does not touch the part when inserted with a force of 4.45 N (1 pound) through any opening in the guard.



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## 133 Performance

### 133.1 Water splash test

133.1.1 There shall be no dielectric breakdown of a floor insert fan as a result of the test specified in 133.1.2. The insulation resistance shall be at least 50,000 ohms.

133.1.2 A cotton mop, which has been completely immersed in a pail of water for at least 5 minutes, is to be immediately upon removal from the pail swabbed across the floor insert fan's grill five times with the fan de-energized. Within one minute after the last swabbing operation, the insulation resistance measurement and dielectric voltage withstand tests in Section 37 are to be performed.

### 133.2 Crush test

133.2.1 A floor insert fan shall sustain a 1779 N (400 pound) load applied over a square foot area for 1 minute over the top exhaust grille of the fan, without:

- a) Damage to the speed control; and
- b) Breakage or cracking of the enclosure or guard, after which the probe illustrated in Figure 132.1 shall not contact a portion of a moving part that results in a risk of injury to persons when inserted through any opening in the guard or enclosure.

## OUTDOOR USE EQUIPMENT

### 134 General

134.1 The requirements in Sections 135 – 138 supplement and, in some cases, modify the general requirements in Part 1 of the Standard. The requirements for grounding and power supplies supersede those requirements in Sections 14 and 28. The corrosion protection requirements specifically cover appliances constructed of cast ferrous metal, sheet steel, or ferrous tubing. These requirements apply only to those fans intended for use in indoor and outdoor wet locations subject to rain or the spray of non-corrosive and non-flammable liquids. These appliances may be exposed to the weather and may be unprotected. Also, see 5.1.

## 135 Construction

### 135.1 General

135.1.1 The requirements found in 135.2.1 – 135.2.5 do not apply to a part such as a decorative grille that is not required to form a part of the enclosure.

### 135.2 Protection against corrosion

135.2.1 The inside and outside surfaces of cast ferrous metal, sheet steel, or ferrous tubing shall be protected against corrosion by one of the coatings described in Table 135.1.

*Exception No. 1: Other finishes are not prohibited from being used, including paints, special metallic finishes, and combinations of the two, when it is determined that they provide equivalent protection by comparative tests with galvanized-sheet steel conforming with Type G90 of Table 135.1. Outdoor paint shall comply with the requirements in UL 1332, Organic Coatings for Steel Enclosures for Outdoor Use Electrical Equipment.*

*Exception No. 2: A metal part, such as a decorative part, that is not required for conformance with this Standard is not required to be protected against corrosion.*

*Exception No. 3: Stainless steel is not required to be additionally protected against corrosion.*

*Exception No. 4: Edges, fasteners, and welds complying with 135.2.2 – 135.2.5 are not required to be additionally protected against corrosion.*

*Exception No. 5: When the inside surfaces of the appliance are protected from the elements such that no water enters the appliance during the water spray test, the inside surfaces are to be provided with protection against corrosion equivalent to that specified in 75.1 – 75.5.*

135.2.1 revised September 24, 2001

135.2.2 Hinges, bolts, and fasteners made of ferrous materials shall be protected against corrosion as described in 75.1 for damp locations.

*Exception: Hinge pins are not required to be provided with the protection against corrosion required in 75.1.*

135.2.3 The acceptability of a coating on hinges, bolts, and fasteners is to be determined by visual inspection.

135.2.4 Punched holes and cut edges in ferrous material are not required to be protected against corrosion.

**Table 135.1  
Sheet steel coatings**

Type of coating	mm (Inches)	Type or thickness <sup>a</sup> description
(A) Hot-dipped mill galvanized steel	G90 <sup>b</sup> G60 <sup>b</sup> A60 <sup>b</sup>	– with 1 coat of outdoor paint <sup>c</sup> with 1 coat of outdoor paint <sup>c</sup>
(B) Zinc coating other than Type (A)	0.0155 (0.00061) <sup>d</sup> 0.0104 (0.00041) <sup>d</sup>	– with 1 coat of outdoor paint <sup>c</sup>
(C) Cadmium coating	0.0254 (0.0010) 0.01905 (0.00075) 0.0127 (0.0005)	– with 1 coat of outdoor paint <sup>c</sup> with 2 coats of outdoor paint <sup>c</sup>
(D) Vitreous enamel <sup>e</sup>	–	–

<sup>a</sup> As determined by ASTM Method B555-86 (Reapproved 1991), Standard Guide for Measurement of Electrodeposited Metallic Coating Thicknesses by the Dropping Test.

<sup>b</sup> Conforming with the coating designation G90, G60, or A60 in accordance with ASTM A653/A653M-94, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process, with no less than 40 percent of the zinc on any side based on the minimum single spot test requirement in this ASTM standard.

<sup>c</sup> Identified as outdoor paint by paint manufacturer.

<sup>d</sup> Average thickness with a spot minus tolerance of 0.00178 mm (0.00007 inch).

<sup>e</sup> Acceptable on sheet steel at least 0.66 mm (0.026 inch) thick.

135.2.5 Welds in iron or steel (other than stainless steel) shall be painted with one coat of any outdoor paint.

*Exception: One coat of any indoor paint is acceptable over a spot weld on galvanized steel.*

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### 135.3 Field-wiring connections

135.3.1 An opening in an appliance for a power-supply or external control-circuit connection shall be threaded unless:

- a) It is located entirely below the lowest uninsulated live part within the enclosure; or
- b) Its location prevents drainage into the enclosure.

The metal at a threaded opening for a wiring system shall be a minimum 6.35 mm (1/4 inch) thick, and an end-stop shall be provided, unless the thread is tapered. See 135.6.2.

### 135.4 Internal wiring

135.4.1 Internal wiring of an appliance shall be of such type and assembled to reduce the risk of electric shock resulting from exposure to water or humidity.

135.4.2 There shall be no water on uninsulated live parts or on film-coated wire, other than motor windings, of an appliance as a result of the Water Spray Tests specified in 38.1.2.

135.4.3 Internal wiring of an appliance shall be located so that it is not immersed in water as a result of the appliance's exposure to the weather. Compliance with this requirement is determined by visual examination and by the Water Spray Test specified in Section 38.

135.4.4 The use of moisture-resistant wiring material such as Type RW, RHW, TW, XHHW, MTW, THW – MTW, or THWN, enclosed in rigid or flexible steel conduit, electrical metallic tubing, or moisture-resistant non-metallic sheathed cable, is considered acceptable for the wiring between electrical component enclosures. Wiring materials that are not inherently moisture resistant may be installed in either:

- a) Rigid conduit or electrical metallic tubing with rain-tight fittings; or
- b) Liquid-tight flexible metal or non-metallic conduit with acceptable fittings.

Bushings shall be nonabsorptive.

135.4.4 revised February 21, 2003

### 135.5 Insulating material

135.5.1 Electrical insulation used in the construction of an electrical component shall be nonabsorptive. Vulcanized fiber in a component is acceptable only when the component is not wetted during the water spray tests.

### 135.6 Enclosures

135.6.1 A panel or cover in the outer enclosure of an appliance shall require the use of a tool or tools for removal.

*Exception: When removal or opening of the panel or cover does not result in a risk of electric shock when the appliance is subjected to the Water Spray Test specified in Section 38, it is not required to comply with this requirement.*

135.6.2 The enclosure of an electrical component of a roof-mounted appliance shall have provision for drainage when a knockout or unthreaded opening is provided in the enclosure. See 135.6.1.

135.6.3 A non-metallic enclosure is to be judged on the basis of the effect of exposure to ultraviolet light and water for 720 hours. See 136.3.1.

135.6.4 An enclosure or enclosures shall be so constructed as to reduce the risk of electric shock due to weather exposure and to prevent the wetting of live parts, electrical components, or wiring not identified for use in contact with water. Parts identified for use in contact with water include flexible cords whose marking ends with a "W," liquid tight flexible metal or non-metallic conduit, outlet boxes marked for use in wet locations, rigid conduit, and the like.

*Exception: The outer surface of the glass envelope of a lamp that is wetted meets the intent of this requirement.*

135.6.4 revised February 21, 2003

135.6.5 An appliance shall be constructed so it prevents the entrance of any water into the enclosure.

*Exception: When a drain hole is provided to drain water from the appliance, and water enters the appliance, there shall be no wetting of live parts as described in 135.6.4.*

135.6.6 To determine compliance with 135.6.4 and 135.6.5, a complete assembly is to be installed as described in 135.6.7 and subjected to the Water Spray Test, Section 38.

135.6.7 During the Water Spray Test specified in Section 38, unspecified lengths of conduit are to be attached to the field wiring box with normal torque and without pipe-thread compound. At each unthreaded opening, a lock nut and bushing are to be installed. The unattached end of each conduit is to be closed to prevent the entrance of water.

135.6.8 A cover for a roof-mounted appliance having an area not more than 0.37 m<sup>2</sup>(4 square feet) shall be of a material classified as HB, V-0, V-1, V-2, or 5V. When the cover is required for the appliance to comply with the requirements of the rain test (see 38.1.1 (b) and (c)), then additional tests, such as impact, environmental conditioning, and ultraviolet exposure tests, are to be conducted on the material.

## 135.7 Grounding and power supply connections

135.7.1 A cord-connected wet location appliance shall employ a 3-conductor grounding type W-rated power supply cord and shall be provided with installation instructions as specified in 138.1.

*Exception: Appliances with no parts requiring electrical continuity in accordance with 28.1.2, and having no dead metal parts likely to become energized which are in contact with water, are not required to be provided with an equipment grounding conductor.*

135.7.1 revised September 24, 2001

## 136 Performance

### 136.1 Sealing compound

136.1.1 A sealing compound depended upon for protection from rain is to be conditioned as specified in 136.1.2. The sealing compound shall not melt, become brittle, or otherwise deteriorate to a degree that affects its sealing properties as determined by comparing the aged sample to an unaged sample.

136.1.2 To determine whether the sealing compound complies with the requirements in 136.1.1, it is to be applied to the surface it is intended to seal. For a surface having a temperature rise not exceeding 35°C (95°F), a representative sample of the surface with the sealing compound applied is to be conditioned for 7 days in an air oven at 87.0 ±1.0°C (189.0 ±1.8°F).

### 136.2 Gasket

136.2.1 A gasket employed to comply with the requirements for outdoor use shall comply with the requirements of the thermal conditioning test in 136.2.3.

136.2.2 When an adhesive is used to secure a gasket, six samples of the gasket assembly are to be subjected to the gasket conditioning test described in 136.2.3. Following conditioning, removal of the gasket is to be attempted by pulling on the edge of the gasket in a plane perpendicular to the surface on which the gasket is mounted. The force necessary to remove the gasket from its mounting surface shall be at least 60 percent of the value measured prior to conditioning. Three samples are to be checked within 1/2 hour following conditioning and the remaining three samples are to be checked 24 hours after the test.

136.2.3 After conditioning for 168 hours in a circulating air oven at a temperature 20°C (68°F) above the temperature measured on the gasket or bushing during the temperature test, a gasket employed to comply with the requirements for wet location appliances shall have a tensile strength of not less than 60 percent and an elongation of not less than 75 percent of the values determined before conditioning.

*Exception No. 1: This test is not required to be conducted when a gasket or bushing is tested while installed in the appliance as described in 136.2.4.*

*Exception No. 2: Neoprene rubber is acceptable for 60°C (140°F) and silicone rubber is acceptable for 105°C (221°F) without being subjected to the test.*

136.2.4 As an alternative to the test described in 136.2.3, a gasket or bushing employed to comply with the requirements for wet locations is to be tested as follows. With the gasket(s) or bushing(s) in place, the appliance is to be conditioned in a circulating air oven for 240 hours at 20°C (68°F) above the temperature measured during the Temperature Test described in Section 36. After the conditioning, any parts which depend on the gasket or bushing for sealing are to be removed. The results are acceptable when a visual inspection shows no damage to the gasket and the gasket has remained in place with respect to the part removed. The appliance parts, including the gasket that was conditioned, are then to be replaced and the appliance subjected to the appropriate water spray test. After the water spray, any part which depends on the gasket or bushing for sealing is to be removed. The results are acceptable when a visual inspection shows no damage to the gasket, and the gasket has remained in place with respect to the part removed.

### 136.3 Exposure to sunlight (ultraviolet radiation)

136.3.1 A non-metallic enclosure or watershield of a fan employing a fluorescent light or a non-metallic enclosure of a fan intended for outdoor use shall withstand 720 hours of twin enclosed carbon-arc or 1000 hours of xenon-arc conditioning in accordance with the Ultraviolet Light Exposure Test in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, without impairment of its impact resistance when tested as specified in 136.3.2.

Revised 136.3.1 effective February 21, 2005

136.3.2 Each of three non-metallic enclosure samples are to be exposed to ultraviolet radiation. After 720 hours of exposure, each sample is to be removed from the ultraviolet radiation and within 1 minute be subjected to an impact of 1.4J (1 foot-pound) by means of a solid, smooth, steel sphere, 50.8 mm (2 inches) in diameter, applied to the external surfaces. The sphere is to be dropped from the height necessary to produce the specified impact upon the surface being tested. For a surface that is not horizontal, the sphere is to be suspended by a cord and swung vertically as a pendulum from the necessary distance.

### 137 Marking

137.1 A portable appliance intended for outdoor use shall be plainly marked "CAUTION" and the following or the equivalent: "To Reduce The Risk Of Electric Shock, Connect Only To An Outlet Provided With A Ground Fault Circuit Interrupting Device."

*Exception: This marking is not required when a GFCI device is provided as a part of the appliance.*

137.1 revised February 21, 2003

137.2 An appliance that complies with the requirements in Sections 134 – 137 and that is intended for use in wet locations shall be marked "OUTDOOR USE" or "ROOFTOP USE".

137.2 revised February 21, 2003

137.3 A cord-connected outdoor use appliance shall be marked with the following or equivalent wording: "Do Not Use An Extension Cord With This Fan."

## 138 Instructions

138.1 A cord-connected outdoor use appliance shall be provided with installation instructions that consist of the following or equivalent wording: "Use Only on GFCI Protected Receptacles."

*Exception: This marking is not required when a GFCI device is provided as a part of the appliance.*

138.1 revised February 21, 2003

138.2 When user servicing or cleaning operations are anticipated, the instructions shall indicate that the source of electrical supply is to be disconnected prior to the beginning of any such servicing or cleaning operation.

## DAMP LOCATION COMPONENT FANS

### 138A General

138A.1 Damp location component fans are component fans intended to be installed in end products which are suitable for installation in interior locations protected from weather and subject to moderate degrees of moisture (such as some basements, barns, cold storage warehouses, and similar locations), and also partially protected locations (such as under canopies, marquees, roofed open porches, and similar locations).

138A.1 added February 21, 2003

138A.2 In addition to the applicable requirements in Part 1 of this Standard, the component fan shall also comply with the requirements in Sections 38 (Water Spray Test), 75 (Construction – Protection Against Corrosion), and 76.1 (Construction – Electrical).

*Exception: A low voltage component fan shall comply with the low voltage component fan requirements described in Sections 150 – 154 in addition to Sections 38, 75, and 76.1.*

138A.2 added February 21, 2003

### 138B Construction

138B.1 If the fan employs encapsulation materials (such as epoxy, polyurethane, silicone rubber) which are required for compliance to the Water Spray Test, the encapsulation material shall comply with the applicable requirements of UL 746C, the Standard for Polymeric Material – Use in Electrical Equipment Evaluations.

138B.1 added February 21, 2003

138B.2 For an encapsulation material as described in 138B.1, the Water Spray Test should be conducted before and after the Thermal Cycling Test of 138G.1.

*Exception: The Thermal Cycling Test of 138G.1 can be waived if an epoxy material is employed and if the epoxy material does not exceed 90°C (with  $T_{mra}$  factored in) during the Temperature Test.*

138B.2 added February 21, 2003

138B.3 Use of conformal coatings on the printed wiring board for protection against environmental conditions or used in lieu of electrical spacings shall be evaluated to UL 746C, the Standard for Polymeric Material – Use in Electrical Equipment Evaluations.

138B.3 added February 21, 2003

138B.4 Use of sealants and gaskets required for compliance to the Water Spray Test, Section 38, shall comply with 136.1 and 136.2.

138B.4 added February 21, 2003

### 138C Performance

138C.1 Damp location component fans shall be subjected to the Thermal Cycling Test of Section 138G.1.

138C.1 added February 21, 2003

### 138D Markings

138D.1 A component fan in compliance with all applicable requirements including enclosure requirements and environmental conditioning shall be marked "Suitable for Use in Damp Locations".

138D.1 added February 21, 2003

## WET LOCATION AND OUTDOOR-USE COMPONENT FANS

### 138E General

138E.1 Wet location and outdoor-use component fans are component fans intended to be installed in end products which are suitable for locations which are unprotected and exposed to weather.

138E.1 added February 21, 2003

138E.2 In addition to the applicable requirements in Part 1 of this Standard, a component fan shall also comply with the requirements in Sections 135, Construction, and 136, Performance. A low voltage component fan shall comply with the requirements specified in Sections 150 – 154, 135, and 136.

138E.2 added February 21, 2003

### 138F Construction

138F.1 If the fan employs encapsulation materials (such as epoxy, polyurethane, silicone rubber) which are required for compliance to the Water Spray Test, Section 38, the encapsulation material shall comply with the applicable requirements of UL 746C, the Standard for Polymeric Material – Use in Electrical Equipment Evaluations, and comply with 136.3.

138F.1 added February 21, 2003

138F.2 For an encapsulation material as described in 138F.1, the Water Spray Test should be conducted before and after the Thermal Cycling Test of 138G.1.

*Exception: The Thermal Cycling Test of 138G.1 can be waived if an epoxy material is employed and if the epoxy material does not exceed 90°C (with  $T_{mra}$  factored in) during the Temperature Test.*

138F.2 added February 21, 2003

138F.3 Use of sealants and gaskets required for compliance to the Water Spray Test, Section 38, shall comply with 136.1 and 136.2.

138F.3 added February 21, 2003

138F.4 Use of conformal coatings on the printed wiring board for protection against environmental conditions or used in lieu of electrical spacings shall be evaluated to UL 746C, Standard for Polymeric Material – Use in Electrical Equipment Evaluations.

138F.4 added February 21, 2003

## 138G Performance

### 138G.1 Thermal cycling test

138G.1 added February 21, 2003

138G.1.1 For components or subassemblies which are adequately enclosed by enveloping or hermetic sealing to prevent ingress of dirt and moisture, examples of such construction include parts in boxes that are hermetically sealed by adhesive or otherwise, and parts enveloped in a dip coat, compliance is checked by inspection from the outside, measurement and test. A component or subassembly is considered to be adequately enclosed if a sample passes the following sequence of tests.

The sample is subjected 10 times to the following sequence of temperature cycles:

68 h at  $T_1^\circ\text{C} \pm 2^\circ\text{C}$   
 1 h at  $25^\circ\text{C} \pm 2^\circ\text{C}$   
 2 h at  $0^\circ\text{C} \pm 2^\circ\text{C}$   
 not less than 1 h at  $25^\circ\text{C} \pm 2^\circ\text{C}$

Where:

$T_1 = T_2 + T_{mra} - T_{amb} + 10^\circ\text{C}$ , or  $85^\circ\text{C}$ , whichever is higher;

$T_2$  = the temperature of the parts measured during the Temperature Test;

$T_{amb}$  = the room ambient temperature during the Temperature Test; and

$T_{mra}$  = the maximum room ambient temperature permitted by the manufacturer's specification or  $25^\circ\text{C}$ , whichever is greater.

138G.1.1 added February 21, 2003

138G.1.2 The period of time taken for the transition from one temperature to another is not specified, but the transition is permitted to be gradual.

138G.1.2 added February 21, 2003

138G.1.3 The sample is allowed to cool to room temperature and is subjected to the Humidity Conditioning Test of Section 41, followed by the Dielectric Voltage Withstand Test of Section 37.

138G.1.3 added February 21, 2003

138G.1.4 For transformers, magnetic couplers and similar devices, where insulation is relied upon for safety, a voltage of 500 V r.m.s at 50 Hz to 60 Hz is applied between windings during the thermal cycling conditioning. No evidence of insulation breakdown shall occur during this test.

138G.1.4 added February 21, 2003

### 138H Markings

138H.1 Component fans in compliance with all applicable requirements including enclosure requirements and environmental conditioning shall be marked "Suitable for Use in Wet Locations" or "Suitable for Outdoor-Use".

138H.1 added February 21, 2003

## FANS FOR USE IN UNATTENDED AREAS

### 139 General

139.1 In addition to any other motor requirements specified in UL 507, the requirements specified in Sections 139 and 140 apply to any motor used in fan products which are built into or within the building structure and which operate unattended or in situations in which the operator may not detect a locked rotor condition. Examples include: wall-insert fans, through-wall fans, ceiling-insert fans, attic exhaust fans, whole house fans, and duct fans. Fans intended for use in cooking areas with integral blower assemblies and ceiling-suspended fans are not included.

*Exception No. 1: These requirements do not apply to motors employing a single-operation device, a thermal cutoff, or a manual reset thermal protector when the device opens during the normal locked rotor testing in accordance with UL 2111, the Standard for Overheating Protection for Motors.*

*Exception No. 2: These requirements do not apply to a motor in which there are no openings in the enclosure through which molten metal, burning insulation, flaming particles, or other ignited material could fall onto flammable material, or through which a flame could be projected.*

Revised 139.1 effective February 21, 2005

139.2 There shall be no increased risk of fire as evidenced by the burning of cotton. All cotton used for this test is to be sterile or surgical 100 percent cotton.

139.3 A motor shall be tested in accordance with this Section at each speed and rated voltage. A motor with a single tapped winding is required to only be tested at high speed.



## 140 Performance

### 140.1 Test preparation – fan motor failure mode analysis

140.1.1 The test procedure specified in this Section is to be conducted on either ten samples of a complete fan or ten samples of the motor.

*Exception: For a motor employing a thermal cutoff or a manual reset thermal protector as a secondary or "back-up" protection, only three samples are to be tested. See 2.2.18.*

140.1.2 For the purpose of this test, motor samples are to be provided without an automatic reset thermal protector. A "back-up" protector is to remain in the circuit.

140.1.3 A thermocouple is to be attached to the motor winding to verify constant temperature rise (motor heating) during the test. The rotor is to be locked.

140.1.4 Each sample of a complete fan is to be oriented as intended in the application. One layer of cotton is to be loosely draped around the area of the motor and any other area of the fan where flame or molten metal is emitted. When a barrier or guard is provided for the purpose of preventing flames or molten metal from escaping from the motor area, the cotton is to be loosely draped around the barrier or guard.

140.1.5 Each sample of a fan motor is to be placed on one layer of cotton on a wood surface. Each motor is then to be surrounded with one layer of loosely draped cotton.

### 140.2 Test procedure – fan motor failure mode analysis

140.2.1 The supply circuit is to be provided with a 20 amp slow blow fuse. If the fuse opens during the test procedure, it is to be replaced with the largest standard size fuse needed to continue the test.

140.2.2 The fan motor is to be energized in a room ambient temperature of 10 to 40°C (50 to 104°F) initially at the rated voltage of the fan until the winding temperature stabilizes.

140.2.3 Following stabilization, the voltage is to be gradually increased to achieve a maximum 10°C temperature rise per minute until ultimate results are observed (opening of motor winding, opening of a "back-up" protector, or ignition of the cotton).

## FANS INTENDED FOR INSTALLATION OVER A BATHTUB OR SHOWER

### 141 General

141.1 In addition to the applicable requirements in Part 1 of this Standard, a ceiling-insert fan, wall-insert fan, or ceiling-insert fan/light combination intended for use over a bathtub or shower shall comply with the requirements in Sections 142 – 144. Also see 5.1.

141.2 A polymeric enclosure or water shield of a fan employing a fluorescent light shall comply with the requirements of Section 136.3.

*Exception: A polymeric enclosure or water shield that complies with the Ultraviolet Light Exposure Test in the Standard for Polymeric Materials - Use in Electrical Equipment Evaluations, UL 746C, does not need to comply with the requirements of Section 136.3.*

Added 141.2 effective February 21, 2005

### 142 Performance

#### 142.1 Water spray test

142.1.1 During the water spray applications described in 142.1.7 and 142.1.8, no water shall contact the lampholder screwshell (of a fan/light combination) or uninsulated live parts of the appliance. Immediately following each series of water spray applications, compliance with the test shall be determined by all of the following:

- a) A visual inspection to determine that there is no wetting of insulated and uninsulated parts or wiring to the extent that these parts are immersed in water. The accumulation of water droplets may be determined to be acceptable provided the fan complies with the tests in (b) and (c). A drain hole may be provided to reduce the accumulation of water above a level that would result in the wetting of an electrical part or wiring compartment.
- b) An insulation resistance test described in 142.1.9.
- c) A dielectric voltage withstand test described in 142.1.10.

142.1.2 The water spray apparatus is to consist of one spray head of the type shown in Figures 142.1 and 142.2. (See Figure 38.2) The water pressure for the test is to be maintained at 138 kPa (20 psi).

142.1.3 The water to be used for the test is to have its resistivity adjusted before the test is started to 3500 ohm-centimeters  $\pm 5$  percent when measured at 25°C (77°F). At the conclusion of the test, the resistivity of the water is to be not less than 3200 ohm-centimeters or more than 3800 ohm-centimeters at 25°C.

*Exception: The test may be conducted using water with an initial resistivity of less than 3500 ohm-centimeters  $\pm 5$  percent at 25°C (77°F), and/or a final resistivity of less than 3200 ohm-centimeters at 25°C, when agreeable to all concerned.*

142.1.3 revised September 24, 2001

142.1.4 A ceiling-insert fan or ceiling-insert fan/light combination is to be positioned in front of the spray head as illustrated in Figure 142.1 and tested as specified in 142.1.6 and 142.1.7.

142.1.5 A wall-insert fan is to be positioned in front of the spray head as illustrated in Figure 142.2 and tested as specified in 142.1.6 and 142.1.8.

142.1.6 The appliance is to be energized and tested at the voltage described in 36.1.8 and with the lamp (in fan/light combinations) connected to a separate supply source to yield maximum marked lamp wattage.

142.1.7 Each quadrant of a ceiling-insert fan or ceiling-insert fan/light combination is to be exposed to a 1-minute application of the water spray.

142.1.8 A wall-insert fan, with the grill positioned to allow the most water ingress to the fan, is to be exposed to a 1-minute application of the water spray.

142.1.9 Immediately after the water spray test, the insulation resistance measured between live parts and interconnected dead metal parts of an appliance shall be 50,000 ohms or more. After the insulation resistance measurement, the appliance shall comply with the dielectric voltage withstand test described in 142.1.10.

142.1.10 Within one minute of cessation of the water spray, a dielectric voltage withstand test shall be conducted at an applied potential of 1000 volts for one minute. See Section 37, Dielectric Voltage Withstand Test.

## **142.2 Thermal shock test**

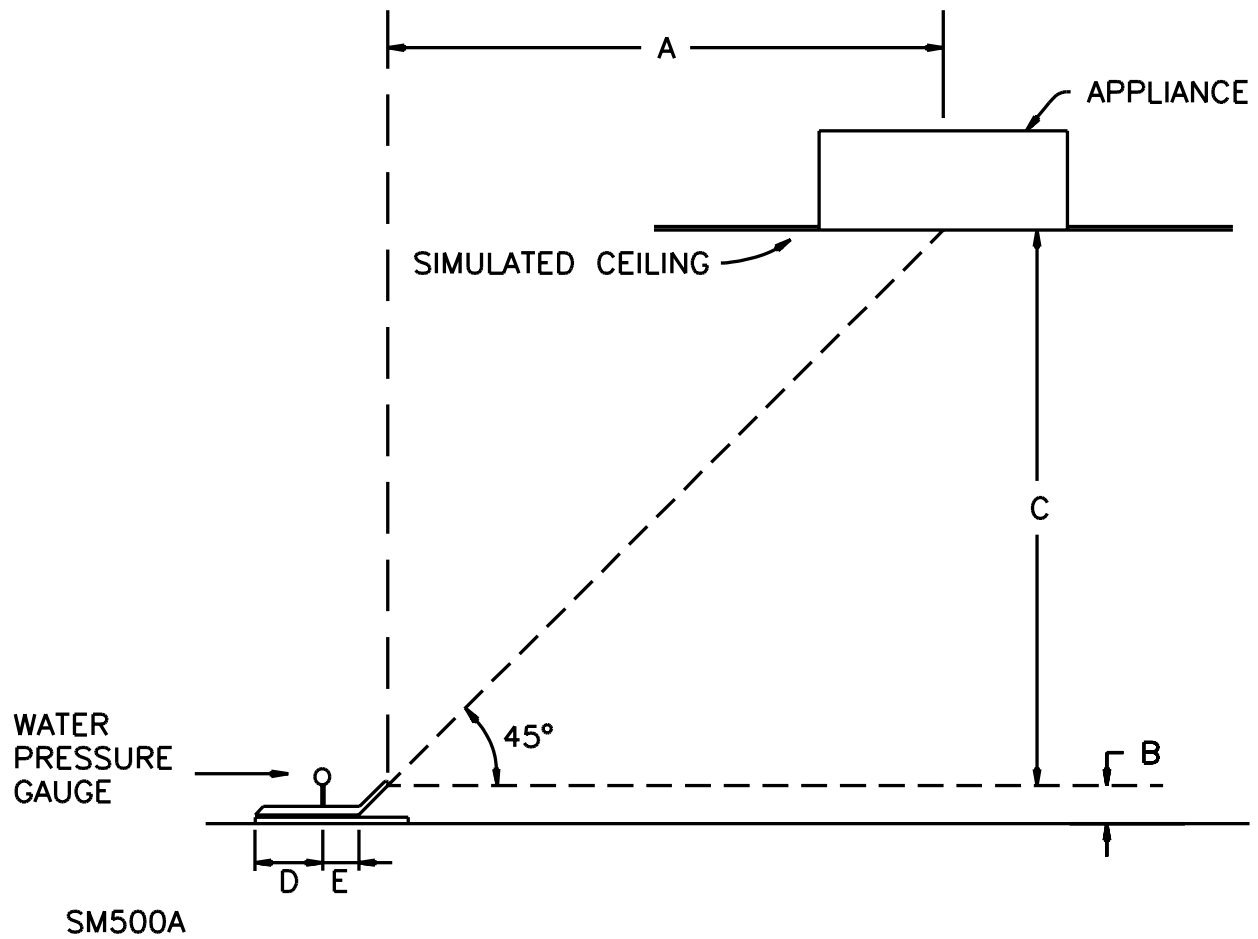
142.2.1 A glass diffuser provided in a ceiling-insert fan/light combination shall be subjected to the test described in 142.2.2 and 142.2.3. The diffuser shall remain intact and evidence no cracking or breakage as a result of the test.

142.2.2 The fan/light combination is to be installed as intended in a box with cellulosic insulation in accordance with sub-section 114.1 and energized for 30 minutes at rated voltage with the fan off. (An integrated thermostat that energizes the fan is not to be defeated.)

142.2.3 Immediately following the 30 minutes, the fan/light combination is to be subjected to the waterspray test described in 142.1.2 – 142.1.4 for one minute at 138 kPa (20 psi).

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Figure 142.1  
Water spray test set-up for ceiling-insert fans or ceiling-insert fan/light combinations



Conditions:

Water pressure = 138 kPa (20 psi)

A – 762 mm (30 inches)

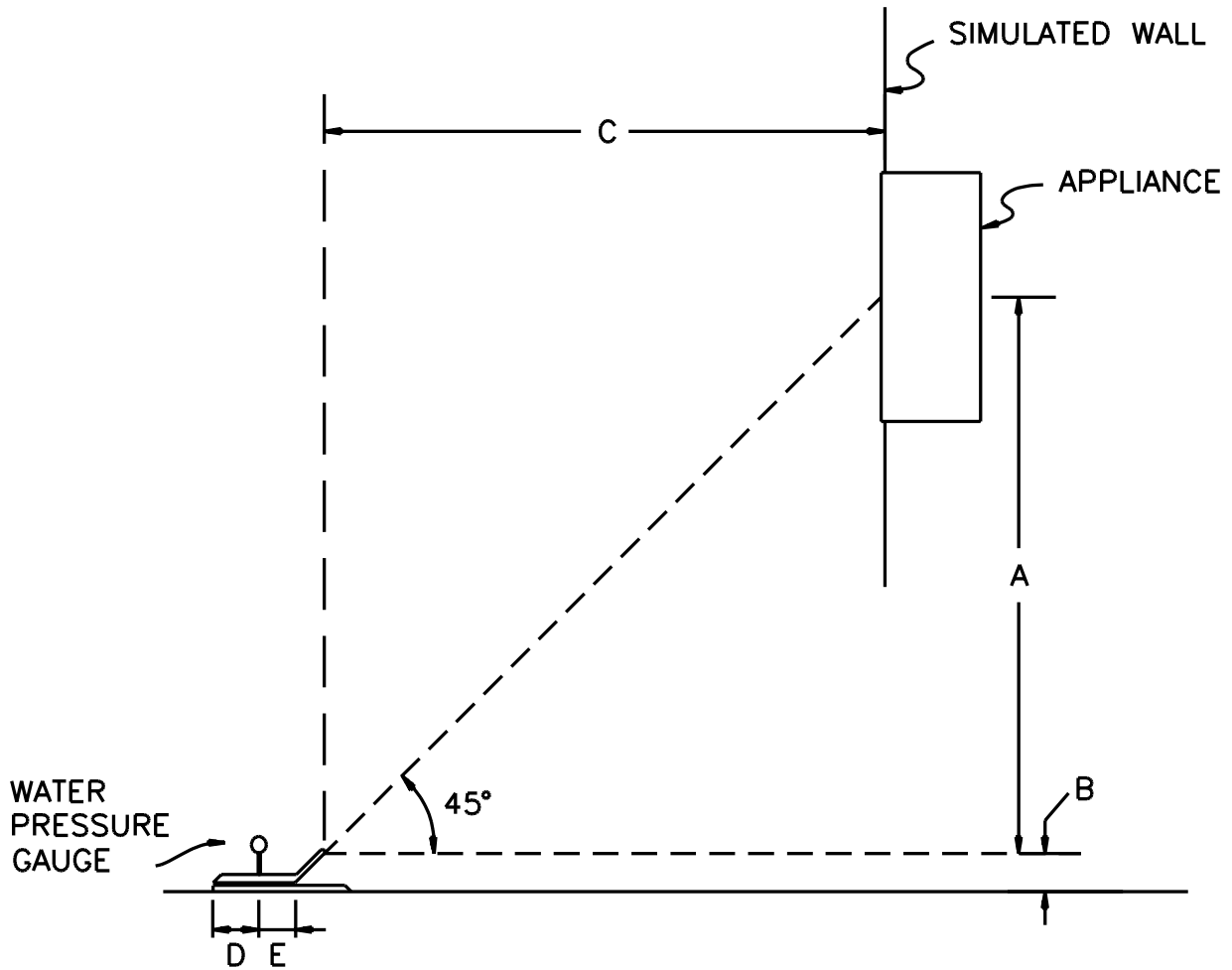
B – 76.2 – 152.4 mm (3 – 6 inches)

C – 762 mm (30 inches)

D – 228.6 mm (9 inches)

E – 76.2 mm (3 inches)

Figure 142.2  
Water spray test set-up for wall-insert fans



SM501A

Conditions:

Water pressure = 138 kPa (20 psi)

A – 762 mm (30 inches)

B – 76.2 – 152.4 mm (3 – 6 inches)

C – 762 mm (30 inches)

D – 228.6 mm (9 inches)

E – 76.2 mm (3 inches)

### 143 Marking

143.1 A ceiling-insert fan, wall-insert fan, or ceiling-insert fan/light combination intended to be used over a bathtub or shower shall be marked where visible during installation with the following or equivalent: "Acceptable for use over a bathtub or shower when installed in a GFCI protected branch circuit."

143.2 A wall-insert fan intended for installation over a bathtub or shower shall be marked where visible during installation with the following or equivalent: "Install Fan At Least 1.5 m (5 feet) Above The Floor." This marking shall be in addition to the marking required in 143.1.

### 144 Installation Instructions

144.1 Detailed installation instructions with illustrations shall be provided with all ceiling-insert, wall-insert, and ceiling-insert fan/light combinations intended for use over a bathtub or shower. The instructions shall also include the wording from the marking specified in 143.1.

144.2 A wall-insert fan intended for installation over a bathtub or shower shall be provided with instructions indicating that the fan is to be installed at least 1.5 m (5 feet) above floor level.

## DOWN-DRAFT FANS

### 145 General

145.1 In addition to the applicable requirements in Part 1 of this Standard, a down-draft fan shall comply with the requirements in Sections 146 – 149. Also see 5.1.

### 146 Construction

#### 146.1 Power supply connections

146.1.1 A down-draft fan shall be provided with a means of permanent connection to the power supply or with a power supply cord. See 13.1.2.

#### 146.2 Actuating members

146.2.1 An actuating member is a part of the operating mechanism of the down-draft fan which extends outside of the enclosure and is intended for contact by the user.

146.2.2 A down-draft fan which is marked for installation on a specific range shall comply with the requirements in 146.2.3 and 146.2.4 when installed in accordance with the instructions required by 149.1. See also 148.1. A down-draft fan not marked for use with specific ranges shall comply with these requirements when installed in accordance with the instructions required by 149.2.

146.2.3 The actuating member of a control shall have its center at least 152.4 mm (6 inches) above the utensil support surface when the control is located:

- a) On a panel of the back guard; and
- b) Within an area defined by vertical planes 101.6 mm (4 inches) outside the outermost edges of any surface cooking unit and perpendicular to the back guard.

146.2.4 With reference to 146.2.3, if the center access of the actuating member is not parallel to the surface of the cooktop, the center of the smallest cylinder that will completely enclose the actuating member is considered to be the center of the actuating member.

### 146.3 Ducts

146.3.1 A fan and integral duct assembly provided for removal of grease-laden air shall be constructed so that cleaning of the fan and integral surfaces of the duct can be accomplished without completely removing the range or oven from its installed position.

*Exception: A fan is not required to comply with this requirement when it is determined that accumulation of grease on internal surfaces of a duct that cannot be cleaned does not result in an increased risk of fire. See 147.3.1 – 147.3.3.*

### 146.4 Accessibility of moving parts

146.4.1 The housing of a down-draft fan which is designed to open on activation and close on deactivation shall comply with the requirements in 8.2.1.

## 147 Performance

### 147.1 Temperature test

147.1.1 A down-draft fan shall be mounted as specified in the installation instructions provided with the unit and shall be mounted adjacent to:

- a) The specific range or ranges marked on the down-draft fan (see 148.1);
- b) The standard gas test range described in 147.1.2 for a down-draft fan intended to be used with a gas range or either a gas or electric range; or
- c) The standard electric test range described in 147.1.3 for a down-draft fan intended to be used only with an electric range. See 148.2.

The combination shall in turn be mounted in the test enclosure shown in Figure 147.1.

147.1.2 The standard test gas range to be employed shall have four surface burners rated 2.93 kW (10,000 Btu per hour) each and a grill rated 4.1 kW (14,000 Btu per hour) when supplied with natural gas.

147.1.3 The standard electric test range to be employed shall have two 152.4-mm (6-inch) diameter, 1200 W minimum elements, two 203.2-mm (8-inches) diameter, 2000 W minimum elements, and a 3000 W minimum grill.

147.1.4 A stove plate is to be placed on one surface cooking unit when there are not more than four surface cooking units, and on two cooking units when there are more than four surface cooking units. Each remaining surface cooking unit is to be covered with a pan of water. The unit or units to be covered with a plate shall be in accordance with the following order of precedence:

- a) Front cooking unit, if any. See 147.1.5.
- b) Cooking units having the highest wattage rating.
- c) Cooking units farthest from the wall of the test booth.



d) Cooking units having the largest diameter.

147.1.5 With reference to 147.1.4(a), the front of a range having no oven is considered to be the long side adjacent to the highest wattage cooking unit unless the installation instructions indicate otherwise.

147.1.6 The stove plates are to be circular cast-iron or steel plates. The plate used with a 152.4 mm (6 inch) or smaller diameter surface cooking unit is to be 190.5 mm (7-1/2 inch) in diameter and is to weigh approximately 1.4 kg (3 lb). The plate used with a surface cooking unit of diameter larger than 152.4 mm (6 inch) is to be 266.7 mm (10-1/2 inch) in diameter and is to weigh approximately 3.2 kg (7 lb). The plates are to be flat on one side but may be ribbed on the other side to prevent warping. The plates are to be kept free from rust by use of steel wool or the like.

147.1.7 The pans are to have essentially vertical sides. The diameter of the bottom surface of the pan is to be no less than the maximum diameter of the active part of the surface cooking unit on which the pan is used, and no more than 25.4 mm (1 inch) larger than that diameter. The pans are to be aluminum.

147.1.8 For the standard gas test range, the control for each surface burner covered with a pan of water is to be adjusted to 888.68 W (3031 Btus per hour).

147.1.9 For the standard electric range, the control for each 1200-watt element is to be set so that the average power input is 650 watts. The control for the 2000-watt element on which a pan of water is placed is to be set so that the average power input is 833 watts.

147.1.10 The griddle of the 914.40-mm (36-inch) standard electric range is to be operated with its control set so that the temperature at the center of the griddle plate is close to, but not less than, 246°C (475°F).

147.1.11 The control for each surface cooking unit covered with a stove plate is to be adjusted to result in a temperature of 246°C (475°F) at the center of the top surface of the stove plate. An automatic or cycling type intermittent input-control is to be set so that the average temperature at the center of the top surface of the stove plate is 246°C (475°F). When a control on an electric range having a definite number of settings can not be set to result in this temperature, the surface cooking unit is to be connected to an external power supply with a means for varying its output voltage; the output voltage is to be set so that the temperature at the center of the top surface of the stove plate is 246°C.

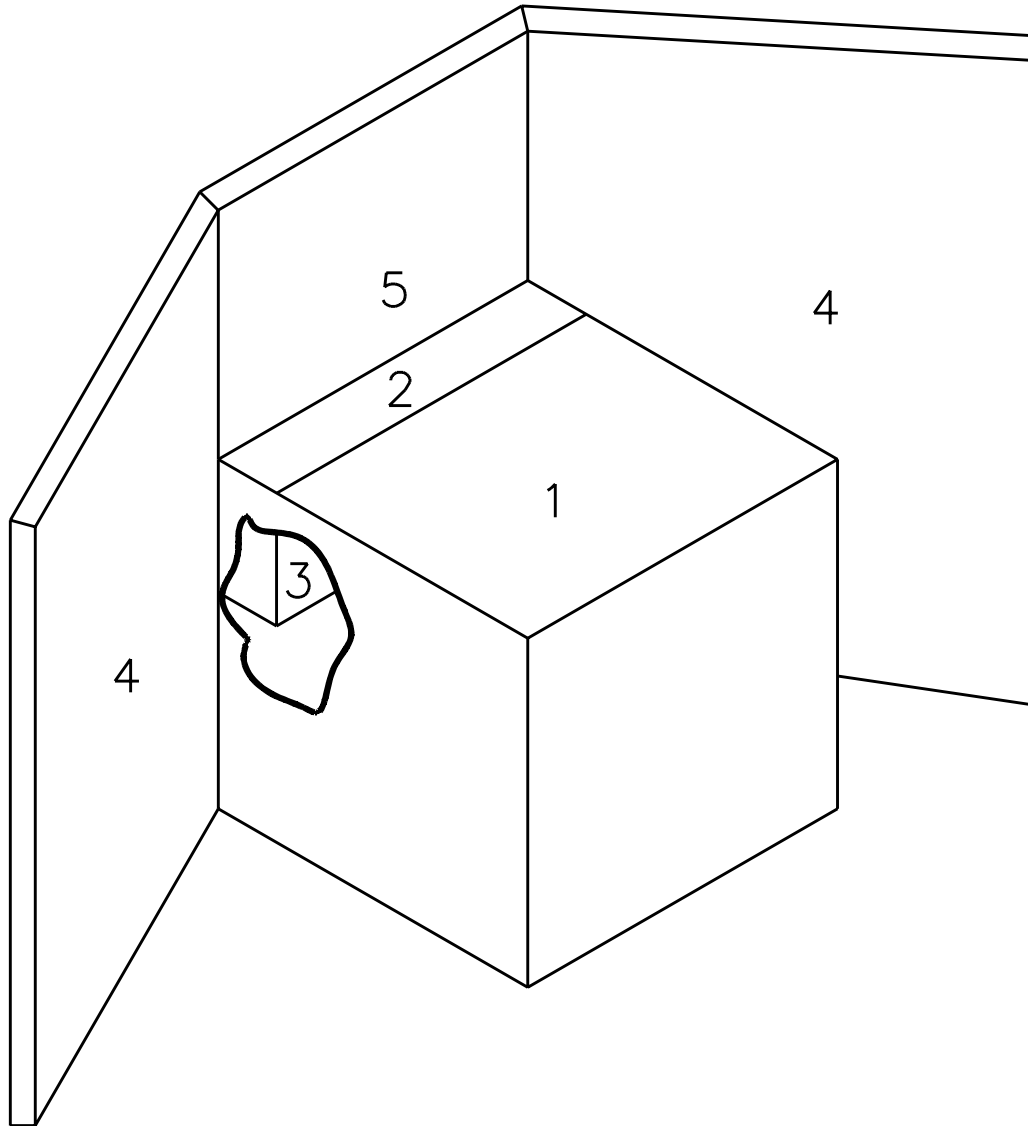
*Exception No. 1: When the control has only one setting, the test is to be conducted with the control set in this position.*

*Exception No. 2: When setting the control in the position that provides maximum heat results in a temperature less than 246°C (475°F) at the center of the top surface of the stove plate, the test is to be conducted with the control set in this position.*

147.1.12 When a downdraft fan is intended for use with a specific gas range or ranges, the range or ranges are to be operated using the stove plates and pans of water noted in 147.1.4, 147.1.6, 147.1.7, 147.1.8, and 147.1.11. The control for the surface burner covered with a stove plate is to be adjusted to result in a temperature of 246°C (475°F) at the center of the top surface of the stove plate. The control for each burner covered with a pan of water is to be adjusted so that the power input to the burner is not less than:

- a) 50 percent of rated power input for a burner rated 1200.54 W (4096 Btu per hour) or less; or
- b) 400 watts plus 1/6 of the power rating of the burner in watts.

Figure 147.1  
Test enclosure for down-draft fan



SM515

1. Cooking Surface
2. Down-draft Fan Intake
3. Down-draft Fan Assembly
4. Building Side Wall (See 99.1.2.1 and 99.1.2.2)
5. Building Back Wall (See 99.1.2.1 and 99.1.2.2)

147.1.13 The devices shall operate as specified above until temperatures become constant. See 36.1.10. After temperatures become constant, the grill is to be operated at its maximum setting for a period of one hour.

147.1.14 When a downdraft fan is intended for use with a specific electric range or ranges, the range or ranges are to be operated as specified in the Standard for Household Electric Ranges, UL 858.

## **147.2 Flare-up test**

147.2.1 A down-draft fan intended for general use shall comply with the requirements specified in 147.2.2 after being tested in accordance with 147.2.3 and 147.2.4. A down-draft fan intended for use with a specific range or ranges shall comply with the test when the heat source is below the cooking surface, and the average temperature at any point of the heat source exceeds 260°C (500°F) or the maximum temperature at any point of the heat source exceeds 300°C (572°F).

147.2.2 There shall be no glowing or flaming of combustible material, either wood or cheesecloth, in proximity to the appliance as installed when the appliance is operated under the conditions described in 147.2.3 and 147.2.4. There shall be no visible damage to wiring. The fan shall comply with the dielectric strength requirements of Section 37 upon completion of this test.

147.2.3 The appliance is to be installed as intended and mounted in the test enclosure shown in Figure 147.1. The surfaces of the test enclosure above, to each side of, and behind the appliance are to be covered with two layers of cheesecloth secured as tightly as practicable to the enclosure surface. The cheesecloth on the side and back walls of the test enclosure is to extend below the horizontal top cooking surface of the range.

147.2.4 After the appliance has been subjected to maximum normal heating for 10 minutes, the cooking surface above the active heating element area is to be covered uniformly with 76.2 mm (3 inch) diameter, 25.4 mm (1 inch) thick patties of ground beef. The adjacent edges of the patties are to be touching as the cooking begins. The ground beef is to consist of a mixture of 50 percent each by weight of lean beef and suet that have been ground together twice. Lean beef is considered to be beef with all fat cut away from the edges and from the interior of the cut. The patties are to be broiled on one side until they appear to be half-cooked and then turned over once. The patties are then to be cooked until substantially all fat has been rendered. Melted fat is to be allowed to accumulate in the normal manner except any instructions for adding water or similar materials to the fat receptacle are to be disregarded.

## **147.3 Temperature and grease build-up profile**

147.3.1 A down-draft fan incorporating ducts which cannot be cleaned shall be subjected to a temperature and grease build-up profile as indicated in 147.3.2 and 147.3.3.

147.3.2 Batches of 9.07 kg (20 lb), 70 percent lean hamburger formed into 0.1 kg (1/4 lb) patties will be cooked on the active element until ultimate results are obtained. During the cooking procedure, ambient air and surface temperatures within the duct assembly are to be monitored. These temperatures shall not exceed 275°C (527°F).

147.3.3 After each batch of patties are cooked, the duct is to be examined to observe build-up of grease and signs of ignition. There shall be no ignition or propagation of flame within the duct during cooking.

## 148 Marking

148.1 A down-draft fan intended for use with a specific range or ranges shall be marked with the following, or the equivalent: "For use only with \_\_\_\_\_ range." The range may be identified by manufacturer's name and a catalog or model number, or the equivalent. The marking shall be located so that it is visible during installation.

148.2 With regard to 147.1.1(c), a down-draft fan intended for general use with an electric range shall be marked with the following, or the equivalent: "For use only with an electric range." The marking shall be located so that it is visible during installation.

## 149 Installation Instructions

149.1 A down-draft fan intended for use with a specific range or ranges shall be provided with installation instructions. The installation instructions shall include complete information on assembly of the range and down-draft fan, including a tabulation of the specific ranges which are suitable.

149.2 A down-draft fan intended for general use shall be provided with installation instructions. The instructions shall include information on assembly of the range and down-draft fan such that the assembly complies with the requirements in this Standard.

149.3 The installation instructions for cord connected down-draft fans shall include directions for connecting the power supply cord to the receptacle located below the cooktop surface. The instructions shall indicate that the cord is to be:

- a) Routed beneath the appliance; and
- b) Routed away from heat generated by the cooktop.

## LOW VOLTAGE COMPONENT FANS

### 150 General

150.1 Low voltage component fans shall comply with the applicable requirements (see 6.1.1, 16.3, 16.6, 19.1, 21.6, 36.1.1 – 36.1.7, 36.1.10, 37.2, 37.5, and Sections 12, 15, 17, and 58) in Part 1 of the Standard and the requirements in Sections 151 – 154. The requirements in Sections 151 – 154 supplement and, in some cases, modify the applicable requirements in Part 1 of the Standard.

150.1 revised December 23, 2003

## 151 Construction

### 151.1 Flammability of non-metallic enclosures and other parts

151.1.1 A non-metallic enclosure, frame, or impeller of a low voltage component fan shall be of a material rated a minimum of V-2 in accordance with the Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

*Exception: A non-metallic enclosure, frame, or impeller of a low voltage component fan shall have a minimum rating of V-1 in accordance with UL 94 , Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, when it is intended for use in an end-product application requiring a minimum rating of V-1 for the fan component material.*

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151.1.2 A printed-wiring board shall be rated a minimum of V-1 in accordance with the Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

### **151.2 Internal wiring – electrical connections**

151.2.1 Wiring leads and motor windings that are "tack soldered" to the printed-wiring board shall be provided with routing such that a detached lead does not move to the extent that it results in reduced spacings in the fan or in an end-product in which it is installed.

151.2.2 The printed-wiring board may contain surface mount components.

### **151.3 Insulating material**

151.3.1 Bobbin material or other insulating material inside a metallic enclosure, or a non-metallic enclosure in accordance with 151.1, shall be rated a minimum HB in accordance with the tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

151.3.2 Bobbin material or other insulating material not enclosed as described in 151.3.1 shall be rated a minimum V-2 in accordance with the tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

151.3.3 Insulating materials classified using 1.6-mm (1/16-inch) thick bar specimens shall not be used at less than their specified thickness unless the flame rating at 1.6 mm (1/16 inch) meets or exceeds the requirement in 151.3.1 or 151.3.2.

## **152 Performance**

### **152.1 Test voltages**

152.1.1 A low voltage component fan is to be tested at its rated voltage. When a range of operational voltages is provided, the fan is to be tested at the voltage which represents the most severe case.

### **152.2 Input test**

152.2.1 The input current to a low voltage component fan shall be not more than 120 percent of the rated value when the fan is operated under conditions of intended service, when connected to a power-supply circuit of maximum rated voltage and rated frequency (if applicable).

### **152.3 Temperature test**

152.3.1 The Temperature Test of Section 36 is to be conducted for a low voltage component fan with the requirements in 152.3.2 supplementing the requirements in Section 36, Temperature Test.

152.3.2 For a multispeed fan, the temperature test is to be conducted at the maximum speed at rated voltage. When a fan is equipped with a temperature sensing speed control, the temperature test is to be conducted at the lowest ambient temperature required to attain maximum speed.

#### 152.4 Dielectric voltage withstand test

152.4.1 A low voltage component fan is to withstand for 1 minute without breakdown the application of a 500 volt, 60-hertz essentially sinusoidal potential between the input leads or terminals and dead metal parts, or between the input leads or terminals and metal foil which is wrapped around the hub of the fan.

#### 152.5 Abnormal operation locked rotor test

152.5.1 A low voltage component fan is to be connected to a supply source at rated voltage while placed on a soft wood surface which is to be covered by a single layer of white tissue paper. The fan is to be covered with a single layer of cheesecloth. The fan is to then be operated with the rotor locked for 7 hours and the winding temperature is to be monitored.

152.5.2 In order to comply with the locked rotor test, the tissue or cheesecloth shall not ignite during or after the test as described in 152.5.1. If a circuit component opens during the test, the test shall be conducted two more times on new samples.

152.5.2 revised December 23, 2003

152.5.3 Following the locked rotor test described in 152.5.1, the dielectric voltage withstand test described in 152.4.1 is to be repeated.

152.5.3.1 Following the locked rotor test described in 152.5.1, a low voltage component fan with board traces acting as a coil winding shall be inspected for degradation of the printed wiring board as indicated by wrinkling, cracking, blistering, or loosening of any conductor, or any delamination of the base material or bonding layer.

152.5.3.1 added February 21, 2003

152.5.4 When the stabilized winding temperature exceeds the temperatures for the class of insulation per Table 36.1, the locked rotor test shall be continued in accordance with 40.3 – 40.7.

Exception: When the stabilized winding temperatures of a low voltage component fan with board traces acting as a coil winding exceeds the maximum operating temperature limits as indicated in UL 796, the Standard for Printed-Wiring Boards, the test shall be continued for 18 days. When the fan construction is such that the circuit de-energizes during locked rotor, the fan is to be reset 50 times.

152.5.4 revised February 21, 2003

152.5.4.1 When low voltage protected fans are tested according to 40.3 – 40.7, temperatures should be evaluated according to Table 14.1 of UL 2111, the Standard for Overheating Protection for Motors.

152.5.4.1 added February 21, 2003

152.5.5 For a multispeed fan, the locked rotor test is to be conducted at the maximum speed at rated voltage. When a fan is equipped with a temperature sensing speed control, then the locked rotor test is to be conducted at the lowest ambient temperature required to attain maximum speed.



### 153 Rating

153.1 A low voltage component fan shall be rated in volts dc, nominal voltage range in volts dc, volts ac and frequency, or nominal voltage range in volts ac and frequency. The frequency shall be expressed in one of the following terms: hertz (HZ), cycles-per-second, cps, cycles/second, or c/s.

153.2 A low voltage component fan shall also be rated as nominal power and/or current expressed in amperes, watts, amperes and watts, or kilowatts.

### 154 Marking

154.1 Each low voltage component fan shall be marked with a model number, catalog number, or similar identifying designation; the manufacturer's name or trademark; and the electrical ratings. When the product is produced at more than one factory, each finished fan shall have a distinctive marking, such as a code, which identifies the fan as the product of a particular factory.

154.1 revised February 21, 2003

154.2 Low voltage component fans which employ electronic circuitry which causes the locked rotor current to be less than 50 percent of the normal operating current may be marked "Electronically Protected" or "E.P.".

154.2 revised February 21, 2003

## DRYER TYPE AND COMMERCIAL BLOWER INFLATOR TYPE FANS

### 155 General

155.1 Dryer type and commercial blower inflator type fans shall comply with the applicable requirements in Part 1 of the Standard and shall also comply with 109.4, Section 55, Hassock Fan Load Test, Section 156, Construction, and Section 156A, Performance. The requirements in Sections 156 and 156A supplement, and in some cases, modify the applicable requirements in Part 1 of the Standard.

155.1 revised February 21, 2003

155.2 Dryer type fans shall also comply with 137.1, 137.3, 138.1, and 138.2.

*Exception: Dryer type fans intended for indoor use only shall be marked per 63.5.*

155.2 added February 21, 2003

155.3 Inflators intended for outdoor use shall also comply with the requirements in Sections 134 – 138.

155.3 added February 21, 2003

## 156 Construction

### 156.1 Convenience receptacle

156.1.1 For compliance with the Exception to 38.1.1(h), the convenience receptacle on a dryer type fan shall be located at least 38 mm (1-1/2 inches) from the floor.

156.1 revised and renumbered as 156.1.1 February 21, 2003

### 156.2 Power supply cord

156.2.1 A dryer type or inflator type fan shall be provided with:

- a) A flexible cord and attachment plug in accordance with Section 14, Power Supply Connections – Permanently-Connected Appliances, except the flexible cord ampacity, shall be in accordance with Table 156.1;
- b) A short "stubby cord" power supply cord and attachment plug intended for connection to an extension cord where the "stubby cord" is permanently attached to the fan and complies with 14.1.1, 14.1.2, and 14.1.5 – 14.1.11; or
- c) An inlet (motor attachment plug) for connecting an extension cord.

156.2.1 added February 21, 2003

156.2.2 For a fan provided with a power supply cord as described in 156.2.1(b), the construction of the fan and the length of the cord shall be such that the cord connector of the extension cord shall be located at least 38 mm (1.5 inches) from the floor when the fan is in a normal operating position.

156.2.2 added February 21, 2003

156.2.3 For a fan provided with a power supply cord as described in 156.2.1(b), the attachment plug on the supply cord shall be constructed such that, when inserted in the connector of an extension cord, the blades will not be energized until they are inaccessible to contact by persons. See the attachment plug test of 156A.2.

156.2.3 added February 21, 2003

156.2.4 A flexible cord set (extension cord) provided with, or made available for use with, a dryer type or inflator type fan shall be one of the types specified in Table 14.1 Item 8, shall not exceed 30.5 m (100 feet) in length, and shall have a minimum ampacity in accordance with Table 156.1.

156.2.4 added February 21, 2003

**Table 156.1**  
**Ampacities for flexible cords for dryer type and inflator type fans**

Table 156.1 added February 21, 2003

Conductor Size		Ampacity (Amperes)	
AWG	(mm <sup>2</sup> )	15.2 m (50 ft) or less in length	Over 15.2 m (50 ft) in length
18	(0.82)	10	7
17	(1.04)	12	10
16	(1.31)	13	12
14	(2.08)	18	13
12	(3.31)	25	18

156.2.5 A dryer type or inflator type fan intended for use with an extension cord shall not be provided with terminal pins that will accommodate a standard flatiron or appliance plug.

156.2.5 added February 21, 2003

## 156A Performance

### 156A.1 General

156A.1.1 For a dryer type or inflator type fan provided with a power supply cord as described in 156.2.1(a), testing shall be conducted with the maximum intended length power supply cord to determine potential overheating of the motor caused by voltage drops from a long power supply cord.

156A.1.1 added February 21, 2003

156A.1.2 For a dryer type or inflator type fan provided with a short "stubby cord" intended for use with an extension cord, testing shall be conducted with a 30.5 m (100 foot) extension cord of the minimum size specified in Table 156.1 for the ampacity of the fan.

156A.1.2 added February 21, 2003

### 156A.2 Attachment Plug Test

156A.2.1 When tested as described in 156A.2.2, the test probe shall not contact any blade of the attachment plug while the plug is conductively connected to the connector of the extension cord.

*Exception: The probe may contact the grounding blade of a 3-conductor grounding plug.*

156A.2.1 added February 21, 2003

156A.2.2 The receptacle used in the test is to comply with the requirements in the Standard for Attachment Plugs and Receptacles, UL 498, or the equivalent. The receptacle is to be connected to the extension cord of the test assembly illustrated in Figure 156A.1. The plug is to be inserted in the receptacle as far as possible. The plug is then to be withdrawn not more than the distance that is necessary to permit the test probe to be inserted between the plug body and the extension cord receptacle. The test probe is to be inserted with a force of 18 N (4.1 lbs) or less, until the probe contacts one blade of the plug. While the probe is in contact with the blade, the electrical continuity is to be determined by an ohmmeter or similar instrument between the contacts of the extension cord receptacle and the test probe. The test is then to be repeated for the other blade of the attachment plug.

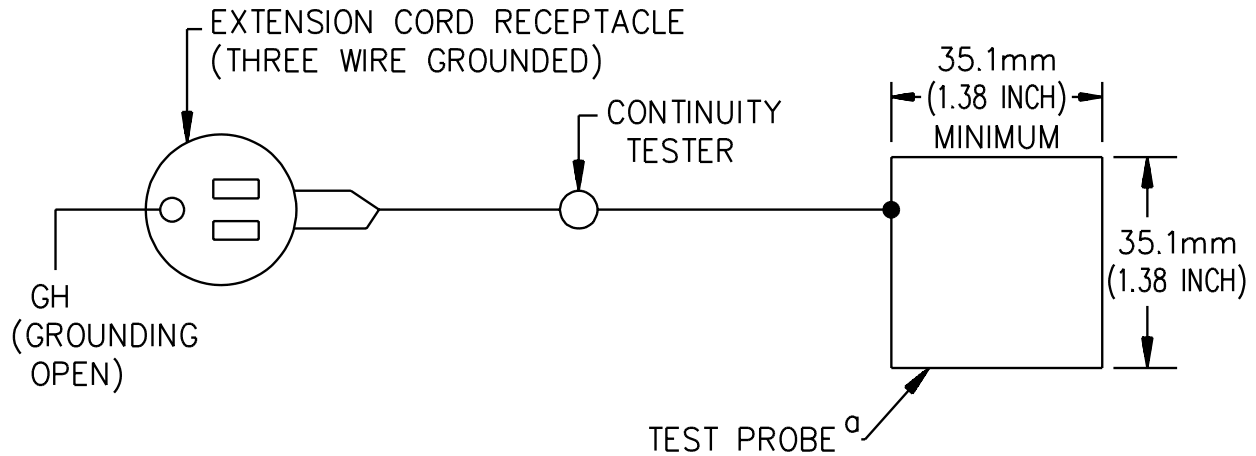
156A.2.2 added February 21, 2003

156A.2.3 The test probe mentioned in 156A.2.2 is to be made of 1.5-mm (0.06-inch) thick metal that is 35 mm (1.38 inches) wide, and not less than 35 mm long.

156A.2.3 added February 21, 2003

**Figure 156A.1**  
**Test assembly for accessibility of attachment-plug blades**

Figure 156A.1 added February 21, 2003



<sup>a</sup> TEST PROBE IS TO BE MADE OF 1.5mm (0.06 INCH) THICK METAL.

SA1832B

## 156B Markings

### 156B.1 General

156B.1.1 A dryer type or inflator type fan shall be marked "CAUTION" and the following or the equivalent: "To reduce the risk of electric shock, connect only to an outlet provided with a ground fault circuit interrupting device."

156B.1.1 added February 21, 2003

156B.1.2 A dryer fan intended for indoor use only that has not been subjected to the Water Spray Test in 38.1.1 shall be marked in a readily visible location with the word "WARNING" and the following or equivalent: "To reduce the risk of electric shock, do not expose to water or rain."

156B.1.2 added February 21, 2003

156B.1.3 A blower inflator type fan that is intended for use in wet or outdoor locations shall be marked "outdoor use".

156B.1.3 added February 21, 2003

156B.1.4 A dryer or blower inflator type fan without a "stubby cord" in accordance with 156.2.1(b) shall be marked with the following or equivalent: "Do not use an extension cord with this fan".

156B.1.4 added February 21, 2003

## 156C Instructions

### 156C.1 General

156C.1.1 The important safety instruction section of the instruction manual for products intended for use with an extension cord as described in 156.2.1 (b) or (c) shall include the following:

a) "Warning" and the following or equivalent: "To reduce the risk of electric shock, use only with an extension cord type S, SO, ST, STO, SJ, SJT, SJO, or SJTO."; and

b) The following or equivalent: "Extension Cord – Make sure your extension cord is in good condition and be sure to use one heavy enough to carry the current your product will draw. An undersized extension cord will cause a drop in line voltage resulting in loss of power and overheating. If in doubt, use the next heavier gauge. The smaller the gauge number, the heavier the cord." Correct gauge should be specified per Table 156.1.

156C.1.1 added February 21, 2003

156C.1.2 A cord-connected outdoor use appliance shall be provided with installation instructions that consist of the following or equivalent wording: "Use Only on GFCI Protected Receptacles."

*Exception: This marking is not required when a GFCI device is provided as a part of the appliance.*

156C.1.2 added February 21, 2003

156C.1.3 When user servicing or cleaning operations are anticipated, the instructions shall indicate that the source of electrical supply is to be disconnected prior to the beginning of any such servicing or cleaning operation.

156C.1.3 added February 21, 2003

## EVAPORATIVE COOLERS AND AIR-FILTERING APPLIANCES FOR COMMERCIAL-INDUSTRIAL APPLICATIONS

### 157 General

157.1 These requirements cover evaporative coolers and air-filtering appliances that:

a) Are of the stationary type, typically installed on the outside of a building, including a rooftop;

b) Are intended for connection to a duct system that interconnects rooms or spaces within a building for distributing moistened and/or filtered air or are intended for direct discharge of air into large open spaces such as warehouses;

c) Employ a three phase blower motor rated not more than 600 V, or a single phase blower motor rated not more than 600 V and not less than 3/4 hp; and

d) Are intended for connection to the supply circuit by a permanent wiring method in accordance with the National Electrical Code, ANSI/NFPA 70- 2002.

157.1 revised February 21, 2003

157.2 The requirements in Sections 157 – 160 supplement, and in some cases modify, the general requirements of Part 1 of the Standard. In addition, a commercial-industrial evaporative cooler or air-filtering appliance shall comply with the outdoor use equipment requirements in Sections 134 – 138. Commercial-industrial evaporative coolers shall also comply with the evaporative cooler requirements in Sections 128 – 130, with the exception of sub-section 129.2, Motors and pumps.

157.2 added September 24, 2001

157.3 A water pump used to circulate water through the filter media material of an evaporative cooler shall comply with the requirements in the Standard for Motor Operated Water Pumps, UL 778.

*Exception: A water pump which complies with the requirements in UL 778 in all other ways may be provided with an SPT-2 supply cord provided the cord is strictly for internal connections within the appliance enclosure and:*

- a) *Is reliably routed away from all sources of water; or*
- b) *Is protected by a GFCI type receptacle within the appliance.*

157.3 added September 24, 2001

## 158 Construction

### 158.1 Assembly and shipping

158.1.1 A factory assembled commercial-industrial evaporative cooler shall include the complete outer cabinet, filter media material, water distribution lines, backflow prevention means, and blower or fan assembly. Other parts that are necessary to assure the cooling performance for which the evaporative cooler was designed, including blower or fan motor(s) and water pump assembly(s), may be furnished separately for installation in the field when these parts are fully identified by a marking on the evaporative cooler.

158.1.1 added September 24, 2001

158.1.2 A factory assembled commercial-industrial air-filtering appliance shall include the complete outer cabinet and blower or fan assembly. Other parts that are necessary to assure the filtering performance for which the appliance was designed, including blower or fan motor(s), may be furnished separately for installation in the field when these parts are fully identified by a marking on the air-filtering appliance.

158.1.2 added September 24, 2001

158.1.3 For both commercial-industrial evaporative coolers and air-filtering appliances, other parts that are intended to be mounted on or in the unit to complete the final assembly, including outlet boxes, internal wiring, flexible conduit, conduit fittings, on/off switch, plug-in receptacle, and the like, need not be provided or be specified in the marking when details of their field installation are included in the installation instructions furnished with each unit. The installation methods shall be reviewed to determine compliance with these requirements.

158.1.3 added September 24, 2001

158.1.4 Outlet boxes, disconnect switches, power transformers, wiring conduit, and the like, intended to be installed at the factory or in the field on the cabinet exterior, shall be suitable for wet locations or outdoor use, as applicable, or be of liquid-tight construction. A receptacle installed within the unit cabinet shall be:

- a) Suitable for wet locations;

- b) Located such that liquid due to overflow, splashing, leakage or cleaning shall not enter the receptacle; and
- c) Mounted such that the face of the receptacle is not less than 60 degrees from the horizontal.

*Exception: A receptacle used in a circuit provided with a ground fault circuit interrupter is not required to be mounted with the face less than a minimum of 60 degrees from the horizontal.*

158.1.4 added September 24, 2001

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## 158.2 Transformers

158.2.1 A transformer necessary to supply a control circuit or power for a pump motor which operates at a different voltage than the fan motor is not required to be shipped with the evaporative cooler when:

- a) The proper selection of transformer as to type and rating is covered in the installation instructions furnished with the unit;
- b) The rules for overcurrent protection of the transformer are included in the installation instructions, and are in accordance with Article 450 of the National Electrical Code, ANSI/NFPA 70-1999; and
- c) The installation instructions caution against mounting the transformer and overcurrent protective devices within the cabinet of the appliance, unless the unit has been evaluated for this installation.

158.2.1 added September 24, 2001

## 158.3 Motor overload protection

158.3.1 All motors shall be protected by inherent thermal protective devices or by overcurrent protective devices, or by a combination of these.

158.3.1 added September 24, 2001

158.3.2 Motor overload protection for a multi-speed motor shall be effective at any speed for which the motor is connected to the supply circuit in accordance with the installation wiring diagram, or to which it is switched by the user during the normal operation of the unit.

158.3.2 added September 24, 2001

158.3.3 A motor employing integral thermal protection where the motor-protector combination complies with the requirements in UL 2111, the Standard for Overheating Protection for Motors, is considered to comply with the requirement specified in 158.3.1.

*Exception: A motor, such as a direct-drive fan motor, that is not subjected to running overloads need comply only with the requirements for protection during locked-rotor conditions.*

158.3.3 revised December 23, 2003

158.3.4 Compliance with the requirement in 158.3.1 is achieved when the protection is provided by a separate device that is responsive to motor current and is rated or set to trip at not more than the percentages of the motor nameplate full-load current rating specified in Column A of Table 158.1.

158.3.4 added September 24, 2001

**Table 158.1**  
**Protective device activation level**

Table 158.1 added September 24, 2001

Motor type	Maximum percent of full-load current rating	
	A	B
Motor with a marked service factor not less than 1.15	125	140
Motor with a marked temperature rise not more than 40°C (104°F)	125	140
Any other motor	115	130

158.3.5 When the overload device, selected in accordance with Column A of Table 158.1, is not sufficient to start the motor or to carry the load, the next higher size device shall be permitted to be used when the trip current of the overload device does not exceed the percentage values specified in Column B of Table 158.1.

158.3.5 added September 24, 2001

158.3.6 A three phase motor shall be provided with overload protection as follows:

- a) Three overcurrent units; or
- b) Thermal protectors as described in 158.3.3, a combination of thermal protectors and overcurrent units, or another method of protection, where the specific protective arrangement has been investigated and found to provide protection under primary, single-phase failure conditions when power is supplied from transformers connected wye-delta or delta-wye.

158.3.6 added September 24, 2001

158.3.7 The overload protection specified in 158.3.4 – 158.3.6 is not required to be provided as part of the unit when all of the following conditions exist:

- a) The motor is to be field-wired to a separate circuit that does not supply any other loads within the unit;
- b) The motor overload protection is part of a separate, field-provided motor controller that does not require wiring interconnection to the unit, except for the motor circuit; and
- c) The product is marked in accordance with the requirements in 159.9.

158.3.7 added September 24, 2001

158.3.8 Fuses shall not be used as motor-overload protective devices unless the motor is protected by the fuse of the highest current rating that can be inserted in the fuseholder.

158.3.8 added September 24, 2001

## 158.4 Overcurrent protection

158.4.1 A pump motor in a unit intended for connection to a branch circuit rated more than 20 A at 115 V, or 15 A up to 600 V, shall be protected by an overcurrent-protective device incorporated in the appliance. The overcurrent-protective device shall have a maximum ampere rating in accordance with the National Electrical Code, ANSI/NFPA 70-1999.

*Exception No. 1: An overcurrent-protective device is not required as a part of the unit when it is determined that protection is obtained from the branch-circuit overcurrent-protective device through which the unit is supplied.*

*Exception No. 2: A motor having an inherent thermal protector that complies with requirements for such devices is not required to have an additional overcurrent-protective device when, in the unit, it is connected in series with a branch-circuit overcurrent-protective device of the same type and having a current rating equal to or less than that with which the motor-protector combination was tested during the investigation of the protector.*

158.4.1 added September 24, 2001

158.4.2 An attachment-plug receptacle intended for general use shall have overcurrent protection rated not more than 20 A in the unit unless the unit is properly connected to a branch circuit rated 20 A or less.

158.4.2 added September 24, 2001

158.4.3 The overcurrent protection specified in 158.4.1 and 158.4.2 shall be located in each ungrounded conductor, and shall comply with the requirements for branch-circuit protection.

158.4.3 added September 24, 2001

158.4.4 The screw shell of a plug fuseholder and the accessible contact of an extractor fuseholder shall be connected toward the load.

158.4.4 added September 24, 2001

## 158.5 Internal wiring

158.5.1 The internal wiring of a commercial-industrial evaporative cooler or air-filtering appliance shall be arranged such that it can be completed to the means provided for field connection, and shall consist of thermoplastic-insulated wiring materials with minimum insulation thickness of nominal 0.8 mm (1/32 inch) for No. 10 AWG and smaller wires. Conductors shall be not smaller than No. 18 AWG, with the exception of short integral lead wires of small electrical components.

158.5.1 added September 24, 2001

158.5.2 Except as indicated in 158.5.3, all high-voltage wiring located within the unit cabinet shall be enclosed in flexible conduit, electrical metallic tubing, metal raceways, control boxes, or the equivalent. Appropriate connection fittings shall be used.

158.5.2 added September 24, 2001

158.5.3 Flexible cords or appliance wiring materials with thermoplastic or neoprene insulation with minimum insulation thickness of 1.6 mm (1/16 inch) for Nos. 18 and 16 AWG sizes, and 2.0 mm (5/64 inch) for Nos. 14, 12 and 10 AWG sizes may be used within the unit cabinet. Cords and appliance wiring materials shall be supported and routed to prevent movement due to air currents, and shall be arranged such that they are not immersed in water unless rated for use in wet locations. In addition, areas accessible during user servicing including replacement of filters or evaporative media, appliance wiring materials shall be protected to prevent snagging, pulling, or other contact by service personnel.

158.5.3 added September 24, 2001

## 159 Markings

159.1 A commercial-industrial evaporative cooler or air-filtering appliance shall be marked with the following:

- a) "CAUTION: For installation by a qualified professional only.";
- b) Operating voltage;
- c) Frequency;
- d) Number of phases; and
- e) The total or individual loads as indicated in 159.2 and 159.3.

159.1 added September 24, 2001

159.2 The individual loads shall be marked as follows:

- a) For a fan or blower motor, the full-load ampere and horsepower ratings where the horsepower rating shall not be less than the horsepower rating on the motor nameplate;
- b) For a water pump motor or other small motor rated less than 1/8 hp, the full-load amperes, or watts, rating; and
- c) For a general-use receptacle, a load equal to 80 percent of the receptacle current rating, unless the receptacle is marked for a lesser rating.

Revised 159.2 effective December 23, 2005

159.3 The nameplate ampere rating for a single-phase unit intended for connection to a single branch circuit may be a single ampere value rather than individual ratings for individual loads when:

- a) The single load rating (amperes), voltage rating, and the marked maximum rating of the supply circuit protective device do not exceed the values in Table 159.1.
- b) The single marked ampere rating is not less than the sum of the individual load ratings (at the maximum concurrent load condition) required to be marked on the unit when the individual load ratings are shown.

159.3 added September 24, 2001

**Table 159.1**  
**Conditions for a single ampere rating**

Table 159.1 added September 24, 2001

Maximum rating, amperes	Maximum rating, voltage	Maximum rating of overcurrent protective device, amperes
12	120	15
16	120	20
12	208 or 240	15

159.3.1 When a commercial-industrial evaporative cooler or air-filtering appliance as described in 159.3 includes a horsepower rating, the rating shall be as indicated in 61.4.

Added 159.3.1 effective December 23, 2005

159.4 A unit not complying with 159.3 and employing more than one motor, or a motor with other loads, shall be marked on the nameplate with the minimum circuit ampacity and the maximum rating of the branch circuit protective device. When a unit is intended for use on two or more circuits, the nameplate shall include the minimum circuit ampacity and the maximum rating of the branch circuit protective device for each circuit.

159.4 added September 24, 2001

159.5 The minimum ampacity required in 159.4 shall be not less than 125 percent of the rated current of the largest motor plus the rated current ratings of the other motors and loads supplied. The largest motor is determined by its rated current. The ampacity marked on the nameplate shall be the highest of those calculated for each concurrent load condition.

159.5 added September 24, 2001

159.6 The maximum rating of the branch circuit protective device required in 159.4 shall not exceed 400 percent of the rated current of the largest motor plus the sum of any additional motors or other concurrent loads.

159.6 added September 24, 2001

159.7 A unit with field-wiring terminals shall be marked:

- a) "Use Copper Conductors Only" when the unit 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" when the unit is intended for field connection with either copper or aluminum wire.

159.7 added September 24, 2001

159.8 When correct field wiring connections are not evident, a wiring diagram shall be attached to each unit to show the intended method of making field-wiring connections. A paper sticker, glued or shellacked to an accessible cover, is considered to comply with this requirement.

159.8 added September 24, 2001

159.9 A unit requiring field-provided motor overload protection as required by 158.3.7 shall have markings readily visible during and after installation stating such, and indicating the motor overload protective devices shall be rated or selected in compliance with the applicable installation code as specified by the authority having jurisdiction.

159.9 added September 24, 2001

## 160 Caution Markings

160.1 When more than one disconnect switch is used to disconnect all power within a control panel or compartment, the panel or compartment shall be marked with the word "CAUTION", and the following or equivalent statement:

"Risk of Electric Shock – More Than One Disconnect Switch May Be Required To De-Energize The Equipment For Servicing."

The warning marking shall be:

- a) Permanent;
- b) In lettering no less than 3.2 mm (1/8 in) in height; and
- c) 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.

160.1 added September 24, 2001

## RETROFIT PUMPS FOR EVAPORATIVE COOLERS

### 161 General

161.1 These requirements cover single-phase recirculating pumps intended as replacement pumps in specific models or groups of models of evaporative coolers where the original pump provided with the cooler was not in full compliance with the Standard for Motor Operated Water Pumps, UL 778. They also cover drain pumps intended to replace existing drain pumps or to retrofit coolers not originally provided with drain pumps.

161.1 revised December 23, 2003

## 162 Construction

162.1 A water pump used to circulate water through the filter media material of an evaporative cooler or to drain mineral-laden water from the cooler reservoir shall comply with the requirements in the Standard for Motor Operated Water Pumps, UL 778.

*Exception No. 1: A pump is not required to comply with outdoor or wet location use requirements provided:*

- a) The pump location in the intended coolers provides protection from sunlight and rain; and*
- b) No part of the pump is exposed to water within the appliance other than those portions necessary for the functioning of the pump.*

*Exception No. 2: A cord-connected pump may be provided with a 3-wire (grounding type) SPT-2 or equivalent power supply cord provided the cord is strictly for internal connection within the appliance enclosure and:*

- a) The intended coolers have provision for the cord to be reliably routed away from all sources of water and the length of the cord is appropriate for the routing method; or*
- b) The pump is protected by a GFCI type receptacle within the intended coolers or the coolers are marked as required in 130A.1.*

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*Exception No. 3: A pump which is not provided with a power supply cord is acceptable only if:*

- a) It is intended to replace a pump not provided with a power supply cord;*
- b) It is provided with a means of connection compatible with the coolers it is intended for, including:*
  - 1) Minimum 3-wire, SPT-2 flexible cord;*
  - 2) Minimum 6-inch leads not smaller than 18 AWG, including an equipment grounding lead; or*
  - 3) A terminal compartment with terminations, including grounding, suitable for field wiring; and*
- c) The intended coolers:*
  - 1) Are provided with connection means suitable for use with water;*
  - 2) Have provision for the means of connection to be reliably routed away or protected from all sources of water and the length of a provided cord or leads is appropriate for the routing method;*
  - 3) The pump is protected by a GFCI type receptacle within the intended coolers; or*
  - 4) The coolers are marked as required in 130A.1.*

*Exception No. 4: A pump may be provided with a polymeric enclosure having a minimum V-2 flame rating.*

*Exception No. 5: Ball Impact testing is not required to be conducted on the pump enclosure provided the pump is installed inside the cooler in such a manner that it is protected from impact in normal use and during normal user servicing. Drop Impact Testing shall be conducted per UL 746C, the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations.*

*Exception No. 6: For pumps weighing no more than 2.3 kg (5 pounds), the Strain Relief Test in UL 778, the Standard for Motor Operated Water Pumps, shall be conducted on provided power supply cords, flexible cords, and leads with a 4.5 kg (10 pound) weight. For pumps weighing more than 2.3 kg (5 pounds) but no more than 6.8 kg (15 pounds), the Strain Relief Test in UL 778 shall be conducted with a weight equal to twice the weight of the pump.*

*Exception No. 7: Accessibility of moving parts shall be evaluated using the probe described in UL 507, Figure 8.2.*

*Exception No. 8: Ratings, Markings and Instruction Manual requirements in UL 778, the Standard for Motor-Operated Water Pumps, are superceded by the requirements in UL 507, Section 163, Rating, Section 164, Marking, and Section 165, Installation Instructions.*

162.1 added February 21, 2003

162.2 A pump shall be constructed in such a way that it can be installed consistent with the existing mounting method provided in the intended coolers.

162.2 added February 21, 2003

162.3 A retrofit drain pump shall comply with 129.2.4.

162.3 added December 23, 2003

162.4 The additional electrical load due to an added drain pump shall be considered in order to determine if the evaporative cooler nameplate rating will remain in compliance with 35.1.

162.4 added December 23, 2003

### 163 Rating

163.1 A pump shall be rated per 61.1 and 61.2.

163.1 added February 21, 2003

### 164 Marking

164.1 A pump shall be marked in compliance with 62.1.1, 62.1.2, 62.1.5 and 62.1.7.

164.1 added February 21, 2003

164.2 A pump shall be marked where readily and clearly visible with the specific coolers or class of coolers for which they are designed. This may include specific trade names and model numbers of the intended coolers or may be more broadly specified provided the pump has been evaluated for all indicated applications.

164.2 added February 21, 2003

164.3 A pump shall be marked "WARNING" and the following or equivalent: "Risk of fire, electric shock or injury. Read and follow installation instructions."

164.3 added February 21, 2003

### 165 Installation Instructions

165.1 Installation instructions specific to each intended installation of the pump shall be provided and shall be prominently marked "WARNING:" and the following or equivalent: "Risk of Fire, Electric Shock, or Injury to Persons. Read and Follow Instructions."

165.1 revised December 23, 2003

165.2 The Installation Instructions shall caution the installer to route the cord in the same manner as was done in the original installation of the product.

165.2 added February 21, 2003

165.3 The Installation Instructions shall indicate that the pump is not submersible and shall indicate the maximum depth of the water reservoir appropriate for the pump.

165.3 revised December 23, 2003

165.4 The Installation Instructions shall include the signal word: "WARNING" and the following or equivalent: "To Reduce the of Risk of Electric Shock or Injury, Disconnect All Electrical Power To Cooler Before Installing Pump."

165.4 added February 21, 2003

165.5 The Installation Instructions shall provide instructions on correct mounting and securement of the pump in the intended coolers.

165.5 added February 21, 2003

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165.6 The Installation Instructions for cord and plug-connected installations shall include the signal word: "CAUTION" and the following or equivalent: "Risk of electric shock – This pump is supplied with a grounding-type attachment plug. Be certain it is connected only to a grounding-type receptacle."

165.6 added February 21, 2003

165.7 Installation Instructions for pumps not provided with power supply cords, or that specify cutting the plug off the power cord for installation in one or more of the intended coolers, shall include the following:

- a) "CAUTION – Risk Of Fire, Electric Shock, Or Injury To Persons. Installation Requires Knowledge of Electrical Systems. If Not Qualified, Do Not Attempt Installation.";
- b) A wiring diagram that shows intended methods of connection to the supply circuit; and
- c) "CAUTION" and the following or equivalent: "Risk of Electric Shock. Make Grounding Connection as Shown in Wiring Diagram."

165.7 added February 21, 2003

## DIRECT PLUG-IN PRODUCTS

### 166 General

166.1 In addition to the requirements in Part 1 of this Standard, a fan that is intended for direct connection to a receptacle shall comply with the requirements in Sections 167 – 169. Dimensions of a plug-in product are shown in Figure 167.1.

Added 166.1 effective February 21, 2005

166.2 A direct plug-in appliance shall comply with all applicable requirements from UL 498A, the Standard for Current Taps.

Added 166.2 effective February 21, 2005

### 167 Construction

#### 167.1 Power supply connections

167.1.1 A direct plug-in appliance shall be provided with a 3-wire grounding-type attachment plug or a 2-wire polarized attachment plug.

*Exception: If the appliance does not utilize switches, lampholders, receptacles, or any other component that depends on polarity, the appliance can be provided with a non-polarized plug.*

Added 167.1.1 effective February 21, 2005

167.1.2 When inserted in a parallel-blade duplex receptacle, no part of a unit shall interfere with full insertion of an attachment plug into the adjacent receptacle.

*Exception: A unit that renders the adjacent receptacle completely unusable is acceptable.*

Added 167.1.2 effective February 21, 2005

167.1.3 A unit shall:

- a) Have a mass of 0.79 kg (28 ounces) or less; and
- b) Comply with the specifications in Table 167.1.

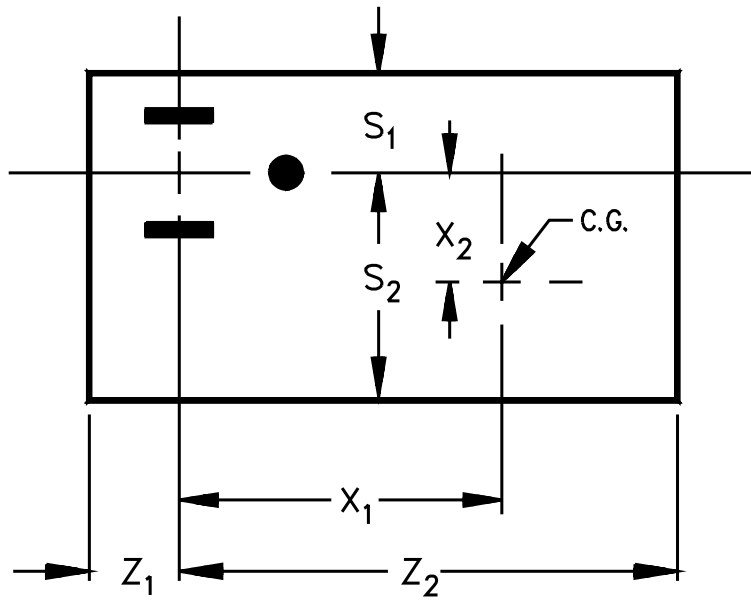
Added 167.1.3 effective February 21, 2005

**Table 167.1**  
**Specifications for plug-in products**

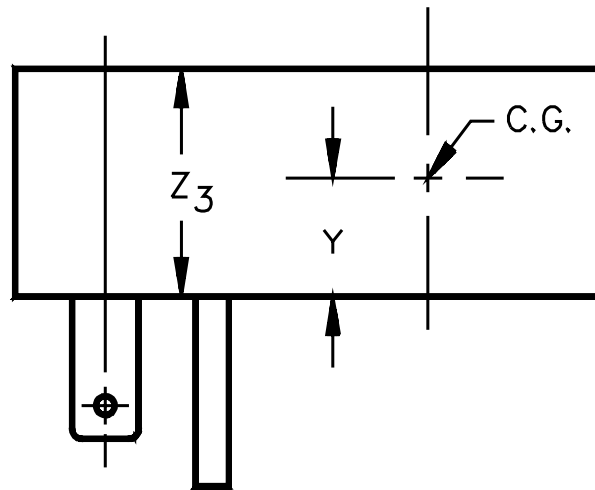
Added Table 167.1 effective February 21, 2005

$WY/Z \leq 1.36 \text{ kg (48 ounces)}$ $WY/S \leq 1.36 \text{ kg (48 ounces)}$ $WX \leq 0.56 \text{ N}\cdot\text{m (80 ounce-inches)}$
<p><i>in which:</i></p> <p><i>W is the weight in kg (ounces)</i></p> <p><i>Y is the distance, in mm (inches), illustrated in Figure 167.1</i></p> <p><i>Z is the shorter distance, in mm (inches), of <math>Z_1</math> or <math>Z_2</math> illustrated in Figure 167.1</i></p> <p><i>S is the shorter distance, in mm (inches), of <math>S_1</math> or <math>S_2</math> illustrated in Figure 167.1</i></p> <p><i>X is the longer distance, in mm (inches), of <math>X_1</math> or <math>X_2</math> illustrated in Figure 167.1</i></p>

**Figure 167.1**  
**Dimensions of a plug-in product**  
 Added Figure 167.1 effective February 21, 2005



FRONT VIEW



SIDE VIEW

C.G. = Center of Gravity

CP100

## 168 Performance

168.1 The test of 46.1 should be conducted in all possible mounting orientations.

Added 168.1 effective February 21, 2005

## 169 Marking

169.1 A unit provided with a grounding pin shall be marked with the word "CAUTION" and the following or the equivalent: "To Reduce The Risk Of Fire Or Electric Shock Connect Directly To A 3-Prong Grounding Receptacle."

Added 169.1 effective February 21, 2005

169.2 A direct plug-in product shall be marked with the word "WARNING" and the following or equivalent: "To Reduce The Risk Of Fire Or Electric Shock Do Not Use With An Extension Cord."

Added 169.2 effective February 21, 2005

## AIR FILTERING APPLIANCES FOR USE IN "OTHER SPACES USED FOR ENVIRONMENTAL AIR"

### 170 General

170.1 These requirements cover air filtering appliances specifically evaluated for use in "other spaces used for environmental air" per Article 300.22 (c) of the National Electrical Code, ANSI/NFPA 70-2002. In addition to the applicable requirements in Part 1 of this Standard, air filtering appliances for use in "other spaces used for environmental air" shall comply with the requirements in all applicable Part 2 sections including, but not necessarily limited to, Fans For Use With Solid-State Speed Controls, Fans For Use In Unattended Areas, and Sections 171 and 172.

170.1 added February 21, 2003

### 171 Construction

171.1 Exception No. 1 of 6.3.1 shall not apply to these air filters. All non-metallic enclosure and cabinet parts, including polymeric grilles, shall be classed 5 VA by the burning tests described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

171.1 added February 21, 2003

171.2 Polymeric parts such as the enclosure, cabinet, grille, insulating liners, and impeller shall comply with the following requirements:

- a) A flame spread index of 25 or less, as determined by UL 723, the Standard for Test for Surface Burning Characteristics of Building Materials, or as determined by the Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source, ASTM E 162-1990; and
- b) A maximum smoke developed index of 50 or less, as determined by UL 723, the Standard for Test for Surface Burning Characteristics of Building Materials.

*Exception No. 1: A molded or formed polymeric material, other than the enclosure, cabinet, or grille, in such quantities that its total exposed surface area within the compartment does not exceed 0.93 square m (10 square feet) need only comply with part a).*



*Exception No. 2: A molded or formed polymeric material, other than the enclosure, cabinet, or grille, in such quantities that its total exposed surface area within the compartment does not exceed 0.93 square m (10 square feet) shall be considered to satisfy this requirement if it complies with the requirements of the vertical burning test for classifying materials 5V in accordance with the Standard Tests for Flammability of Plastic Materials in Devices and Appliances, UL 94.*

*Exception No. 3: Appliances or assemblies exhibiting compliance with UL 2043, the Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces, and marked as specified in 172.2, are considered to meet this requirement.*

171.2 added February 21, 2003

171.3 Air filters shall be rated Class 1 or Class 2 in accordance with UL 900, Standard for Safety for Air Filter Units.

171.3 added February 21, 2003

171.4 If the appliance is intended to discharge into a duct system serving more than one room it shall be evaluated to all pertinent requirements in UL 1995, the Standard for Heating and Cooling Equipment.

171.4 added February 21, 2003

## **172 Markings**

172.1 Air filtering appliances in compliance with Sections 170 and 171 shall be marked "These units evaluated for use in other spaces for environmental air per National Electrical Code Article 300.22 (c)(2)."

172.1 added February 21, 2003

172.2 Air filtering appliances marked as specified in 172.1 and evaluated per Exception No. 3 of 171.2 shall be marked "CAUTION:" and the following or equivalent "Units shall not be installed less than 30.5 cm (12 inches) apart."

172.2 added February 21, 2003

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## SUPPLEMENT SA - FOLLOW-UP INSPECTION INSTRUCTIONS FOR FANS

### INTRODUCTION

#### SA1 Scope

SA1.1 This Supplement describes the manufacturer's production program necessary to verify that the product continues to be in compliance with the requirements in this Standard. This Supplement is only intended to cover fans and not other appliances covered by the Standard.

SA1.2 This Supplement also describes the duties and responsibilities of the field representative of the certification organization. The field representative shall only apply the requirements in this Supplement and those in the Standard that are specifically referenced by this Supplement. See SA10.1.

SA1.3 Recognizing that manufacturers are required to have quality assurance systems in place for the control of their production processes and products, this Supplement only covers the sampling inspections, tests, and other measures taken by the manufacturer and considered to be the minimum requirements of the certification organization. Such inspections, tests, and measures are supplemented by the certification organization as an audit of the means that the manufacturer exercises to determine conformance of products with the certification organization's requirements.

SA1.4 The certification organization shall have additional authority specified in legally binding agreements, signed by both the certification organization and manufacturer, to control the use and application of the certification organization's registered mark(s) for product, packaging, advertising, and associated literature. The legal agreements shall cover the control methods to be used by the certification organization and manufacturer's options for appeal. Any additional inspections, tests, or other measures deemed necessary by the certification organization but to be taken by the manufacturer are to be applied in order to control the use and application of the certification organization's registered mark(s).

SA1.5 Any reference in this Supplement that is not prefixed by SA refers to the requirements in the Standard for Electric Fans, UL 507. Any reference to the term "Standard" also applies to the UL 507 Standard.

#### SA2 Glossary

SA2.1 For the purposes of this Supplement, the following definitions apply.

SA2.2 **CERTIFICATION ORGANIZATION** A third party organization independent of the manufacturer who, under a legally binding contract with the manufacturer, evaluates a product for compliance with requirements specified in the Standard, and who maintains periodic inspection of production of these products to verify compliance with the specifications in the Procedure and this Supplement.

SA2.3 **FIELD REPRESENTATIVE** An authorized representative of the certification organization who makes periodic unannounced visits to the manufacturer's facilities for purposes of conducting inspections and monitoring the manufacturer's production program.

SA2.4 **INSPECTION REPORT** The report generated by the field representative summarizing the results of the inspection visit.

SA2.5 **LISTED PRODUCT** A product that has been determined to comply with the appropriate standards by a certification organization concerned with product evaluation and that maintains periodic inspection of production of Listed products.

**SA2.6 LISTING MARK** A distinctive registered mark of the certification organization (that includes, in addition to the mark, the product name, a control number, and the word "Listed") that the manufacturer is authorized to apply to Listed products as the manufacturer's declaration that the products under the program described in this Supplement conform to the requirements in the Standard.

**SA2.7 MANUFACTURER** The authorized party who maintains and operates the facilities where a Listed product is fabricated, processed, finished, or stored and where the product is inspected and/or tested as described in this Supplement.

**SA2.8 MANUFACTURER'S TEST PROGRAM** The tests described in this Supplement that are conducted by the manufacturer on a periodic or 100 percent basis and for which the manufacturer may be required to keep records.

**SA2.9 PROCEDURE** The document issued by the certification organization, upon determination that a product is eligible for Listing, for use by the authorized manufacturer and the field representative. The document contains requirements and other provisions and conditions regarding the Listed or Recognized product and provides the authorization for the manufacturer to use the Listing Mark or Recognized Component Marking on products fulfilling these requirements.

**SA2.10 RECOGNIZED COMPONENT** A part or subassembly intended for use in other equipment and that has been investigated for certain construction or performance, or both, characteristics. A Recognized Component is incomplete in construction features or is restricted in performance capabilities so as not to warrant its acceptability as a field-installed component. It is intended solely as a factory-installed component of other equipment where its acceptability is determined by the certification organization.

**SA2.11 RECOGNIZED COMPONENT MARKING** A marking that the manufacturer is authorized to apply to Recognized Components as the manufacturer's declaration that the products under the program described in this Supplement conform to the applicable requirements in the Standard. This marking consists of the manufacturer's identification and catalog number, model number, or other applicable product designation. The recognized component marking may also include a distinctive registered trademark of the certification organization.

**SA2.12 SAMPLE SELECTION GUIDE FOR LOCKED-ROTOR TESTS** A table that is prepared by the certification organization during the initial investigation and is included in the Procedure. This table indicates the fans or motors that are to undergo the Locked Rotor Test at either the manufacturer's facility (see Section SA9, Locked Rotor Test) or at the certification organization (see Section SA16, Locked Rotor Tests).

**SA2.13 SAMPLE SELECTION GUIDE FOR THERMOPLASTIC ENCLOSURES** A table that lists each enclosure material and the fan models that employ that material as well as specific information for the thermoplastic enclosure type. The guide is completed by the certification organization during the initial investigation of the product and is included in the Procedure.

**SA2.14 SAMPLE SELECTION GUIDE FOR THERMOPLASTIC PARTS** A table that indicates the group number of similar thermoplastic parts and specific information for the thermoplastic part type. This guide is completed by the certification organization during the initial investigation of the product and is included in the Procedure.

**SA2.15 VARIATION NOTICE (VN)** A document used to record observed differences between a product or manufacturing process and the description of the product or process in the Procedure and/or Standard.

## RESPONSIBILITIES OF THE MANUFACTURER

### SA3 General

SA3.1 It is the manufacturer's responsibility to restrict the use of the Listing Mark or Recognized Component Marking to those products that are found by the manufacturer's own quality assurance program to comply with the Procedure description.

SA3.2 The manufacturer shall confine all Listing Marks or Recognized Component Markings to the location or locations authorized in the Procedure.

SA3.3 The manufacturer shall conduct the Manufacturer's Test Program detailed in Sections SA4 – SA9, and shall maintain records of test performance. See SA3.4 and SA3.5.

SA3.4 The records mentioned in SA3.3 shall consist of the following:

- a) Model or catalog designation of the product;
- b) Date of production;
- c) Test performed;
- d) Number of units tested;
- e) Specific test results; and

*Exception: Test results of the Production Line Dielectric Voltage Withstand Test (Section SA5), the Production Line Grounding Continuity Test (Section SA6), and the Production Line Polarity Test (Section SA7) are not required to be maintained.*

- f) Action taken for noncomplying results.

SA3.5 Records of all required tests shall be retained for at least six months.

SA3.6 The manufacturer shall:

- a) Determine that the test equipment is functioning properly at least once each shift; and
- b) Have the equipment calibrated:
  - 1) At regular intervals, not less than once annually;
  - 2) Whenever it has been subject to abuse (such as being dropped or struck with an object); or
  - 3) When its accuracy is questionable.

Calibration may be by the manufacturer or by an outside laboratory. In either case, the equipment shall be calibrated by comparison with a standard that is traceable to the applicable U.S. or foreign National Standard. Calibration records shall be maintained by the manufacturer until the next succeeding calibration of the equipment, and shall be readily available for review by the field representative.

SA3.7 The manufacturer shall maintain the Standard (including this Supplement) such that it contains the most recent requirements.

## REQUIREMENTS FOR FACTORY TESTS

### SA4 General

SA4.1 The tests described in Sections SA5 – SA7 are to be performed by the manufacturer as production line tests. The manufacturer shall subject 100 percent of the production of the specified product to these tests.

SA4.2 The tests described in Sections SA8, Impact Test on Thermoplastic Enclosures, and SA9, Locked Rotor Test, are to be performed by the manufacturer and witnessed by the field representative not less than once each quarter.

### SA5 Production Line Dielectric Voltage Withstand Test

SA5.1 Tests are to be conducted by the manufacturer for dielectric voltage withstand as described in 58.1 – 58.4, 58.9, 106.1.1, and Table 58.1. The test is to be performed as a production line test (on 100 percent of production of all products) by the manufacturer.

*Exception: This requirement does not apply to a model that is identified in the Procedure as being excluded from the production line dielectric voltage withstand test.*

SA5.2 The manufacturer is to conduct this test using the specific dielectric test equipment model specified for the purpose in the Procedure.

SA5.3 Electrical breakdown as mentioned in 58.1 occurs when the test equipment gives either an audible or visual indication of breakdown.

### SA6 Production Line Grounding Continuity Test

SA6.1 Tests are to be conducted by the manufacturer for grounding continuity as described in 59.1 – 59.3. The test is to be performed as a production line test (on 100 percent of production of all products that have a power supply cord with a grounding conductor) by the manufacturer.

*Exception: This requirement does not apply to a model that is identified in the Procedure as being excluded from the production line grounding continuity test.*

### SA7 Production Line Polarization Test

SA7.1 Tests are to be conducted by the manufacturer for polarity as described in 60.1 and 60.2. The test is to be performed as a production line test (on 100 percent of production of all products as specified in SA7.2) by the manufacturer.

SA7.2 The polarity discussed in SA7.1 shall be determined for all products that have a power supply cord and are provided with:

- a) A manually operated, line-connected, single-pole switch for appliance on-off operation;
- b) An Edison-base lampholder or an Edison-base fuseholder; or
- c) A receptacle.

## SA8 Impact Test on Thermoplastic Enclosures

SA8.1 A sample of each enclosure material that is not Recognized shall be tested not less than twice a year as specified in the sample selection guide for thermoplastic enclosures (see SA2.13). The field representative shall witness the test as part of the product inspection and shall determine if the manufacturer records the test data in compliance with SA3.4. The test shall be performed in accordance with SA8.2 – SA8.7.

SA8.2 The sample shall withstand the impact test described in SA8.3 without being affected to the extent that:

- a) Uninsulated, live parts are accessible to contact (see SA8.4);
- b) The mechanical performance of the fan is adversely affected so as to create a risk of injury to persons (see SA8.5); or
- c) A condition is produced that results in a risk of electric shock (see SA8.6).

SA8.3 The enclosure material is to be subjected to an impact of 6.78 J (5 foot-pounds) on any surface that is exposed to a blow during intended use. The impact is to be produced by dropping the steel sphere specified in 47.2 from a height of 127 cm (50 inches). For surfaces other than the top of the enclosure or for tests on a freestanding fan, the applicable procedure specified in 47.2 is to be followed.

SA8.4 To determine compliance with SA8.2(a), the field representative shall apply the probe illustrated in Figure 9.2 in accordance with the method described in 9.3.1 and 9.3.2. The probe shall not contact an uninsulated, live part.

SA8.5 With respect to SA8.2(b), consideration is to be given to the functioning of safety or constructional features such as thermostats, overload protective devices, and strain relief. Cracking or denting of the enclosure shall not result in exposure of moving parts that present a risk of injury to persons.

SA8.6 To determine compliance with SA8.2(c), the fan is to be subjected to a Dielectric Voltage Withstand Test. The test is to be conducted in accordance with 37.1 using the test equipment specified in SA5.2. The sample shall withstand the required potential without breakdown.

SA8.7 When the impact test sample produces any one of the conditions identified in SA8.2, the test is to be repeated on three previously untested samples from the same lot. The results are considered acceptable when all three samples comply with SA8.2. When a failure occurs on any one of the additional samples, then the lot shall be considered unacceptable.

## SA9 Locked Rotor Test

### SA9.1 General

SA9.1.1 A motor or fan sample from each group specified in the sample selection guide for locked rotor tests (see SA2.12) shall be tested in accordance with the method specified in SA9.5.1 – SA9.5.11 not less than once each quarter. The field representative shall witness the test as part of the product inspection. See SA9.1.2. The test equipment shall be as specified in SA9.3.1 – SA9.3.3. The test sample shall be prepared in accordance with SA9.4.1 – SA9.4.7.

*Exception No. 1: Electronically protected low voltage component fans are not required to be subjected to the Locked Rotor Test.*

*Exception No. 2: This requirement does not apply to fans employing a motor construction covered under the category for Recognized Motor Protective Devices – Inherent Overheating Type or the category for Recognized Impedance-Protected Motors.*

SA9.1.2 The field representative shall verify that the thermocouples are applied in accordance with SA9.3.1, SA9.4.1, and SA9.4.2. The field representative is to determine if the manufacturer records the test data in compliance with SA3.4. The field representative shall verify the test data during and at the completion of the test.

## **SA9.2 Acceptance criteria**

SA9.2.1 After being tested in accordance with SA9.5.1 – SA9.5.11, a sample shall comply with SA9.2.2 or SA9.2.3, as applicable.

SA9.2.2 A sample utilizing a thermally protected motor shall comply with all of the following:

- a) There shall be no flaming or severe or prolonged smoking.
- b) The fuse provided in the grounding lead to the motor frame shall not open.
- c) There shall be no flaking, embrittlement, or charring of the insulation. Simple discoloration of the insulation meets the intent of the requirement. Charring or embrittlement to the extent that the insulation flakes off or material is removed when the windings are rubbed with the thumb does not meet the intent of the requirement.
- d) Any associated component part such as a capacitor or a starting relay shall not malfunction electrically or mechanically.
- e) Temperatures shall not exceed those indicated in Table SA9.1. All values for temperatures in Table SA9.1 are based on an assumed ambient of 25°C (77°F).
- f) After the locked rotor test is performed, the sample shall withstand the dielectric potential indicated in SA9.5.11.

SA9.2.2 revised December 23, 2003



**Table SA9.1**  
**Locked rotor temperature limits**

Type of protector	Maximum temperature				Maximum average temperature <sup>a</sup>			
	Class A		Class B <sup>c</sup>		Class A		Class B <sup>c</sup>	
	°C	°F	°C	°F	°C	°F	°C	°F
Automatically reset:								
1. During first hour of operation	200	392	225	437	–	–	–	–
2. After first hour of operation <sup>b</sup>	175	347	200	392	150	302	175	347
Manual reset:								
Thermal cutoff:								
1. Opens during first hour of test	200	392	225	437	–	–	–	–
2. Opens after first hour of test <sup>b</sup>	150	302	175	347	–	–	–	–

<sup>a</sup> The average temperature is to be determined by taking the arithmetic mean of (1) all maximum peak temperatures and of (2) all minimum temperatures during the second hour of the Locked Rotor Test. When averaging temperatures, the value from the hottest thermocouple is to be used.

<sup>b</sup> The maximum temperature and maximum average temperature may be 200°C (392°F) for a shaded pole motor used in a ceiling insert, wall-insert, or range-hood fan.

<sup>c</sup> Recognized Component Class B or higher insulated motors are restricted to Class B limits.

SA9.2.3 A sample utilizing an impedance-protected motor shall comply with all of the following:

a) The motor shall not obtain a temperature of more than 150°C (302°F) for Class A insulation, 175°C (347°F) for Class B insulation, 200°C (392°F) for Class F insulation, or 225°C (437°F) for Class H insulation.

*Exception: A shaded pole Type F fan motor used in a ceiling insert fan, wall insert fan, or a fan intended for use in cooking areas shall not exceed a temperature of 200°C (392°F).*

b) The wattage measured in SA9.5.9 shall not exceed the wattage indicated for the sample in the Procedure by more than 10 percent.

c) The fuse in the grounding conductor shall not open.

d) The motor shall still be capable of operating electrically. For example, a bearing failure is considered in compliance. The motor windings shall not open or become grounded to the frame as evidenced by using an ohmmeter (applying no more than 10 V).

e) There shall be no flaming or severe or prolonged smoking.

f) There shall be no flaking, embrittlement or charring of the insulation. Simple discoloration of the insulation meets the intent of the requirement. Charring or embrittlement to the extent that the insulation flakes off or material is removed when the windings are rubbed with the thumb does not meet the intent of the requirement.

g) There shall be no electrical or mechanical malfunction of any associated component parts such as capacitors.

h) If an unenclosed motor uses an outerwrap tape, the tape shall not shift to result in a reduction of spacings or expose uninsulated live parts.

SA9.2.3 revised December 23, 2003

### SA9.3 Test equipment

SA9.3.1 The thermocouples are to comply with the specifications of 36.1.4, and the thermocouple wire is to conform with the requirements for special thermocouples as listed in the Table of Limits of Error of Thermocouples in Temperature-Measurement Thermocouple, ANSI MC96.1. A thermocouple junction is to be made according to one of the following methods:

- a) Thermocouple ends are intersected one time and then secured with a spot-weld; or
- b) Thermocouple ends are twisted not more than 1-1/2 turns and then secured with an arc-weld or brazing.

A soldered thermocouple junction without additional welding or brazing is not a sufficient means of mechanically securing the junction.

SA9.3.2 The temperature-indicating potentiometer is to be a constant reading single or multiple point chart recording instrument, or a single point instrument with appropriate selector block. If a multiple point type instrument is used, it shall be such that the hottest thermocouple can be continuously monitored.

SA9.3.3 Voltmeters, ammeters, and wattmeters shall be laboratory-type, and shall be of a range appropriate for reading the values accurately.

### SA9.4 Test preparation

SA9.4.1 Thermocouples are to be attached in accordance with SA9.4.2 according to the following:

- a) For a thermally protected motor, thermocouples are to be attached on the motor windings.
- b) For an open frame type impedance protected motor, thermocouples are to be attached on the motor windings.
- c) For a totally enclosed impedance protected motor, thermocouples are to be attached on the enclosure.

*Exception: Thermocouples are not required to be attached to impedance-protected motors with encapsulated coil constructions. However, when thermocouples are used, they are to be attached to the windings prior to the encapsulating process. See SA9.5.10.*

SA9.4.2 When thermocouples are to be attached on the motor windings as indicated in SA9.4.1, a thermocouple is to be secured on the top turn of each winding and at other points on the windings that reach high temperatures. The thermocouples are to be attached to the surface by means of sodium silicate mixed with Kaolin powder (waterglass), or equivalent means. The thermocouple may be reinforced with tape. Thermocouples are to be attached to the motor windings without removal of integrally applied insulation, such as varnish. Thermocouples are to be placed under any coil wrap or tape that may be provided on the motor.

SA9.4.3 The rotor of the fan motor is to be locked in a stationary position. The motor or fan, as appropriate (see SA9.1.1), is to be mounted on wood or other poor thermal conducting material. A motor is to be positioned no less than 304.80 mm (1 foot) from any other motor being tested.

SA9.4.4 For a sample consisting of the entire fan and not simply the motor, the blades or other load attachments are to be removed from the motor. Integrally mounted brackets and internal fan blades are to remain in place.

SA9.4.5 The frame of the motor is to be grounded through a 3-ampere non time-delay fuse.

SA9.4.5 revised December 23, 2003

*SA9.4.6 Deleted December 23, 2003*

SA9.4.7 For a thermally protected motor, the motor is to be mounted with the protector in the maximum down position.

*Exception No. 1: When the mounting position of the motor is obvious, the motor is to be mounted accordingly.*

*Exception No. 2: A motor tested in the fan is to be located in its normal operating position or positions.*

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## SA9.5 Test method

SA9.5.1 A sample is to be at ambient temperature, 10 to 40°C (50 to 104°F), at the start of the Locked Rotor Test, and is to be energized with the appropriate test voltage indicated in Table SA9.2.

**Table SA9.2**  
**Test voltages**

Motor nameplate rating – volts	Nominal test voltage
110 – 120	120
200 – 208	208
220 – 240	240
254 – 277	277
440 – 480	480
550 – 600	600

SA9.5.2 A bi-directional motor may be connected for operation in either direction. A multi-speed motor is to be tested at the speed which creates the highest input current (usually the high speed). A dual voltage motor is to be connected for operation at the highest voltage rating.

*Exception: The guidelines in this may be superseded by the criteria in the completed sample selection guide for locked rotor tests detailed in the Procedure. See SA2.12.*

SA9.5.3 The hottest thermocouple is to be determined and continuously monitored. Throughout the test, all thermocouples are to be occasionally monitored to determine if a different location is hotter.

SA9.5.4 An impedance-protected motor is to operate until thermal equilibrium is attained. See SA9.5.5.

SA9.5.5 Thermal equilibrium is considered to exist when three consecutive temperature readings taken at fifteen minute intervals are equal.

SA9.5.6 A motor equipped with an automatic reset device is to be allowed to cycle "on" and "off." During the first hour of the test, the highest temperature is to be recorded. After the first hour of the test, the highest temperature and minimum temperature for each cycle of the automatic reset device is to be recorded until thermal equilibrium is attained. See SA9.5.5.

SA9.5.7 A motor equipped with a manual reset device is to operate for ten cycles with the protector being reset immediately after it opens the circuit.

SA9.5.8 A motor equipped with a thermal cutoff is to operate until the cutoff opens or until thermal equilibrium is attained, whichever occurs first. See SA9.5.5.

SA9.5.9 In addition to the temperatures, the maximum locked rotor wattage for an impedance protected motor is also to be recorded. This wattage is to be measured within 30 seconds of energization of the sample.

SA9.5.10 With respect to the Exception of SA9.4.1, the temperatures on impedance-protected motors with encapsulated coil constructions may be determined using the change in resistance method. See 36.1.5 and 36.1.6.

SA9.5.11 Following the Locked Rotor Test, a motor as required by SA9.2.2(f) is to be subjected to a Dielectric Voltage Withstand Test. The test is to be conducted in accordance with 37.1 using the equipment specified in SA5.2. The sample shall withstand the required potential without breakdown. If a motor has a protector that opened during the Locked Rotor Test, then that protector is to be closed prior to conducting the Dielectric Voltage Withstand Test.

## RESPONSIBILITIES OF THE FIELD REPRESENTATIVE

### SA10 General

SA10.1 The field representative shall only apply the requirements in this Supplement and those in the Standard that are specifically referenced in this Supplement. The field representative is not authorized to apply the requirements in the Standard that are not specifically referenced in this Supplement, and the field representative may not make any determination regarding product evaluation, such as determining the suitability of a modified construction or a substituted material. Such a determination is to be made at the certification organization location.

SA10.2 At each visit to the manufacturer's facility, the field representative shall examine the construction of products intended to bear the Listing Mark or Recognized Component Marking to determine compliance with Sections SA3 – SA9, SA11, and SA12.

SA10.3 The field representative shall review the test records, calibration records, and equipment of the manufacturer. These items shall meet the following criteria:

- a) The proper number of samples shall undergo the tests required in Sections SA5 – SA9;
- b) The tests required by Sections SA5 – SA9 shall be performed correctly;
- c) The test records shall be complete as detailed in SA3.3 – SA3.5; and
- d) The test equipment shall be functioning properly and shall be calibrated at the prescribed interval.

SA10.4 The molder of the plastic enclosures or parts shall provide certification papers in each lot of the enclosures or parts indicating the manufacturer and catalog number of the material. The field representative shall verify the certification papers with the Procedure.

SA10.5 The field representative shall issue a Variation Notice (see SA2.15) if one or more of the following conditions exist:

- a) There is a noted difference between the construction of the sample and the description of the product in the Procedure;
- b) The manufacturer's test method, including test frequency, is not performed as indicated by Sections SA4 – SA9;
- c) The test records are not in accordance with SA3.3 – SA3.5;
- d) The manufacturer's inspection program is not being performed as described in Sections SA3 – SA9; or
- e) A sample fails to comply with one or more of the tests in Sections SA5 – SA9.

SA10.6 When a product is found that is no longer in compliance with the requirements of the certification organization as specified in this Supplement and in the Procedure, the field representative shall do one of the following:

- a) Witness the removal of any markings referencing the certification organization from the product;
- b) Require the manufacturer to modify the product such that it complies with the Procedure and this Supplement; or
- c) Hold shipment of the product until instructions from the certification organization are received.

SA10.7 The determination made by the field representative regarding a product's acceptability may be appealed by the manufacturer. When rejection of the product is questioned by the manufacturer, the manufacturer may hold the material at the point of inspection, typically at the factory, pending an appeal.

## **INSTRUCTIONS FOR INSPECTION OF THE PRODUCT**

### **SA11 General Requirements**

SA11.1 During each factory inspection, the field representative shall examine samples of current production for compliance with SA11.2 and with the applicable descriptions in the Procedure. When necessary, the field representative shall examine samples from stock.

SA11.2 The field representative shall evaluate the following features for compliance with the specifications in the Procedure:

- a) Electrical Spacings – The minimum through-air and over-surface spacings shall comply with the spacings specified in the Procedure.
- b) Internal Wiring – Conductors shall be routed away or protected from sharp edges and moving parts.
- c) Markings – The information required in the Procedure shall be legibly marked on the sample, and shall be in the manner and minimum height specified.
- d) Security of Parts – Parts shall be secured to prevent any rotation or shifting which could result in a reduction of electrical spacings.
- e) Protection against Corrosion – A ferrous metal part shall be protected from corrosion by painting, plating, or the equivalent.

### **SA12 Special Requirements**

SA12.1 The requirements specified in SA12.2 – SA12.14 may apply to one or more of the products covered by the Procedure, and shall be evaluated by the field representative in accordance with the specifications in the Procedure.

SA12.2 An accessory or part may be packaged with the product if it is specifically described in the Procedure.

SA12.3 A three-to-two wire grounding-type adapter shall not be furnished with the product.

*Exception: An adapter that is furnished with the product shall be specifically described in the Procedure.*

SA12.4 A connector shall be applied in a manner that contains and insulates all bare wiring strands.

SA12.5 A cord-connected multiple-voltage product shall be provided with an attachment plug that is suitable for the voltage for which the product is set.

SA12.6 The carton or package of a product shall not be marked in a manner that conflicts, or could be construed to conflict, with the use covered in the instruction manual contained in the Procedure.

SA12.7 A printed-wiring board that is described in detail in the Procedure shall show no burning, bubbling, or other visible evidence of damage to its conductors or substrate material as a result of the fabrication process.

SA12.8 A component of a fan employing a power supply cord with a polarized attachment plug shall be wired as follows, as applicable:

a) Lampholder and Receptacles – The identified ground terminal or lead of a lampholder or receptacle shall be connected to the identified (grounded) conductor or terminal of the product.

b) Switches – A manual single pole switch and an automatic control with a marked "off" position shall not be connected to the identified (grounded) conductor.

*Exception: A single pole switch may be connected to the identified conductor provided this connection is specified in the Procedure.*

c) Detachable Power Supply Cord – The polarization shall be maintained through the load fitting of the cord and mating connector on the fan. The three wire fitting shall be an ANSI configuration.

*Exception: The three wire fitting need not be an ANSI configuration provided it is wired as follows (the description applies when viewing the face of the connector on the fan, with the center contact down):*

*1) The right contact shall be connected to the grounded conductor (neutral) of the cord; and*

*2) The center contact shall be connected to the grounding conductor of the cord.*

SA12.9 The equipment-grounding conductor of the flexible cord of a cord-connected fan shall comply with all of the following:

a) The conductor shall be a green color with or without one or more yellow stripes;

b) The conductor shall be connected by the grounding member of the attachment-plug cap;



c) The conductor shall be conductively connected to all exposed dead-metal parts of the fan, and all dead-metal parts within the enclosure that are specified in the Procedure as being connected to the grounding conductor; and

*Exception: The equipment-grounding conductor is not required to be conductively connected to small parts, such as nameplates.*

d) The conductor shall be secured with a corrosion-resistant screw or other reliable means if described in the Procedure. The securing means shall have no purpose other than securing the conductor, and it shall not be removed during servicing. Solder alone is not a sufficient method of securing the conductor.

SA12.10 A permanently-connected fan shall conductively connect all exposed dead-metal parts, and all dead-metal parts within the enclosure that are specified in the Procedure as being connected to the grounding conductor to one or both of the following, as applicable:

a) The enclosure at the point where the metal raceway of the power supply circuit is connected; and

b) The equipment-grounding field-wiring terminal or lead.

SA12.11 The equipment-grounding terminal or grounding lead shall be connected to the frame or enclosure by a positive means, such as by a bolted or screwed connection. The grounding connection shall reliably penetrate nonconductive coatings, such as paint or vitreous enamel. The grounding point shall be so located that it is not likely that the grounding means will be removed during normal servicing.

SA12.12 A wire-binding screw intended for the field connection of an equipment-grounding conductor shall have a green-colored head that is hexagonal, slotted, or both.

SA12.13 A pressure-wire terminal intended for the field connection of an equipment-grounding conductor shall be identified by the marking "G," "GR," "GND," "Ground," or the like.

*Exception: The equipment-grounding conductor may be identified by a suitable marking on a wiring diagram of the fan provided this marking is authorized in the Procedure.*

SA12.14 An insulated lead intended to connect the equipment-grounding conductor shall be green with or without one or more yellow stripes.

## INSTRUCTIONS FOR FOLLOW-UP TESTS AT CERTIFICATION ORGANIZATION

### SA13 Instructions for Sample Pickup

#### SA13.1 General

SA13.1.1 The Follow-Up Tests specified in Sections SA14 – SA17 shall be performed at the certification organization. The field representative shall collect samples from the factory in accordance with SA13.2.1 – SA13.3.1 and shall send them to the certification organization.

*Exception: Recognize thermoplastic enclosures or parts covered under the Recognized Plastics Program are not required to comply with SA13.2, SA13.3, SA13.5, Section SA15, and Section SA17.*

#### SA13.2 Thermoplastic enclosures

SA13.2.1 The field representative shall pick up samples of thermoplastic enclosures in accordance with the sample selection guide for thermoplastic enclosures of the Procedure. See SA2.13 and Section SA14, Thermoplastic Enclosure Tests.

SA13.2.2 When required by the sample selection guide for thermoplastic enclosures, a sample for Follow-Up ID Tests shall consist of a portion of the molded enclosure weighing 49.90 g (1.76 oz). See SA13.2.4 and SA13.2.5.

SA13.2.3 When required by the sample selection guide for thermoplastic enclosures, a sample for the Flame Test shall consist of the complete enclosure. See SA13.2.4 and SA13.2.5.

SA13.2.4 The samples required by SA13.2.2 and SA13.2.3 shall be picked up in a manner such that one enclosure material shall be selected during each regular inspection visit, and each enclosure material shall be represented by tests no less than once over a two year period. An enclosure material that is not Recognized shall be represented by tests no less than twice over a two year period.

SA13.2.5 A sample that is picked up in accordance with SA13.2.2 and SA13.2.3 shall be tagged with the following information:

- a) Material;
- b) Manufacturer;
- c) Model or catalog number; and
- d) The phrase "Thermoplastic ID Tests."

#### SA13.3 Thermoplastic parts

SA13.3.1 The field representative shall select samples no less than once per year in accordance with the sample selection guide for thermoplastic parts in the Procedure (see SA2.14). One model from each group identified shall represent the entire group. See Section SA15, Thermoplastic Parts Test. See SA13.3.3 for instructions on preparing the sample selection guide.

SA13.3.2 A sample that is picked up in accordance with SA13.3.1 shall be tagged with the following information:

- a) Material;
- b) Manufacturer;
- c) Part or catalog number; and
- d) The phrase "Infrared Test."

SA13.3.3 In reference to SA13.3.1, the sample selection guide for thermoplastic parts is prepared by the certification organization during the initial investigation. This guide is not to be completed by the field representative. The sample selection guide shall differentiate the various thermoplastic parts according to thermoplastic material; a group consists of thermoplastic parts having the same thermoplastic material.

#### **SA13.4 Fans and motors**

SA13.4.1 A fan or motor sample from a group shall be picked up each quarter for Locked Rotor Testing. See Section SA16, Locked Rotor Tests. A model from a group identified in the sample selection guide for locked rotor tests in the Procedure (see SA2.12) shall represent the entire group. See SA13.4.4 for instructions on preparing the sample selection guide.

*Exception: This requirement does not apply to fans employing a motor construction covered under the category for Recognized Motor Protective Devices – Inherent Overheating Type or the category for Recognized Impedance-Protected Motors.*

SA13.4.2 The samples required by SA13.4.1 shall be picked up in a manner such that one fan from each motor group is tested at least once during a two year period. A specific motor group shall be tested no more than two times during a one year period. The same motor group shall not be selected for testing at consecutive quarterly inspections.

SA13.4.3 A sample that is picked up in accordance with SA13.4.1 and SA13.4.2 shall be tagged with the following information:

- a) Material;
- b) Manufacturer;
- c) Model or catalog number;
- d) The group from which selected; and
- e) The phrase "Locked Rotor Test."

SA13.4.4 In reference to SA13.4.1, the sample selection guide for locked rotor tests is prepared by the certification organization during the initial investigation. This guide is not to be completed by the field representative. When a locked rotor test is required, the following determinations shall be made by the certification organization and included in the sample selection guide:

- a) Indicate if the test is to be conducted on a complete fan or only on the motor.

- b) Indicate if the test is to be conducted by the certification organization or by the manufacturer in accordance with Section SA9, Locked Rotor Test.
- c) Assign like models – fans or motors that will have the same test program and are the same mechanically and electrically except for slight variations (such as different shaft lengths) that will not affect the fan's performance – to a group. A group may have one or more model designations. Group numbers shall be assigned consecutively as needed.
- d) State the number of samples required for testing in accordance with the following guidelines:
  - 1) If the motor has thermal protection with a nonreplaceable cutoff, then three samples are required.
  - 2) A motor other than the type described in (1) will require 1 sample.
- e) State any necessary comments on a separate page. Appropriate comments include the size of the samples and the priority of sample selection within a group number.

### SA13.5 Polymeric ball-joint hangers

SA13.5.1 The field representative shall select 9 samples of the ball-joint hanger no less than once each year for each ceiling fan employing a polymeric ball-joint hanger. The ball-joint hanger shall consist of the mounting bracket, polymeric ball, downrod, canopy, and associated hardware. See Section SA17, Polymeric Ball-Joint Hanger Tests.

*Exception: The field representative shall select 2 samples of the ball-joint hanger for a model when the 5-Inch Flame Test is not required for that model.*

SA13.5.2 A sample that is picked up in accordance with SA13.5.1 shall be tagged with the following information:

- a) Polymeric material;
- b) Manufacturer of the polymeric ball;
- c) Type designation of the polymeric ball; and
- d) The phrase "Ball Hanger Tests."

*Exception: The information referenced by (b) and (c) is not required to be included on a model that does not have alternate polymeric materials. See SA13.5.3 and SA13.5.4.*

SA13.5.3 With regard to the Exception to SA13.5.2, more than one polymeric material may be authorized in the Procedure for use in a ball-joint hanger. In this case, 9 samples of each authorized polymeric ball (not the complete polymeric ball-joint hanger) shall be picked up and be sent with the samples required by SA13.5.1. Each sample shall be tagged in accordance with SA13.5.2 (a) – (d).

*Exception: The field representative shall select 2 samples of the alternate polymeric ball when the 5-Inch Flame Test is not required.*

SA13.5.4 When an alternate construction (other than an alternate polymeric material) of the polymeric ball-joint hanger is specified in the Procedure, then the field representative shall select a complete set of samples in accordance with SA13.5.1 – SA13.5.3 for each construction.

## **SA14 Thermoplastic Enclosure Tests**

### **SA14.1 General**

SA14.1.1 The sample thermoplastic enclosure forwarded by the field representative to the certification organization in accordance with Section SA13, Instructions for Sample Pickup, shall be subjected to the applicable tests described in SA14.2.1 – SA14.6.3 at the certification organization location.

### **SA14.2 Qualitative infrared analysis**

SA14.2.1 A thermoplastic enclosure sample shall be subjected to the Qualitative Infrared Analysis (IR) in accordance with the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A, and with SA14.2.2. The results shall comply with SA14.2.3.

SA14.2.2 An infrared spectrum of the material shall be obtained using an infrared spectrophotometer. The instruments used shall be set to the same locations as the instrument settings used in obtaining the original spectrum as indicated in the Procedure.

SA14.2.3 The spectrum obtained in accordance with SA14.2.1 and SA14.2.2 shall indicate the same composition as the spectrum in the Procedure which illustrates that spectrum obtained under the original investigation.

### **SA14.3 Differential scanning calorimetry**

SA14.3.1 The thermoplastic enclosure sample shall be subjected to the Differential Scanning Calorimetry (DSC) test in accordance with the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A, and with SA14.3.2. The results shall comply with SA14.3.3.

SA14.3.2 A thermogram of the material shall be obtained using a thermal analyzer with a differential scanning calorimeter module. The instruments used shall be set to the same locations as the instrument settings used in obtaining the original spectrum as indicated in the Procedure.

SA14.3.3 The thermogram obtained in accordance with SA14.3.1 and SA14.3.2 shall indicate the same thermal response over the programmed temperature range as that recorded in the Procedure during the original investigation.

### **SA14.4 Thermogravimetry**

SA14.4.1 The thermoplastic enclosure sample shall be subjected to the Thermogravimetry (TGA) test in accordance with the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A, and with SA14.4.2. The results shall comply with SA14.4.3.

SA14.4.2 A thermogram of the material shall be obtained using a thermal analyzer with a thermogravimetric module. The instruments used shall be set to the same locations as the instrument settings used in obtaining the original thermogram of the material as indicated in the Procedure.

SA14.4.3 The thermogram obtained in accordance with SA14.4.1 and SA14.4.2 shall indicate the same characteristic weight loss over the programmed temperature range as that recorded in the Procedure during the original investigation.

#### **SA14.5 Flame test – 3/4 inch**

SA14.5.1 A previously untested thermoplastic enclosure sample shall be conditioned in a forced draft air-circulating oven for 7 days at a temperature of 70°C (158°F). When a higher aging temperature is specified in the Procedure, then the sample shall be aged at that temperature.

SA14.5.2 After the sample is aged in accordance with SA14.5.1, the sample shall be subjected to the 3/4 Inch Flame Test in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. The results shall comply with SA14.5.3. There shall be an interval of one minute between applications.

SA14.5.3 After two 30 second applications of the test flames in accordance with SA14.5.2, the enclosure sample shall not flame for more than one minute. The enclosure shall not be completely consumed.

#### **SA14.6 Flame test – 5 inch**

SA14.6.1 A previously untested thermoplastic enclosure shall be conditioned in a forced draft air-circulating oven for seven days at a temperature of 70°C (158°F). When a higher aging temperature is specified in the Procedure, then the sample shall be aged at that temperature. The sample shall then be conditioned for a period of 40 hours at a temperature of 23 ±2°C (73.4 ±3.6°F) and at a relative humidity of 50 ±5 percent.

SA14.6.2 After being conditioned as described in SA14.6.1 the enclosure sample shall be subjected to the 5 Inch Flame Test in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

SA14.6.3 The sample tested in accordance with SA14.6.2 shall not continue to burn for more than 60 seconds after the fifth five-second application of the test flame. The sample shall not be damaged in the area of application of the test flame such that the integrity of the enclosure is reduced, or live parts become accessible. The enclosure shall not emit flaming drops or flaming or glowing particles at any time during the test.

#### **SA15 Thermoplastic Parts Test**

SA15.1 The thermoplastic part sample forwarded by the field representative to the certification organization in accordance with Section SA13 shall be subjected to the Qualitative Infrared Analysis described in SA14.2.1 and SA14.2.2.

SA15.2 The spectrum obtained in accordance with SA14.2.1 and SA14.2.2 shall indicate the same composition as the spectrum obtained for the thermoplastic part under the original investigation of the fan by the certification organization.

#### **SA16 Locked Rotor Tests**

SA16.1 The fan or motor sample forwarded by the field representative to the certification organization in accordance with Section SA13, Instructions for Sample Pickup, shall be subjected to the Locked Rotor Test described in SA9.5.1 – SA9.5.11.

*Exception: This requirement does not apply to fans employing a motor construction covered under the category for Recognized Motor Protective Devices – Inherent Overheating Type or the category for Recognized Impedance-Protected Motors.*

SA16.2 After being subjected to the locked rotor conditions, the sample shall comply with SA9.2.2 or SA9.2.3, as applicable, and with Table SA9.1.

## **SA17 Polymeric Ball-Joint Hanger Tests**

### **SA17.1 General**

SA17.1.1 The polymeric ball-joint hanger samples forwarded by the field representative to the certification organization in accordance with Section SA13, Instructions for Sample Pickup, shall be subjected to the tests described in SA17.3.1 – SA17.5.3.

### **SA17.2 Temperature conditioning**

SA17.2.1 One sample of the polymeric ball-joint hanger shall be conditioned in accordance with 71.2.2.1. The sample shall show no evidence of breaking or cracking.

### **SA17.3 Static load test**

SA17.3.1 The polymeric parts of one polymeric ball-joint hanger shall be conditioned in accordance with 71.2.2.2. The sample shall then be subjected to the static load described in 71.1.2.2. After the load is removed, the security of the mounting means to the building structure or outlet box and the security of the connection of the fan to the mounting means shall be as originally installed.

### **SA17.4 Qualitative infrared analysis**

SA17.4.1 One polymeric ball-joint hanger sample shall be subjected to the Qualitative Infrared Analysis described in SA14.2.1 and SA14.2.2.

SA17.4.2 The spectrum obtained in accordance with SA14.2.1 and SA14.2.2 shall indicate the same composition as the spectrum obtained for the ball-joint hanger under the original investigation of the fan.

### **SA17.5 Flame test – 5 inch**

SA17.5.1 Six samples of the polymeric ball-joint hanger shall be conditioned in accordance with SA14.6.1.

SA17.5.2 After being conditioned as described in SA14.6.1, the ball-joint hanger samples shall be subjected to the 5 Inch Flame Test in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. The sample is to be oriented in the test stand described in UL 746C, and the tip of the flame is to contact the area of the polymeric ball.

SA17.5.3 A sample tested in accordance with SA17.5.2 shall not continue to burn for more than 60 seconds after the fifth five-second application of the test flame. The sample shall not be damaged in the area of application of the test flame such that the integrity of the enclosure is reduced, or live parts become accessible. The sample shall not emit flaming drops or flaming or glowing particles at any time during the test.

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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

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Attachment Plugs and Receptacles – UL 498  
Capacitors and Suppressors for Radio- and Television-Type Appliances – UL 1414  
Cord Sets and Power-Supply Cords – UL 817  
Electric Motors – UL 1004  
Electromagnetic Interference Filters – UL 1283  
Air Filter Units – UL 900  
Flexible Cord and Fixture Wire – UL 62  
Fuseholders – UL 512  
Fuses for Supplementary Overcurrent Protection – UL 198G  
Industrial Control Equipment – UL 508  
Lampholders, Edison-Base – UL 496  
Marking and Labeling Systems – UL 969  
Motor-Operated Appliances – UL 73  
Overheating Protection for Motors – UL 2111  
Plastic Materials for Parts in Devices and Appliances, Tests for Flammability of – UL 94  
Polymeric Materials – Use in Electrical Equipment Evaluations – UL 746C  
Printed-Wiring Boards – UL 796  
Solid-State Fan Speed Controls – UL 1917  
Supplementary Protectors for Use in Electrical Equipment – UL 1077  
Switches, Clock-Operated – UL 917  
Switches, Snap, General-Use – UL 20  
Switches, Special-Use – UL 1054  
Tape, Polyvinyl Chloride, Polyethylene, and Rubber Insulating – UL 510  
Temperature-Indicating and -Regulating Equipment – UL 873  
Thermal Cutoffs for Use in Electrical Appliances and Components – UL 1020  
Transformers, Specialty – UL 506  
Wire Connectors and Soldering Lugs for Use with Copper Conductors – UL 486A  
Wire Connectors for Use with Aluminum Conductors – UL 486B  
Wires and Cables, Thermoset-Insulated – UL 44  
Wires and Cables, Thermoplastic-Insulated – UL 83  
Vehicle Battery Adapters – UL 2089

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## CANADIAN REQUIREMENTS COMPARISON GUIDE CRG 507

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UL AND CANADIAN STANDARDS FOR ELECTRIC FANS



Product Category: Electric Fans

UL Category Control Number: GPWV7, GPWV8, GPRT7, AEDX7, AEDX8, EOGX7

UL Standard:

Standard for Electric Fans  
UL 507  
Ninth Edition

Canadian Standard:

Fans and Ventilators  
CAN/CSA-C22.2 No. 113-M1984  
Sixth Edition

Canadian TILs: (Technical Information Letters)

No. H-5 dated August 3, 1965  
No. H-11 dated January 17, 1985  
No. G-38A dated October 31, 1986  
No. G-38B dated February 28, 1989  
No. G-37B dated September 18, 1998  
No. G-40 dated June 1, 1988  
No. G-45 dated October 15, 1993  
No. G-46 dated August 9, 1994  
No. G-47 dated April 10, 1996

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: 507

Issue No.: 4

Issue Date: December 23, 2003

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. 113-M1984, and its associated Technical Information Letters (TILs), that are in addition to the requirements in UL 507 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.

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Requirements Topics	CSA Clause	Comparison
ALL FANS Construction	4.2.1 and Table 1	Minimum sheet metal enclosure thicknesses shall comply with Table 1 of the CSA Standard. These thicknesses apply to sheet metal enclosures for live parts.
	4.2.5, Table 3 and Table 4	Clause 4.2.5 specifies the construction requirements for openings in enclosures and guards. The probes in Tables 3 and 4 of the CSA Standard are to be used to evaluate the accessibility of bare live parts and moving parts. (Also see "Evaluation of Fan Guards" for CSA clause 6.12 in this guide.)
Performance	4.1.3	For other than normal indoor locations, enclosures shall comply with the requirements in CSA C22.2 No. 94, Special Purpose Enclosures 2, 3, 4, and 5.
	4.14 and Table 6 4.15.1	Spacing requirements for bare live parts. A lampholder shall comply with CSA C22.2 No. 43, Lampholders.
	6.4.10	Remote speed controls are to be installed and tested with the fan.
	4.10.7 and 6.10.1	A fan shall be able to start and run after a power interruption. The starting current test shall be conducted at over- and under-voltage and with the speed control at the minimum setting.
	6.11	The abnormal temperature test shall be conducted. See Tables 1 – 3 at the end of this guide for voltages to be applied during the temperature test.
	6.13	Limited short circuit test for speed controls (1000 Amps).
	(C22.2 No. 0.4) Section 4	Grounding continuity test (impedance test).
Markings	5.1(j)	The date code shall provide the month and year of manufacture.
	5.1(i)	The type of motor protection shall be marked – such as "IMPEDANCE PROTECTED" or "THERMALLY PROTECTED" Warning and Cautionary Markings shall be bilingual in French and English. If a light is provided with the fan, each lampholder shall be marked with the "type" of lamp in addition to the maximum wattage (for example, MAX 60 WATTS, TYPE A).
	5.1(g)	A fan motor shall indicate the horsepower or watts.

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## Table Continued

Requirements Topics	CSA Clause	Comparison
	5.2	Markings shall comply with C22.2 No. 0 (Canadian Electrical Code, Part II). Fans shall be marked "continuous duty," and "on/off" or "1/0."
	5.3	A fan intended for use with a variable speed controller shall be marked to indicate which controllers can be used with the fan.
<b>DESK/STAND FANS</b>		
Construction	2.1, Notes (1) and (2)	Indicates that pedestal fans are those more than four feet high and are not considered to be household fans. This clause applies only to industrial or commercial fans.
	4.4.2.4 and 4.4.3.2	Cord requirements for desk/stand fans.
	4.8.4 and 4.8.10	Internal wiring requirements.
Performance	6.7.3	Cords which are subjected to flexing shall be subjected to a flexing test. This requirement applies to oscillating fans.
<b>BATHTUB AND SHOWER STALL FANS</b>		
Performance	6.22.1 and 6.22.3	A fan shall be evaluated for shock hazard by subjecting it to four 15 minute applications of water spray. Following the shock hazard test, the fan is to be subjected to a humidity exposure and then a dielectric test.
	6.23	A fan shall be subjected to the thermal shock test. The fan is to be exposed to a wet cloth for 1 minute and then a fine spray of water for 1 minute.
Markings	5.20	Marking requirements for a fan or fan-light combination for installation over a bathtub or shower stall.
<b>UNGUARDED FANS</b>		
Performance	6.18	Testing for pliability of the blades.
	6.19	Kinetic energy. The "k" factor is to be calculated as indicated in Clause 6.19.
	6.24	A fan blade shall be tested to determine its impact force. The impact force shall not exceed 175 N.
<b>MOTORS</b>		
Performance	4.10.2	Following the locked rotor and endurance testing on motors, the dielectric potential shall be twice the maximum rated motor voltage but not more than the rated voltage plus 1000 volts in accordance with clause 5.6.7 in CSA C22.2 No. 100. Motors shall comply with CSA C22.2 No. 77, Motors with Inherent Overheating Protection.

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## Table Continued

Requirements Topics	CSA Clause	Comparison
		When the motor is UL Recognized or an Unlisted Component, instead of retesting with the specified protectors at their worst case tolerance, the opening temperature is to be calculated using the previous UL testing and is acceptable when the opening temperature is still within the required temperature limit.
FANS FOR USE IN COOKING AREAS		
Construction	4.4.1.7	When a remote fan is used with a rangehood, the wiring shall be in accordance with the Canadian Electrical Code, Part 1.
	4.10.3	The location of a motor, intended for commercial use, shall not be in an airstream.
Performance	6.4	The temperature test is to be conducted in a black alcove over burners.
Markings	5.9 and 5.14	Markings required.
CEILING INSERT FAN/LIGHTS		
Construction	4.4.1.3	Field wiring compartment requirements.
Performance	6.4.9	For testing purposes, thermal insulation of R40 rating shall be placed around the fan. (R40 = 3.33 R/in. = 10.4 inches of insulation rated 3.85 R/in.)
	6.11	Abnormal Temperature Test – For the fan on, light on condition, only subject the fan motor to the over and under voltage test. The light shall be connected to rated voltage and energized to rated wattage. For the fan off, light on condition, subject only the light to the over and under voltage test. The over and under voltage test is not required for the light off, fan on condition.
Instructions	5.15	Installation instructions shall state that the fan not be installed in a ceiling thermally insulated to a value greater than R40.
CEILING-SUSPENDED FANS		
Construction	4.3.4 (a) (iii)	Indicates special requirements for strain relief on motor leads when the fan is not completely assembled in the factory. This requirement has been waived and the UL 507 requirements are sufficient.
	4.3.6	Additional means of support shall be provided in case the mounting means fail. The support shall be independent of the outlet box.
	4.3.7	Requirements for shipping light kits. Specifically, C- UL Listed light kits shall not be shipped separately from the ceiling-suspended fan unless polarized type connectors are used.

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## Table Continued

Requirements Topics	CSA Clause	Comparison
	4.3.8	A ceiling-suspended fan intended to be mounted to an outlet box shall be provided with two No. 10-32 screws.
	4.4.1.8(b)	The ceiling area which is exposed within the fan canopy shall be covered by a non-combustible material, or a metal plate which is at least 0.52 mm thick, which is provided with the fan.
Performance	6.2.1	Supporting strength tests.
Markings	5.11.1	A ceiling-suspended fan shall be marked to indicate that the height from the floor to the lowest moving part of a ceiling-suspended fan shall be 2.5 m.
	4.2.5.10 and 5.11.2	Height marking exception. The marking for ceiling-suspended fan blade height may indicate 2.1 m if it complies with Table 10.
	5.23	Outlet box marking.
Instructions	5.22	Instructions required for periodic tightening of set screws.
	5.24	Outlet box statement is to be included in the installation instructions.
Thermal Cut Off Devices Used As A Safety Limit Control		TIL No. H-11 indicates items to be observed and documented when thermal cutoffs are used.
Mobile Homes And Trailers	4.10.8	TIL No. H-5 defines the dimensions of the kitchen area above, or near the cooking equipment in which the fan complying with this clause can be installed.
Evaluation of Fan Guards	6.12	TIL No. G-47 indicates that UL 507 requirements for fan guards may be used.
Alternative Requirements For Non-Metallic Enclosures	4.2.4	TIL No. G-46 indicates alternative requirements for evaluation of a non-metallic enclosure used to enclose insulated live parts with insulation thicknesses 0.71 mm (0.028 in) or greater. When a fan complies with TIL No. G-46, a flammability rating of HB may be used for portable household fans.
Openings In Enclosures Beneath Open Frame Motors	4.10.6	TIL No. G-45 contains requirements for evaluation of openings in the enclosures beneath open (skeleton) type motors.
Lampholder-Connected Fans		TIL No. G-40 describes construction, marking, and test requirements for a fan intended to be screwed into a medium base lampholder.
Acoustic Sound Hoods Used With Electronic Data Processing Equipment		TIL No. G-38A indicates that acoustic sound hoods with or without a fan are covered as a fan under CSA C22.2 No. 113 and that the sound hoods are tested with the specific electronic data processing equipment is it specified for use with.

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**Table Continued**

Requirements Topics	CSA Clause	Comparison
Acoustic Sound Hoods Equipped With Fan Assembly		TIL No. G-38B supplements G-38A and indicates construction, marking, and test requirements for a sound hood with a fan assembly which is used with a printer.
Electrically Commutated (Brushless) DC Fans	(CSA C22.2 No. 113) 1.4.1, 1.4.2, 6.3, 6.4, 6.5, 6.15, Table 8	TIL No. G-37B describes requirements for brushless DC Fans.
	(CSA C22.2 No. 77) 6.4, 6.4.1, 6.4.2, 6.6	Revised December 23, 2003

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**Table 1**  
**Temperature test voltages for single phase conductors**

Normal temperature test voltages, volts (v)	Abnormal temperature test voltages, volts (v)
120	104 and 127
240	208 and 254
480	416 and 508
600	520 and 635

**Table 2**  
**Temperature test voltages for 3-phase 4-wire conductors**

Normal temperature test voltages, volts (v)	Abnormal temperature test voltages, volts (v)
120/208Y	108/187 and 127/220
240/416Y	216/374 and 254/440
277/480Y	240/416 and 293/508
347/600Y	300/520 and 367/635

**Table 3**  
**Temperature test voltages for 3-phase 3-wire conductors**

Normal temperature test voltages, volts (v)	Abnormal temperature test voltages, volts (v)
240	208 and 254
480	416 and 508
600	520 and 635

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**Superseded requirements for  
the Standard for  
Electric Fans**

**UL 507, Ninth Edition**

The requirements shown are the current requirements that have been superseded by requirements in this edition. The numbers in parentheses refer to the new requirements with future effective dates that have superseded these requirements. To retain the current requirements, do not discard the following requirements until the future effective dates are reached.

6.2.1 Wood shall not be employed as an appliance enclosure unless:

- a) The enclosure is not intended for use in a cooking area, a bathroom, a damp location, or outdoors;
- b) The wood complies with the requirements specified for polymeric materials in 6.3.1, as applicable to wood; and
- c) The enclosure is in accordance with the Temperature Test requirements in Table 36.1, as applicable to wood.

6.2.2 A wood enclosure serving as an enclosure of uninsulated live parts shall be subjected to the Flammability – 12 mm Flame Test in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

6.3.1 A non-metallic enclosure shall comply with the applicable mechanical and electrical property considerations, flammability, and thermal requirements as specified in UL 746C, the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations. A 6.8 J (5 ft-lbf) impact value shall apply to all appliances when determining the impact resistance of polymeric enclosures.

*Exception No. 1: A polymeric grille used in a fan is not required to comply with the flammability requirements of UL 746C when:*

- a) The material has a minimum flame class rating of HB;*
- b) It is used as an enclosure of insulated live parts and the insulation thickness is 0.71 mm (0.028 inch) or greater; and*
- c) The grille is completely external when installed as intended.*

*Exception No. 2: A polymeric grille used in a fan intended to be mounted at least 2.1 m (7 feet) above the floor is not required to comply with the Resistance to Impact Test of UL 746C.*

6.4.2 An impeller of polymeric material outside a motor shall not be located within 25.4 mm (1 inch) of an opening in the motor housing.

*Exception: An impeller is not prohibited from being within 25.4 mm of an opening in the motor housing when:*

- a) The material is classed as V-2, V-1, V-0, or 5V in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94;*

- b) *The material complies with the requirements for enclosure flammability using a 19-mm (3/4-inch) flame, in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C; or*
- c) *No motor opening within 25.4 mm of the blade has a dimension more than 6.75 mm (17/64 inch) or an area more than 35.48 mm<sup>2</sup>(0.055 square inch), and no more than six such openings are provided;*
- d) *In a skeleton or open frame type motor:*
- 1) *The impeller is of material classed HB or less flammable in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94;*
  - 2) *The coil is completely wrapped with insulation at least 0.8 mm (1/32 inch) thick; and*
  - 3) *The space between the coil wrap and bobbin does not exceed 0.8 mm.*
- e) *The material has a hot wire ignition rating of at least 7 seconds as described in the Standard Test Method for Ignition of Materials by Hot Wire Sources, ASTM D3874-1990a;*
- f) *The fan employs a thermally protected motor to drive the impeller and complies with the test requirements in Section 50, Impeller Ignition Test; or*
- g) *The fan complies with the requirements for unattended areas as specified in Sections 139 and 140.*

7.1 Non-metallic enclosures or parts listed in (a) – (e), and which are part of a fan intended to be permanently connected electrically, shall have a flame spread rating of zero in accordance with UL 723 , the Standard for Test for Surface Burning Characteristics of Building Materials.

- a) Enclosure;
- b) Sleeve;
- c) Sound deadening material;
- d) Skirt; and
- e) Venturi system.

*Exception No. 1: A part that is installed exterior to the building structure so that the entire part of the fan is visible to the user is not required to comply with the flame spread requirements.*

*Exception No. 2: A material having a flame-spread rating of 50 or less, as determined by the Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source, ASTM E162-1990, is an alternative for a sleeve or outer enclosure of a fan.*

*Exception No. 3: When a fan is marked as specified in 62.5.3, a material with a flame-spread rating of 200 or less, as determined by the Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source, ASTM E162-1990, is an alternative for a sleeve or outer enclosure of a wall- or ceiling-insert fan.*

*Exception No. 4: This requirement does not apply to sound deadening material that is rated HB or HF-2.*

*Exception No. 5: A skirt or other part of a venturi system may have a flame-spread rating of 50 or less as determined by the Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source, ASTM E162-1990, unless marked in accordance with 62.5.3, in which case it is to have a flame spread rating of 200 or less.*

8.3.1 The impeller of a stationary or permanently connected fan shall not be less than 3.05 m (10 feet) above the floor and the unit shall be marked as specified in 63.6.

*Exception No. 1: An impeller that is less than 3.05 m (10 feet) but not less than 2.1 m (7 feet) above the floor meets the intent of this requirement when a guard is provided that prevents a 25.4-mm (1-inch) diameter probe as illustrated in Figure 8.2, when inserted through the opening, from touching a moving part that causes injury to a person and the unit is marked as specified in 63.4.*

*Exception No. 2: A nonresidential fan intended to be permanently connected electrically is not required to be guarded when the moving part is mounted at least 2.1 m (7 feet) above the floor and marked as specified in 63.4.*

*Exception No. 3: This requirement does not apply to residential attic fans and whole house fans.*

*Exception No. 4: Ceiling-suspended fans shall comply with Section 70.2 and 72.1.*

*Exception No. 5: Fans for use in cooking areas shall comply with 91.3.1 – 91.3.3.*

8.3.3 The 25.4-mm (1-inch) diameter probe as illustrated in Figure 8.2, when inserted through an opening on the air-inlet side of a wall-insert fan, shall not contact a moving part that presents a risk of injury to a person.

*Exception No. 1: This requirement does not apply to a wall-insert fan provided with a reusable metal filter or marked to be mounted at least 2.1 m (7 feet) above floor level. See 63.4.*

*Exception No. 2: This requirement does not apply to a wall-insert fan having an impeller diameter of 254 mm (10 inches) or less, when:*

- a) The wall-insert fan is marked as specified in 62.5.7; and*
- b) The installation instructions specified in 64A.6 are provided.*

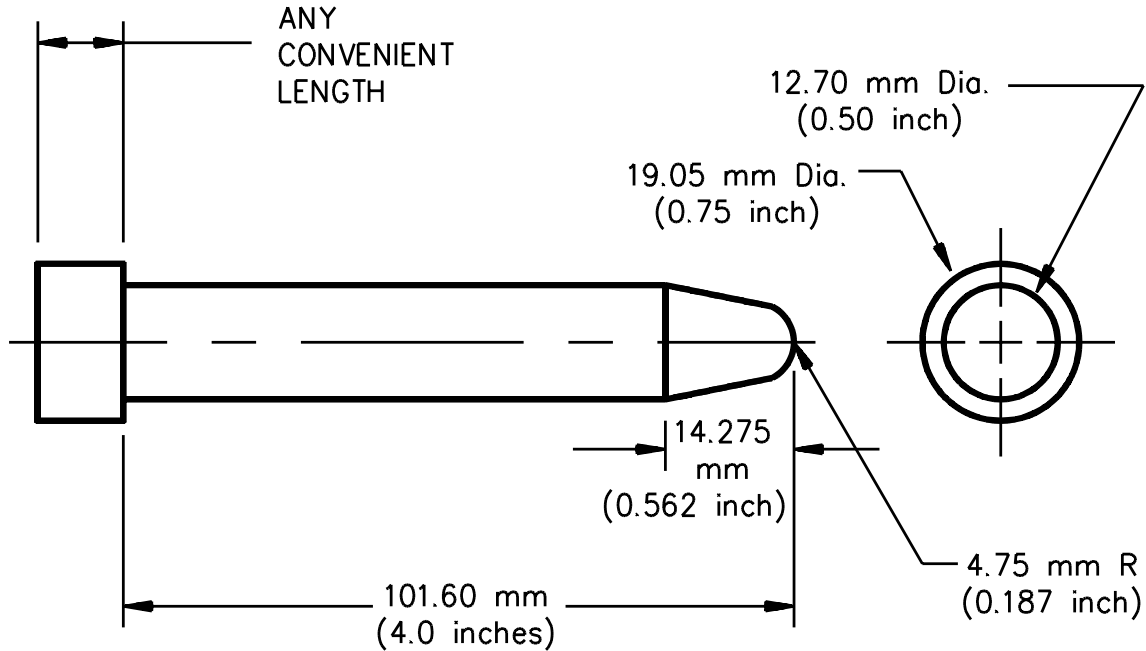
*Exception No. 3: This requirement does not apply to a wall-insert fan having an impeller 152.4 mm (6 inches) or less in diameter.*

9.3.1 The probes referenced in Table 9.1 and illustrated in Figures 9.1 and 9.2 shall be applied to any depth that the opening permits and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to try to contact an uninsulated live part or film-coated wire. If necessary, the configuration shall be changed after insertion through the opening. Configuration refers to positioning of the jointed portions of the probes.

**Table 9.1**  
**Accessibility of live parts**

Fan type	Figure reference of probe for judging accessibility	
	Uninsulated live parts other than film-coated wire	Film-coated wire
Ceiling-suspended, ceiling-insert, roof-mounted and attic fans	Figure 9.2 (Probe)	No requirement
All other fans	Figure 9.2 (Probe)	Figure 9.1 (Probe)

**Figure 9.1**  
**Probe for film-coated wire**



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9.3.2 The probes referenced in Table 9.1 and illustrated in Figures 9.1 and 9.2 shall be used as measuring instruments to judge the accessibility to uninsulated live parts and film-coated wire provided by openings and not as instruments to judge the strength of a material. Force is not to be applied to the probe when judging accessibility.

9.4.1 During an examination to determine whether an appliance complies with the requirements specified in 9.1.1, 9.3.1, and 9.3.2 and Table 9.1, a part of the enclosure is to be removed before the examination when it is intended to be removed without using a tool by the user to attach an accessory, to make an operating adjustment, or for other reasons.

9.4.3 With reference to the requirements specified in 9.1.1, 9.3.1, and 9.3.2 and Table 9.1, insulated brush caps are not required to be additionally enclosed.



13.1.2 With reference to the requirement specified in 13.1.1, the following types of appliances shall be provided with means for permanent electrical connection to the power supply:

- a) An attic fan;
- b) An appliance intended for permanent attachment to a building structure; and
- c) c) A duct-connected appliance.

*Exception No. 1: An in-wall, in-glass, or surface-mounted fan (other than ceiling-suspended fan) not intended to be used in a cooking area is not required to be provided with a means for permanent electrical connection when it is provided with a power-supply cord that:*

- a) Is at least 0.46 m (18 inches) and not more than 3.05 m (10 feet) long;*
- b) Has three conductors, one being the equipment grounding conductor;*
- c) Is Type S, SJ, SJO, SJT, SJTO, SO, SP-3, SPT-3, ST, or STO;*
- d) Is permanently attached to the fan at a location below the surface of the cooking area; and*
- e) Complies with the requirements in 14.1.2 and 14.2.1 – 14.2.5.*

*Exception No. 2: A window fan or desk fan with provision for temporary mounting, such as keyhole slots, is not required to be provided with means for permanent electrical connection when it is provided with a power-supply cord that is permanently attached to the fan and complies with the requirements of 14.1.2, 14.2.1 – 14.2.5, and Table 14.2.*

*Exception No. 3: A wall-mounted fan marked for commercial, industrial, or agricultural use is not required to have provision for permanent electrical connection when provided with a power-supply cord that:*

- a) Has three conductors;*
- b) Is Type SJ or heavier terminating in an acceptable grounding type attachment plug;*
- c) Has a length of 0.305 – 0.46 m (12 – 18 inches);*
- d) Is permanently attached to the fan; and*
- e) Complies with the requirements of 14.1.2 and 14.2.1 – 14.2.5.*

*Exception No. 4: A down-draft fan is not required to be provided with a means for permanent electrical connection when it is provided with a power supply cord that:*

- a) Is at least 457.2 mm (18 inches) but not more than 762 mm (30 inches) long;*
- b) Has three conductors, one being the equipment grounding conductor;*
- c) Is Type S, SJ, SJO, SJT, SJTO, SO, ST, or STO;*
- d) Is permanently attached to the fan at a location intended to be below the surface of the cooking area; and*

e) Complies with the requirements in 14.1.2 and 14.2.1 – 14.2.5.

13.3.3 The minimum usable volume of an outlet box or terminal compartment in which field-installed wiring connections to the power supply are to be made shall be as specified in Table 13.3.

*Exception: A motor containing an integral wiring compartment that complies with the Standard for Electric Motors, UL 1004, need not comply with this requirement.*

**Table 13.2**  
**Minimum usable volume of terminal compartment**

Size of field-installed conductors,		Volume for each field-installed wire originating outside of the compartment and terminating inside the compartment <sup>a</sup>	
AWG	(mm <sup>2</sup> )	cm <sup>3</sup>	(cubic inches)
14	(2.1)	32.77	(2.00)
12	(3.3)	36.87	(2.25)
10	(5.3)	40.97	(2.50)
8	(8.4)	49.16	(3.00)
6	(13.3)	81.94	(5.00)

<sup>a</sup> Including a grounding conductor.

18.1 A 15- or 20-ampere attachment-plug receptacle intended for general use in an appliance shall be of the grounding type. The grounding contact of the receptacle shall be electrically connected to dead metal that will be grounded when the appliance is in use.

25.3.3 (28.3.3) A power-supply cord of a stationary fan, an evaporative cooler, or a fan intended to be used, or that may be used, outdoors in accordance with the literature provided with the fan shall include an equipment-grounding conductor.

46.1 When subjected to the test specified in 46.2, a cord-connected wall-surface-mounted appliance shall comply with the following:

- a) The security of the attachment of the appliance to the wall shall not be adversely affected;
- b) There shall be no evidence of a risk of fire or electric shock;
- c) The insulation resistance between live and dead-metal parts shall not be less than 50,000 ohms; and
- d) The appliance shall withstand for 1 minute without breakdown the application of a 60-hertz essentially sinusoidal potential of 1000 volts between live and dead-metal parts.

46.2 An appliance as mentioned in 46.1 is to be mounted in the intended manner and subjected to a static load equal to three times the weight of the appliance, for 1 minute. The load is to be applied so as to transmit the maximum amount of stress to the mounting means.

57.1.11 (64.1) The important safety instructions for a fan intended for use in cooking areas shall include the following statements verbatim and in the order shown regarding the means for reducing the risk of a range top grease fire:

WARNING – TO REDUCE THE RISK OF A RANGE TOP GREASE FIRE:

- a) Keep fan, filters and grease laden surfaces clean.
- b) Always turn hood ON when cooking at high heat.
- c) Use high range settings on range only when necessary. Heat oil slowly on low to medium setting.
- d) Don't leave range unattended when cooking.
- e) Always use cookware and utensils appropriate for the type and amount of food being prepared.

62.1.10 A fan that complies with Exception No. 3 to 13.1.2 shall be marked with the following or equivalent: "Suitable for commercial or industrial use only."

62.5.3 A household wall- or ceiling-insert fan having a combustible sleeve or outlet enclosure with a flame-spread rating between 50 and 200 shall be marked "Suitable for residential use only."

63.6 A fan described in 8.3.1 shall be marked with the word "CAUTION" and the following or equivalent wording: "To Reduce The Risk Of Injury To Persons, Install Fan At Least 3.05 meters (10 Feet) Above The Floor."

64.11 The important safety instructions for a fan intended for use in cooking areas shall include the following statements verbatim and in the order shown regarding the means for reducing the risk of a range top grease fire:

WARNING – TO REDUCE THE RISK OF A RANGE TOP GREASE FIRE:

- a) Never leave surface units unattended at high settings. Boilovers cause smoking and greasy spillovers that may ignite. Heat oils slowly on low or medium settings.
- b) Always turn hood ON when cooking at high heat or when cooking flaming foods.
- c) Clean ventilating fans frequently. Grease should not be allowed to accumulate on fan or filter.
- d) Use proper pan size. Always use cookware appropriate for the size of the surface element.

91.3.5 Non-metallic parts other than the enclosure shall comply with the requirements in sub-section 6.4, Non-metallic parts other than enclosures, and Section 7, Flame Spread Requirements for Non-metallic Enclosures and Other Parts of Permanently Connected Equipment.

136.3.1 A non-metallic enclosure of an appliance intended for outdoor use shall withstand 720 hours of exposure to ultraviolet radiation in accordance with the Ultraviolet Light Exposure Test in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, without impairment of its impact resistance when tested as specified in 136.3.2.

139.1 In addition to any other motor requirements specified in UL 507, the requirements specified in Sections 139 and 140 apply to any motor used in fan products which are built into or within the building structure and which operate unattended or in situations in which the operator may not detect a locked rotor condition. Examples include: wall-insert fans, in-wall fans, ceiling-insert fans, attic exhaust fans, whole house fans, and duct fans. Fans intended for use in cooking areas and ceiling-suspended fans are not included.

*Exception No. 1: These requirements do not apply to motors employing a single-operation device, a thermal cutoff, or a manual reset thermal protector when the device opens during the normal locked rotor testing in accordance with UL 2111, the Standard for Overheating Protection for Motors.*

*Exception No. 2: These requirements do not apply to a motor in which there are no openings in the enclosure through which molten metal, burning insulation, flaming particles, or other ignited material could fall onto flammable material, or through which a flame could be projected.*

159.2 The individual loads shall be marked as follows:

- a) For a fan or blower motor, the full-load ampere and horsepower ratings;
- b) For a water pump motor or other small motor rated less than 1/8 hp, the full-load amperes, or watts, rating; and
- c) For a general-use receptacle, a load equal to 80 percent of the receptacle current rating, unless the receptacle is marked for a lesser rating.