UL 507

STANDARD FOR SAFETY

Electric Fans

UL Standard for Safety for Electric Fans, UL 507

Tenth Edition, Dated November 9, 2017

Summary of Topics

The revisions for ANSI/UL 507 dated August 24, 2023 include the following changes in requirements:

– Alternate insulation; 144.1.1, 144.1.3, 144.1.6, 144.1.6A, 144.1.12, Figure 144.0

– Remote safety software update requirements; SA2.7

– Ducted fans to the outside; 83.10

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated April 29, 2022 and July 7, 2023.

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The most recent designation of ANSI/UL 507 as an American National Standard (ANSI) occurred on August 24, 2023. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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.

Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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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, whole-house window, through wall, and direct discharge fans;

c) Ducted fans and blowers that exhaust air to the outside of a building structure, such as in-line, wall insert and ceiling insert fans;

d) Dryer type fans used for drying carpets or floors;

e) Commercial display blowers;

f) Evaporative coolers;

g) Evaporative cooler replacement pumps;

h) Air-filtering appliances;

i) Component fans;

j) Low voltage component fans;

k) Residential cooking area fans, such as rangehoods and downdrafts;

l) Hand dryers without heater; and

m) Recirculating and blending units except as noted in 1.2(h).

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

1.2 These requirements do not cover:

a) Air heaters incorporating fans, heating-ventilating units, or blowers comprising components of such equipment as furnaces, mechanical-refrigeration equipment, or air conditioners;

b) Fusible links, and the like, provided to disconnect a fan or close shutters in the event of fire;

c) Fans for use in cooking areas when the fan is intended for other than household use;

d) Fans intended to be used in hazardous locations as defined in the National Electrical Code, ANSI/NFPA 70;

e) Fans intended to be installed over solvents or chemically flammable liquids or vapors;

f) Fans located in chemically corrosive environments;

g) Humidifiers;

h) Fans intended to move heated or conditioned air;

i) Heated hand dryers;

j) Ionizers, products with ionization features, or electrostatic air cleaners;

k) Household or commercial blowers or inflators intended for use with inflatable bouncing toys or similar children's products.

l) Microwaves, ventilating or otherwise;

m) Ducted or non-ducted heat recovery ventilators;

n) Deodorizers and air fresheners.

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.

2.2.4 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.

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

2.2.6 BOX FAN – A portable fan sometimes referred to as a "suitcase" fan. This product consists of a front and back grill mounted to a central frame, typically rectangular or square in shape, with width and height dimensions each measuring greater than 16 inches. The fan is typically designed to be placed on the floor or desk during operation, but may be provided with hardware for window mounting.

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

2.2.8 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.

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

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

2.2.11 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.

2.2.12 EVAPORATIVE COOLER (also referred to a swamp cooler or desert cooler) – An appliance used to lower the temperature and increase the humidity of air by using latent heat of vaporization, changing liquid water to water vapor. The evaporative cooler unit uses a fan to draw air through a wetted membrane, or pad, which provides a large surface area for the evaporation of water 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.

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

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

2.2.15 COMMERCIAL DISPLAY BLOWER – Blower intended for use with commercial displays possessing an outlet intended to be exposed to normal atmosphere.

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

2.2.17 THROUGH-WALL FAN – A fan installed through the wall or other structure and intended to draw air from the outside or exhaust air from the inside.

2.2.18 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.

2.2.19 OUTER SHELL – A continuous casing which collects the air and guides the air stream towards the duct system of the building in case of exhaust installation, or towards the point(s) where the cleaned air is discharged back into the room in case of recirculating installation.

Note: The air intake and the air discharge are not considered as openings in the outer shell.

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

2.2.20.1 PRIMARY PROTECTION – A protector that does operate during the Locked Rotor (abnormal operation) Test of Section 50.

2.2.21 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.

2.2.22 SECONDARY PROTECTION (BACK-UP PROTECTION) – A thermal cutoff, manual reset thermal protector, or supplemental-fuse overcurrent protection provided as part of a motor or fan assembly that does not operate during the Locked Rotor Test of Section 50.

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

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

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

2.2.26 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.

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

2.3 Additional terms

2.3.1 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.

2.3.2 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.

2.3.3 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.

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

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

2.3.6 CONVENIENCE RECEPTACLE – Receptacle intended for the connection of an independent appliance or product.

2.3.7 COOKING AREA – An area in close proximity (as defined in Figure 80.1) to a stove, range, or oven, where fumes, grease laden air, or the like may be present.

2.3.7A DUCT-CONNECTION ADAPTOR – An assembly for the transition between the integral duct-connection fitting of fans for use in cooking areas and the ductwork of the building, often provided to accommodate different size or shape duct configurations.

2.3.8 ELECTRONICALLY PROTECTED MOTOR – A motor that relies upon an electronic circuit to prevent overheating of the motor. The motor is defined as the combination of the motor coil and the associated control and/or power supply that is required for proper motor operation.

2.3.9 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.

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

2.3.10A INTEGRAL DUCT-CONNECTION FITTING – The part of a fan for use in cooking areas that provides transition between the outer shell and ductwork of the building. It can be part of the assembled appliance when it leaves factory, or shipped disassembled from the appliance.

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

2.3.12 OPERATING CONTROL – A device or circuit, the operation of which, starts or regulates the appliance during normal operation.

Note: Examples of operating controls include motor controls not relied upon for overtemperature protection under normal and abnormal operating conditions.

2.3.13 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.

2.3.14 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.

2.3.15 PROTECTIVE CONTROL – A device or circuit, the operation of which is intended to prevent a hazardous situation during abnormal operation of the machine or equipment.

2.3.16 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.

2.3.17 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.

2.3.18 SPECIAL-USE RECEPTACLE – Receptacle intended for the connection of a specific component of the end-product appliance.

2.3.19 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.

2.3.20 USABLE NORMAL CONDITION – Operation in excess of 25 rpm for ceiling suspended fans and operation at 10% or greater of measured as-received high speed rpms for all other fans, excluding fans for use in unattended areas.

Exception No. 1: An increase in volume or change in pitch of noise emitted from the fan is considered to signify an abnormal condition.

Exception No. 2: Operation of a motor thermal protector prior to temperature stabilization is considered to signify an abnormal condition.

2.3.21 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.

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

3 Units of Measurement

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

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

4 Undated References

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

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 80.5.1 and 112.1.

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.

5.5 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 Components

6.1 General

6.1.1 A component of a product covered by this standard shall:

a) Comply with the requirements for that component as indicated in 6.2 – 6.10 or the individual component section;

b) Be used in accordance with its rating(s) established for the intended conditions of use;

c) Be used within its established use limitations or conditions of acceptability;

d) Additionally comply with the applicable requirements of this end product standard; and

e) Not contain mercury.

Note – 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.

Exception No. 1: A lamp is not required to comply with the requirements for mercury.

Exception No. 2: A component of a product covered by this standard is not required to comply with a specific component requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product, or

b) Is superseded by a requirement in this standard, or

c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

Exception No. 3: A component complying with a UL component standard other than those cited in 6.2 – 6.10 or the individual component section is acceptable if:

a) The component also complies with the applicable component standard of 6.2 – 6.10 or the individual component section; or

b) The component standard:

1) Is compatible with the ampacity and overcurrent protection requirements of the National Electrical Code, ANSI/NFPA 70, where appropriate;

2) Considers long-term thermal properties of polymeric insulating materials in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B, and

3) Any use limitations of the other component standard is identified and appropriately accommodated in the end use application. For example, a component used in a household application, but intended for industrial use and complying with the relevant component standard may assume user expertise not common in household applications.

6.1.2 A component that is also intended to perform other functions, such as over current protection, ground-fault circuit-interruption, surge suppression, any other similar functions, or any combination

thereof, shall comply additionally with the requirements of the applicable UL standard(s) that cover devices that provide those functions.

Exception: Where these other functions are not required for the application and not identified as part of markings, instructions, or packaging for the appliance, the additional component standard(s) need not be applied.

6.1.3 A component not anticipated by the requirements of this standard, not specifically covered by the component standards of 6.2 – 6.10 or individual component sections and that involves a potential risk of electric shock, fire, or personal injury, shall be additionally investigated in accordance with the applicable UL standard, and shall comply with 6.1.1 (b) – (d).

6.1.4 With regard to a component being additionally investigated, reference to construction and performance requirements in another UL end product standard is appropriate where that standard anticipates normal and abnormal use conditions consistent with the application of this standard.

6.2 Attachment plugs, receptacles, connectors, and terminals

6.2.1 Attachment plugs, receptacles, appliance couplers, appliance inlets (motor attachment plugs), and appliance (flatiron) plugs, shall comply with the Standard for Attachment Plugs and Receptacles, UL 498. See 6.2.9.

Exception: Attachment plugs and appliance couplers integral to cord sets or power supply cords are covered under the requirements of the Standard for Cord Sets and Power-Supply Cords,UL 817, and need not comply with UL 498.

6.2.2 Quick-connect terminals, both connectors and tabs, for use with one or two 22 – 10 AWG copper conductors, having nominal widths of 3.5, 3.2, 4.8, 5.2, and 6.3 mm (0.110, 0.125, 0.187, 0.205, and 0.250 in), intended for internal wiring connections in appliances, or for the field termination of conductors to the appliance, shall comply with the Standard for Electrical Quick-Connect Terminals, UL 310.

Exception: Other sizes of quick-connect terminals shall be investigated with respect to crimp pull out, insertion-withdrawal, temperature rise, and all tests shall be conducted in accordance with UL 310.

6.2.3 Single and multipole connectors for use in data, signal, control and power applications within and between electrical equipment, and that are intended for factory connection and for factory assembly to copper or copper alloy conductors, or for factory assembly to printed wiring boards, shall comply with the Standard for Component Connectors for Use in Data, Signal, Control and Power Applications, UL 1977. See 6.2.9.

6.2.4 Wire connectors shall comply with the Standard for Wire Connectors, UL 486A-486B.

6.2.5 Splicing wire connectors shall comply with the Standard for Splicing Wire Connectors, UL 486C.

6.2.6 Multi-pole splicing wire connectors that are intended to facilitate the connection of hard-wired utilization equipment to the branch-circuit conductors of buildings or that are intended for consumer connection within and between parts of electrical equipment, shall comply with the Standard for Insulated Multi-Pole Splicing Wire Connectors, UL 2459. See 6.2.9.

6.2.7 Equipment wiring terminals for use with all alloys of copper, aluminum, or copper-clad aluminum conductors, shall comply with the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

6.2.8 Terminal blocks shall comply with the Standard for Terminal Blocks, UL 1059, and, if applicable, be suitably rated for field wiring.

6.2.9 Female devices (such as receptacles, appliance couplers, and connectors) that are intended, or that may be used, to interrupt current in the end product, shall be suitably rated for current interruption of the specific type of load, when evaluated with its mating plug or connector. For example, an appliance coupler that can be used to interrupt the current of a motor load shall have a suitable horsepower rating when tested with its mating plug.

Exception: This requirement is not intended to address those connectors required by 19.17.

6.3 Boxes and raceways

6.3.1 Electrical boxes and the associated bushings and fittings, and raceways, of the types specified in Chapter 3 of the National Electrical Code, ANSI/NFPA 70 and that comply with the relevant UL standard (such as the Standard for Metallic Outlet Boxes, UL 514A, Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C, Standard for Cover Plates for Flush-Mounted Wiring Devices, UL 514D) and 6.1 are considered to fulfill the requirements of this Standard.

6.4 Cords, cables, and internal wiring

6.4.1 A cord set or power supply cord shall comply with the Standard for Cord Sets and Power Supply Cords, UL 817.

6.4.2 Flexible cords and cables shall comply with the Standard for Flexible Cords and Cables, UL 62. Flexible cord and cables are considered to fulfill this requirement when preassembled in a cord set or power supply cord complying with the Standard for Cord Sets and Power Supply Cords, UL 817.

6.4.3 Internal wiring composed of insulated conductors shall comply with the Standard for Appliance Wiring Material, UL 758.

Exception No. 1: Insulated conductors need not comply with UL 758 if they comply with one of the following:

a) Standard for Thermoset-Insulated Wires and Cables, UL 44;

b) Standard for Thermoplastic-Insulated Wires and Cables, UL 83;

c) Standard for Fixture Wire, UL 66; or

d) The appropriate UL standard(s) for other insulated conductor types specified in Chapter 3 (Wiring Methods and Materials) of the National Electrical Code, ANSI/NFPA 70.

Exception No. 2: Insulated conductors for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit not involving the risk of fire or personal injury need not comply with UL 758.

6.5 Cord reels

6.5.1 A cord reel shall comply with the special-use cord reel requirements of the Standard for Cord Reels, UL 355.

6.6 Light sources and associated components

6.6.1 Lampholders and indicating lamps shall comply with the Standard for Lampholders, UL 496.

Exception: Lampholders forming part of a luminaire that complies with an appropriate UL luminaire standard are considered to fulfill this requirement.

6.6.2 Lighting ballasts shall comply with the:

a) Standard for Fluorescent-Lamp Ballasts, UL 935; or

b) Standard for High-Intensity Discharge Lamp Ballasts, UL 1029.

Exception No. 1: Ballasts forming part of a luminaire that complies with an appropriate UL luminaire standard are considered to fulfill this requirement.

Exception No. 2: Ballasts for other light sources shall comply with the appropriate UL standard(s).

6.6.3 Light emitting diode (LED) light sources shall comply with the Standard for Light Emitting Diode (LED) Equipment For Use In Lighting Products, UL 8750.

Exception No. 1: LED light sources forming part of a luminaire that complies with an appropriate UL luminaire standard are considered to fulfill this requirement.

Exception No. 2: Individual LED light sources mounted on printed wiring boards and intended for indicating purposes need not comply with UL 8750, but shall comply with the applicable requirements of this end product standard.

6.7 Overcurrent protection

6.7.1 Fuses shall comply with the Standard for Low-Voltage Fuses – Part 1: General Requirements, UL 248-1; and the applicable UL 248 Part 2 (e.g. UL 248-5). Defined use fuses that comply with UL 248-1 and another appropriate UL standard for the fuse are considered to fulfill this requirement.

6.7.2 Circuit breakers shall comply with the Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures, UL 489.

Exception: Circuit breakers used in telecommunications circuitry that comply with the Standard for Circuit Breakers For Use in Communications Equipment, UL 489A, need not comply with UL 489.

6.7.3 Circuit breakers having integral ground fault circuit interrupter capability for protection against electrical shock shall additionally comply with the Standard for Ground-Fault Circuit-Interrupters, UL 943.

6.7.4 Supplementary protectors shall comply with the Standard for Supplementary Protectors for Use in Electrical Equipment, UL 1077.

6.7.5 Fusing resistors shall comply with the Standard for Fusing Resistors and Temperature-Limited Resistors for Radio- and Television-Type Appliances, UL 1412.

6.8 Power supplies

6.8.1 A Class 2 power supply shall comply with one of the following:

a) Standard for Class 2 Power Units, UL 1310;

b) Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1 that complies with the limited power source (LPS) requirements and is marked "LPS"; or

c) Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1, that complies with the limited power source requirements (LPS) requirements and is marked "LPS".

6.8.2 A non-Class 2 power supply shall comply with one of the following:

a) Standard for Power Units Other Than Class 2, UL 1012; or

b) Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1; or

c) Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

6.9 Supplemental insulation, insulating bushings, and assembly aids

6.9.1 The requirements for supplemental insulation (e.g. tape, sleeving or tubing) are not specified unless the insulation or device is required to fulfill a requirement of this standard. In such cases:

a) Insulating tape shall comply with the Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape, UL 510, or for tapes requiring greater than 80 C rating, the Standard for Component Tapes, UL 510A;

b) Sleeving shall comply with the Standard for Coated Electrical Sleeving, UL 1441;

c) Tubing shall comply with the Standard for Extruded Insulating Tubing, UL 224.

6.9.2 Insulating bushings that comply with Section 6.1 of this end-product standard, and the Standard for Insulating Bushings, UL 635, are considered to fulfill the requirements of this Standard. Tests specified in this Standard (e.g. Strain Relief Test) may still need to be performed to confirm the combination of the insulating bushing and the supporting part are suitable.

6.10 Transformers

6.10.1 General-purpose transformers shall comply with the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1; and the Standard for Low Voltage Transformers – Part 2: General Purpose Transformers, UL 5085-2.

Exception No. 1: A transformer that is completely enclosed within the end product enclosure, and that meets the applicable construction and performance requirements of this end product standard when tested in conjunction with the end product, meets the intent of this requirement.

Exception No. 2: A transformer that complies with the Standard for Transformers and Motor Transformers for Use in Audio-, Radio-, and Television-Type Appliances, UL 1411, and that is used in a circuit involving an audio or video component, meets the intent of this requirement.

6.10.2 Class 2 and Class 3 transformers shall comply with the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1; and the Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3.

Exception: Transformers located in a low voltage circuit, and that do not involve a risk of fire or personal injury, need not comply with this requirement.

7 Frame and Enclosures

7.1 General

7.1.1 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.

7.1.2 A cast- or sheet-metal section of the enclosure shall not be thinner than the applicable value specified in Table 7.1.

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 7.1.

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 7.1 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.

Table 7.1
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)[a]	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)

[a] 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).

7.1.3 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 81.6; 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.

7.1.4 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.

7.1.5 The requirements in 7.1.4 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 the Standard for Impedance Protected Motors, UL 1004-2, 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) Complies with the requirements of the Vertical Wires test in the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581, 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.

7.1.6 The barrier mentioned in 7.1.5 shall be horizontal, shall be located as illustrated in Figure 7.2, 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.

7.1.7 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.

7.2 Wood enclosure parts

7.2.1 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 46.1, as applicable to wood.

7.2.2 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.

7.3 Non-metallic enclosures

7.3.1 A non-metallic enclosure shall comply with the applicable mechanical and electrical property considerations, flammability, and thermal requirements as specified in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. A 6.8 J (5 ft·lbf) impact value shall apply to all appliances when determining the impact resistance of polymeric enclosures in the as-received condition. This impact value shall also be used for cold impact testing of appliances intended to be used 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.

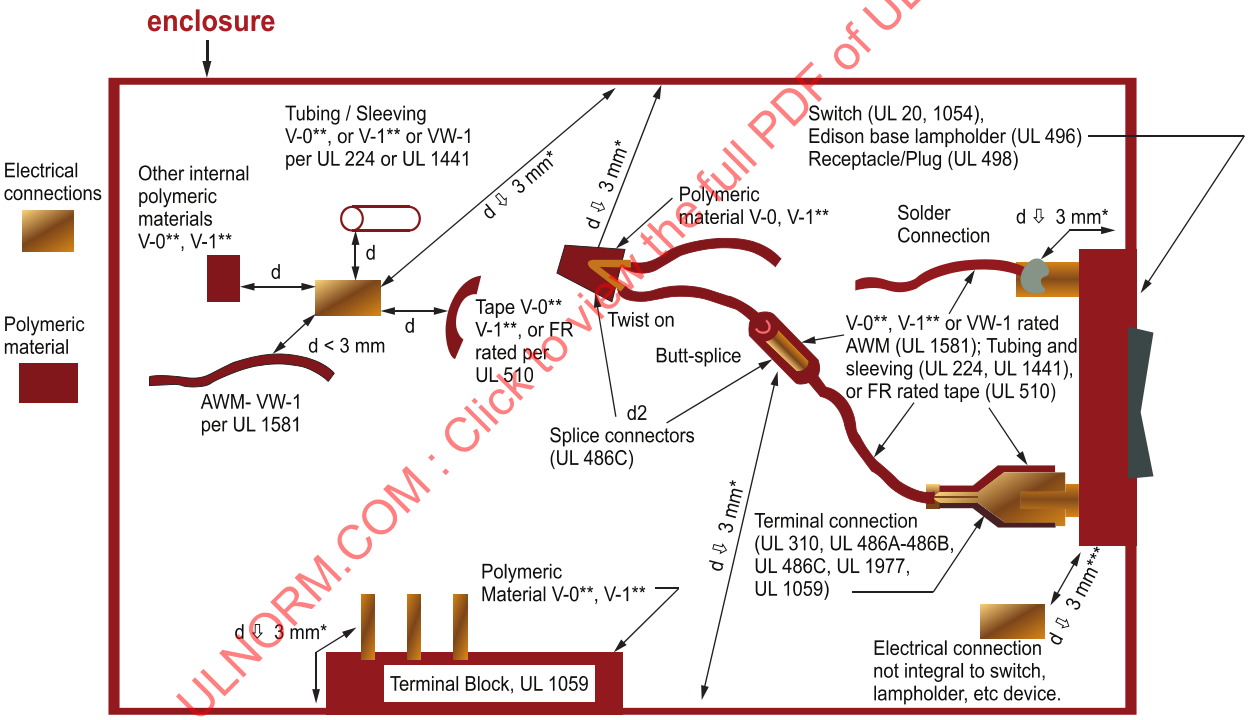
Exception No. 2: A polymeric grille used in a fan intended to be mounted at least 2.1 m (7 feet) above the floor is not required to comply with the Resistance to Impact Test of UL 746C.

Exception No. 3: Compliance with the pullout, torque, and bending tests of footnote i, Table 4.1, of UL 746C is not required for permanently connected products provided with the installation instruction of 83.11.

7.3.2 Section 5 of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, includes an additional set of requirements for Portable Unattended Household Equipment that may be applied to portable fans. Figure 7.1 depicts figuratively the construction requirements for these products. In addition, products evaluated to this set of requirements shall comply with the Severe Conditions Test in accordance with 28.1, Mold Stress Relief Distortion Test, in accordance with Subsection 29.1 (utilizing conditioning guidelines as outlined in Subsection 61.2) and Input to Motor (after Mold-Stress Relief Distortion) in accordance with Subsection 30.1 of UL 746C.

Figure 7.1

Alternate path



su1918

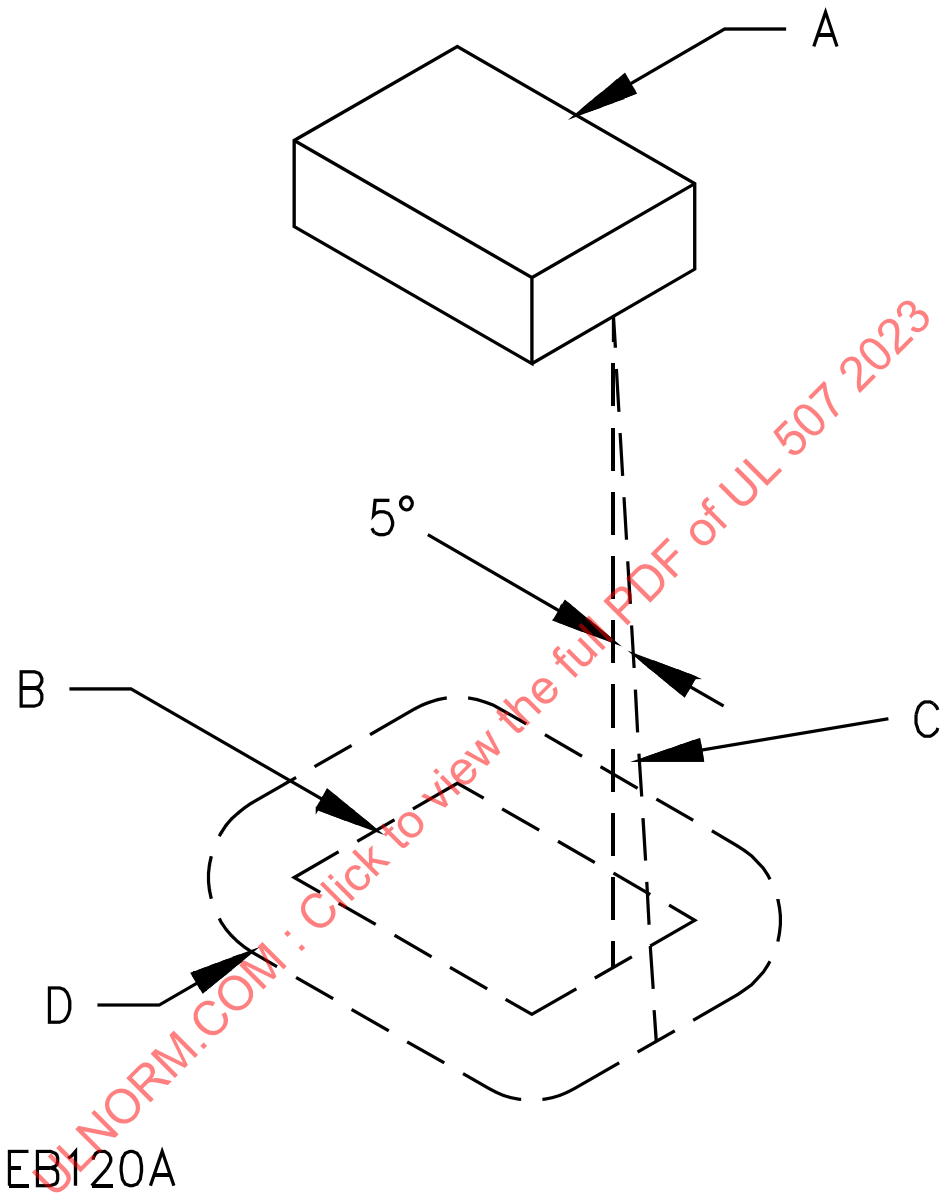
* Or, enclosure min 750°C (1382°F) GWIT and 750°C (1382°F) GWFT; or pass GWEPT

** Alternatively, VTM-0, VTM-1, SC-0, SCTC-0, or SCTC-1; or min 750°C (1382°F) GWIT and 750°C (1382°F) GWFT; or GWEPT

*** Or switch, lampholder, etc. material V-0, V-1, VTM-0, VTM-1, SC-0, SC-1, SCTC-0, or SCTC-1 or min 750°C (1382°F) GWFT; or GWEPT

Figure 7.2

Barrier



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.

7.3.3 When conducting the Severe Conditions Test in accordance with 28.1 of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, motor protection in accordance with 23.1 (a) and (c) may be retained in the circuit.

7.3.4 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.

7.3.5 Metallized or painted polymeric parts or enclosures shall comply with the applicable requirements of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. This requirement is not applicable to exterior surfaces of polymeric enclosure materials or parts provided that the metallized coating or paint does not offer a continuous path for an internal flame to propagate externally.

7.3.6 A non-metallic enclosure of a fan employing a fluorescent light shall comply with the requirements of 167.3, Exposure to sunlight (ultraviolet radiation).

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 167.3, Exposure to sunlight (ultraviolet radiation).

7.3.7 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 80.5.7 and 80.5.8.

7.4 Non-metallic parts other than enclosures

7.4.1 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 the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, 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.

7.4.2 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;

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;

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^2 (0.055 square inch), and no more than six such openings are provided;

d) 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;

e) The fan employs a thermally protected motor to drive the impeller and complies with the test requirements in Section 64, Impeller Ignition Test; or

f) The fan complies with the requirements for unattended areas as specified in Sections 178 and 179A.

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 0.8 mm total.

Exception No. 3: Bobbin-wound skeleton motors employed in a ceiling-insert fan, wall-insert fan, or rangehood, are not required to comply with this requirement.

7.4.3 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.

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

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

7.4.6 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.

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

8.1 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 the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723.

Exception No. 1: A fan grille, duct adapter, or other part that is installed exterior to the enclosure or part described in 8.1 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: This requirement does not apply to sound deadening material inside a fan enclosure that is rated HB or HF-2.

8.2 Compliance with the Standard for 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 8.1.

9 Accessibility of Moving Parts

9.1 General

9.1.1 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 9.2, Portable fans and window fans, or 9.3, Stationary fans and permanently connected fans, 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.

9.1.2 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.

9.1.3 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 the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, in the as-received condition. The impact used is to be 6.8 J (5 ft·lbf). Appliances intended to be used in cold environments, such as fans mounted in the crawl space or attic, and outdoor use products shall also be subjected to the Resistance to Impact Test of UL 746C in the cold condition.

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 61, Impact Test on Guards, and Section 62, Static Force Test on Guards, in the as-received condition. Appliances intended to be used in cold environments, such as fans mounted in the crawl space or attic, and outdoor use products shall also be subjected to the Impact Test on Guards, 61.2, in the cold condition.

Exception: The cold condition Impact Test of UL 746C does not apply to portable fans marked for use in outdoor applications or, where impact testing is required, to ceiling insert fans/fan-light combinations.

9.1.4 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.

9.2 Portable fans and window fans

9.2.1 Other than as described in 9.2.2, a moving part that causes a risk of injury to persons shall be guarded or enclosed.

9.2.2 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 70, 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 56, Unguarded Impeller Tests, Section 61, Impact Test on Guards, and Section 70, 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 9.2.5 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 9.2.2(a)(1), (a)(2), (d), and (e) when the fan complies with 9.2.3.

Exception No. 2: An unguarded impeller is not required to comply with the requirements of 9.2.2(f)(2)(I), (f)(2)(ii), 9.2.2(b)(3), and 9.2.2(c)(2) if the impeller is molded of a component foam material rated a minimum HF-2.

9.2.3 An unguarded impeller that complies with Exception No. 1 to 9.2.2 shall produce an impact force of 175 N (39.34 pounds) or less.

9.2.4 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.

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

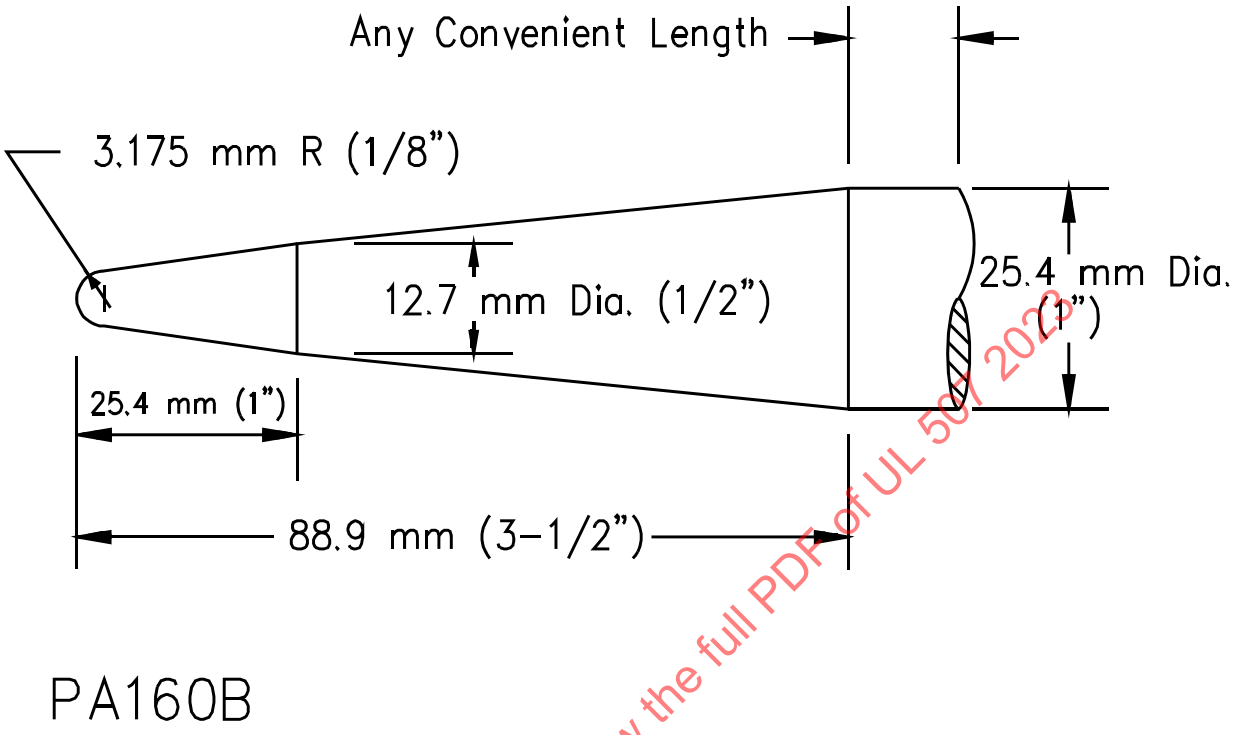
a) The relationship between mass (W) in kg, radius (r) in mm, and speed (N) in revolutions per minute is such that K in the following equation is less than 29264:

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

b) The guarding is such that the probe illustrated in Figure 9.1 cannot touch the leading edge of the blade and hub when inserted as described in 9.2.6. 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.

Figure 9.1

Probe for impellers of portable appliances



9.2.6 The portion of an impeller that entails a risk of injury to persons shall be guarded so that the probe illustrated in Figure 9.1 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.

9.2.7 During an examination to determine whether an appliance complies with the requirements specified in 9.2.6, the guards and impellers of desk and stand fans are not to be removed before examination.

9.2.8 When a part used to comply with the requirement in 9.2.6 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 9.1 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.

9.2.9 A guard employed to comply with the requirement in 9.2.6 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.

9.2.10 The removal force specified in 9.2.9(c)(2) is to be measured after conditioning the holding means by removing and replacing the guard ten times in the intended manner.

9.2.11 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.

9.2.12 Non-metallic impellers on portable fans and window fans shall comply with Section 63, Impeller Test for Portable Fans.

9.3 Stationary fans and permanently connected fans

9.3.1 In accordance with 9.1.1, 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.

9.3.2 The impeller of a stationary or permanently connected fan shall be constructed so that it cannot be contacted by the probe illustrated in Figure 9.2.

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 81.4.

Exception No. 2: An impeller of a wall- or ceiling- insert fan shall comply with 9.3.4 – 9.3.5.

Exception No. 3: 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 81.4 and either 80.1.10 or 141.1.

Exception No. 4: Residential attic fans and whole house fans shall comply with 9.3.6 and 9.3.7.

Exception No. 5: Ceiling-suspended fans shall comply with 90.2 and 92.1.

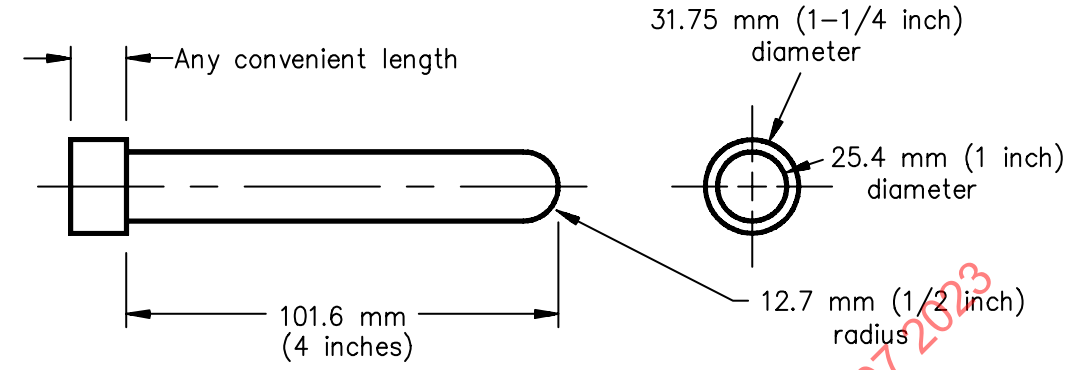
Exception No. 6: Fans for use in cooking areas shall comply with 113.3.1 – 113.3.3.

Exception No. 7: The discharge side of duct connected fans as described in 9.3.8 need not comply with this requirement.

Exception No. 8: The air inlet and/or discharge side of stationary or permanently connected fans need not comply with this requirement if the side(s) is intended by design to be attached to the duct work as specified in the manufacturer's instructions.

Figure 9.2

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



9.3.3 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 9.2.

9.3.4 The 25.4-mm (1-inch) diameter probe as illustrated in Figure 9.2, 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 81.4.

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 80.5.6; and

b) The installation instructions specified in 83.6 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.

9.3.5 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 9.1 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 9.2.

Exception No. 2: A wall-insert fan is not required to comply with these requirements when it is marked as specified in 81.4.

Table 9.1
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)

9.3.6 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 80.6.1.

9.3.7 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 80.6.2.

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

10 Accessibility of Live Parts

10.1 General

10.1.1 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 10.2.1 – 10.3.1 and Table 10.1.

10.2 Application of probes

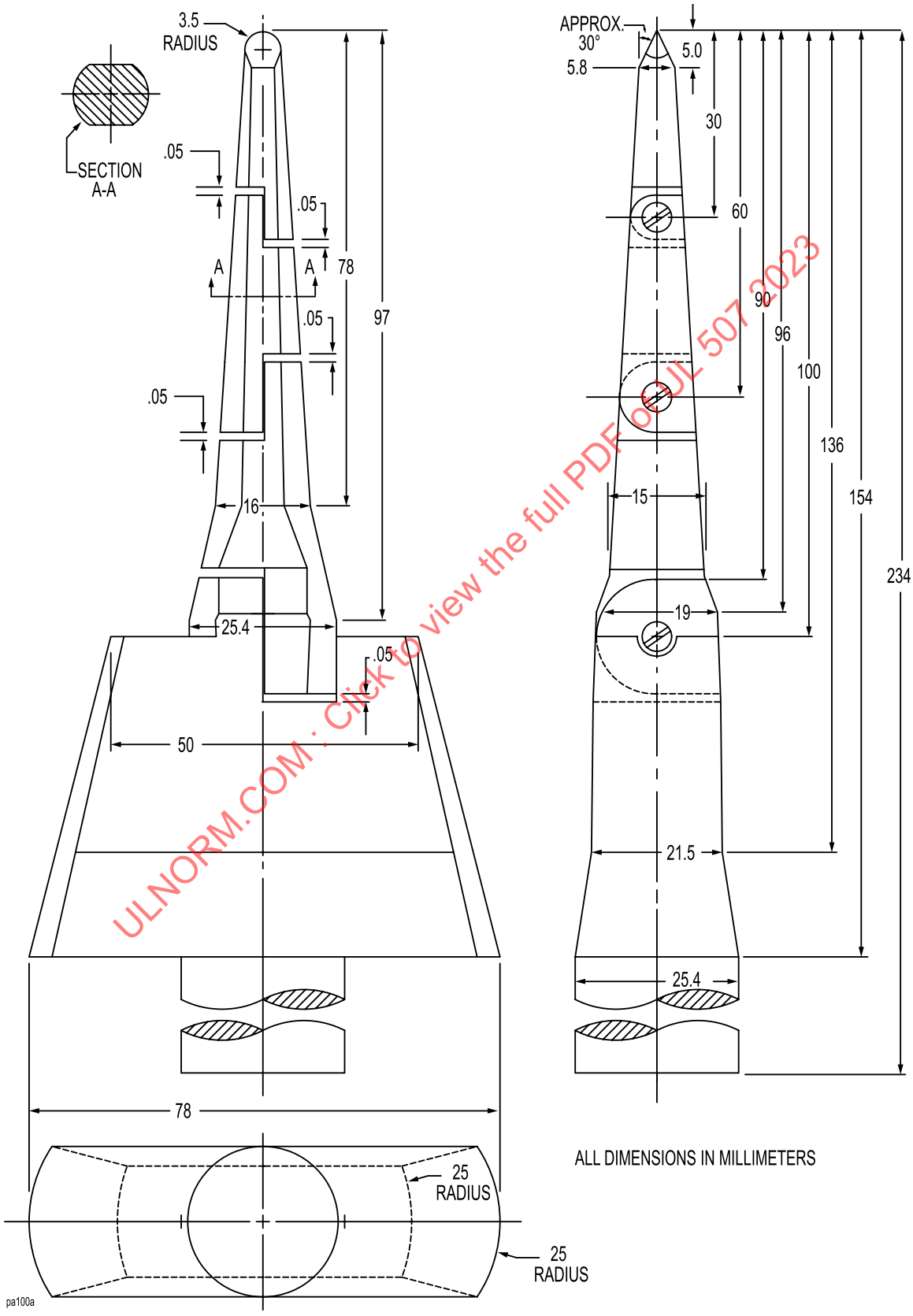
10.2.1 The probes referenced in Table 10.1 and illustrated in Figure 10.1 shall be applied to any depth that the opening permits and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to try to contact an uninsulated live part or film-coated 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 10.1
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, roof- mounted and attic fans	Figure 10.1 (Probe)	No requirement
Ceiling-insert, wall-insert, and rangehoods	Figure 10.1 (Probe)	Figure 10.1 (Probe)
All other fans	Figure 10.1 (Probe)	Figure 10.1 (Probe)

Figure 10.1

Articulate probe with web stop



10.2.2 The probes referenced in Table 10.1 and illustrated in Figure 10.1 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.

10.3 Removal of parts

10.3.1 During an examination to determine whether an appliance complies with the requirements specified in 10.1.1, 10.2.1, 10.2.2 and Table 10.1, 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.

10.3.2 With reference to 10.3.1, 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.

10.3.3 With reference to the requirements specified in 10.1.1, 10.2.1, 10.2.2, and Table 10.1, insulated brush caps are not required to be additionally enclosed.

10.4 Disconnection means

10.4.1 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.

11 Mechanical Assembly

11.1 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.

11.2 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 11.3.

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.

11.3 The means for preventing turning, as required by 11.2, 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.

11.4 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 11.5.

11.5 With reference to 11.4, 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.

11.6 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 80.4.1. The installation instructions shall include statements as specified in 83.9.

11.7 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 14.3.5 or by plug and receptacle connection.

11.8 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.

11.9 An appliance that is shipped from the factory partially disassembled and is not marked in accordance with 80.4.1 shall be shipped in a single shipping container.

11.10 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.

12 Mounting Means

12.1 General

12.1.1 An appliance, other than as noted in 12.2.1 – 12.2.3, is to be mounted in accordance with the mounting requirements specified in the appropriate section of this Standard.

12.2 Cord-connected wall-mounted appliances

12.2.1 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 82, Important Safety Instructions, and Section 83, Installation Instructions.

12.2.2 With reference to 12.2.1, 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.

12.2.3 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.

13 Protection Against Corrosion

13.1 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.

14 Power Supply Connections – Permanently-Connected Appliances

14.1 General

14.1.1 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.

14.1.2 With reference to the requirement specified in 14.1.1, 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 15.1.3 and 15.2.1 – 15.2.5.

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 15.1.3, 15.2.1 – 15.2.5, and Table 15.2.

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 0.50 – 3.7 m (1.5 – 12 feet);

d) Is permanently attached to the fan;

e) Complies with the requirements of 15.1.3 and 15.2.1 – 15.2.5; and

f) Is marked in accordance with 80.1.10 or 141.1.

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 15.1.3 and 15.2.1 – 15.2.5.

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 113.7, Cord-connected rangehoods; 113.8, Rangehood cord-connection kits; 114.6, Tests for cord-connected rangehoods; 114.7, Tests for rangehood cord-connection kits; Section 115, Rating for Cord-Connected Rangehoods; Section 117, Installation Instructions for Rangehoods and Rangehood Cord-Connection Kits, and 116.3 – 116.5.

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 15.1.3, 15.1.5, 15.1.6, and 15.2.1 – 15.2.5; and

f) Is marked in accordance with 80.1.11.

Exception No. 7: An attic 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) Has three conductors, one being the equipment grounding conductor;

b) Is type S, SJ, SJO, SJT, SJTO, SO, ST, or STO;

c) Has a length of 0.50 – 1.82 m (1.5 – 6 feet);

d) Is permanently attached to the fan;

e) Complies with the requirements of 15.1.3 and 15.2.1 – 15.2.5;

f) Is marked or it is noted in the installation instructions "CAUTION: Do not use with extension cord." and

g) Does not contact the fan blade by one of the following methods:

1) Guarding of the moving blade to reduce likelihood of cord contact; or

2) Location of cord exit and length of cord is such that likelihood of cord contact with moving blade is minimized; or

3) Instructions are provided as well as cord tag marking to instruct the installer to route cord away from fan blade.

14.1.3 Power supply terminal or leads identified for connection to Class 2 wiring shall comply with Class 2 circuit requirements, 31.3.

14.2 Knockouts and openings

14.2.1 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, 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 7.1.

14.2.2 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 14.1.

14.2.3 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 14.1.

Exception: A knockout construction complying with the polymeric enclosure tests, Section 8.6 of the Standard for Enclosure of Electrical Equipment, Non-Environmental Considerations, UL 50, and Limited Short-Circuit Test, Section 43, is not required to comply.

Table 14.1
Dimensions associated with openings for conduit

Trade size of conduit		Unthreaded openings			
		Nominal knockout diameter[a]		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)

[a] 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.

14.3 Field-wiring compartments

14.3.1 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.

14.3.2 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, if no instructions are provided.

14.3.3 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 14.2.

Table 14.2
Minimum usable volume of terminal compartment

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^2)	cm^3	(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)

14.3.4 A motor containing an integral wiring compartment shall comply with the requirements of the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1.

14.3.5 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^2); and

h) There are no exposed wiring terminals on the back of the switch, thermostat, and the like.

14.3.6 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.

14.3.7 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.

14.3.8 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 166.6.8.

14.4 Wiring terminals and leads

14.4.1 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.

14.4.2 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^2). 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^2.

14.4.3 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^2) or smaller conductor when upturned lugs or the equivalent are provided to hold the wire in position.

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

14.4.5 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 14 AWG (2.1 mm^2) 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 16 or 18 AWG (1.3 mm^2 or 0.82 mm^2) conductor.

14.4.6 It should be noted that 14 AWG (2.1 mm^2) 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.

14.4.7 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.

14.4.8 Upturned lugs, a cupped washer, or the equivalent shall be capable of retaining a conductor of the size specified in 14.4.2 under the head of a screw or washer.

14.4.9 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.

14.4.10 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.

14.5 Identification

14.5.1 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.

14.5.2 With reference to 14.5.1, 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.

14.5.3 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.

14.5.4 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.

14.5.5 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.

14.5.6 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.

15 Power Supply Connections – Cord-Connected Appliances

15.1 Cords and plugs

15.1.1 A portable appliance shall be provided with a flexible cord in accordance with Table 15.1 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 the Standard for Vacuum Cleaners, Blower Cleaners and Household Floor Finishing Machines, UL 1017, may exceed the maximum length specified in Table 15.1 provided it meets all other requirements in both UL 507 and UL 1017.

15.1.2 A product as described in Table 15.1, rows 1 and 2, but intended for commercial or industrial use, shall employ a cord as described Table 15.1, row 3, and be marked in accordance with 80.1.10.

Table 15.1
Cords for appliances

Appliance	Type of cord[a]	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.	SPT- 2-R, HPN-R, SVT-R, SJT-R. The cord shall comply with the Standard for Flexible Cords and Cables, UL 62	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 or box fan.	SPT-2-R, HPN-R, SVT-R, SJT-R. The cord shall comply with the Standard for Flexible Cords and Cables, UL 62	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	1.5 – 7.6 (5 – 25)
4. Portable or window-type evaporative household cooler and household air filtering appliances.	SP-2, SPT-2, or of a type equally serviceable for the application[a]	1.5 – 3 (5 – 10)
5. Commercial, industrial, or agricultural fan mounted as specified in Exception No. 3 of 14.1.2.	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	0.5 – 3.7 (1.5 – 12)
6. Portable fan employing a general use convenience receptacle, or evaporative cooler with or without 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 display blower 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	1.5 – 30.5 (5 – 100)
8. Dryer type fan and commercial display blower 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	0.203 – 0.457 (0.67 – 1.5)

[a] An SVT cord type is considered equally serviceable to SPT-2.

15.1.3 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.

15.1.4 The flexible cord for products as described in rows 1 and 2 of Table 15.1 shall be attached permanently to the appliance or be in the form of a separate cord set with acceptable means for permanent connection to the appliance.

15.1.4.1 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.

15.1.5 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 80.2.2.

15.1.6 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.

15.1.7 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.

15.1.8 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 15.1, and the polarity identification of the flexible cord shall comply with Table 15.2.

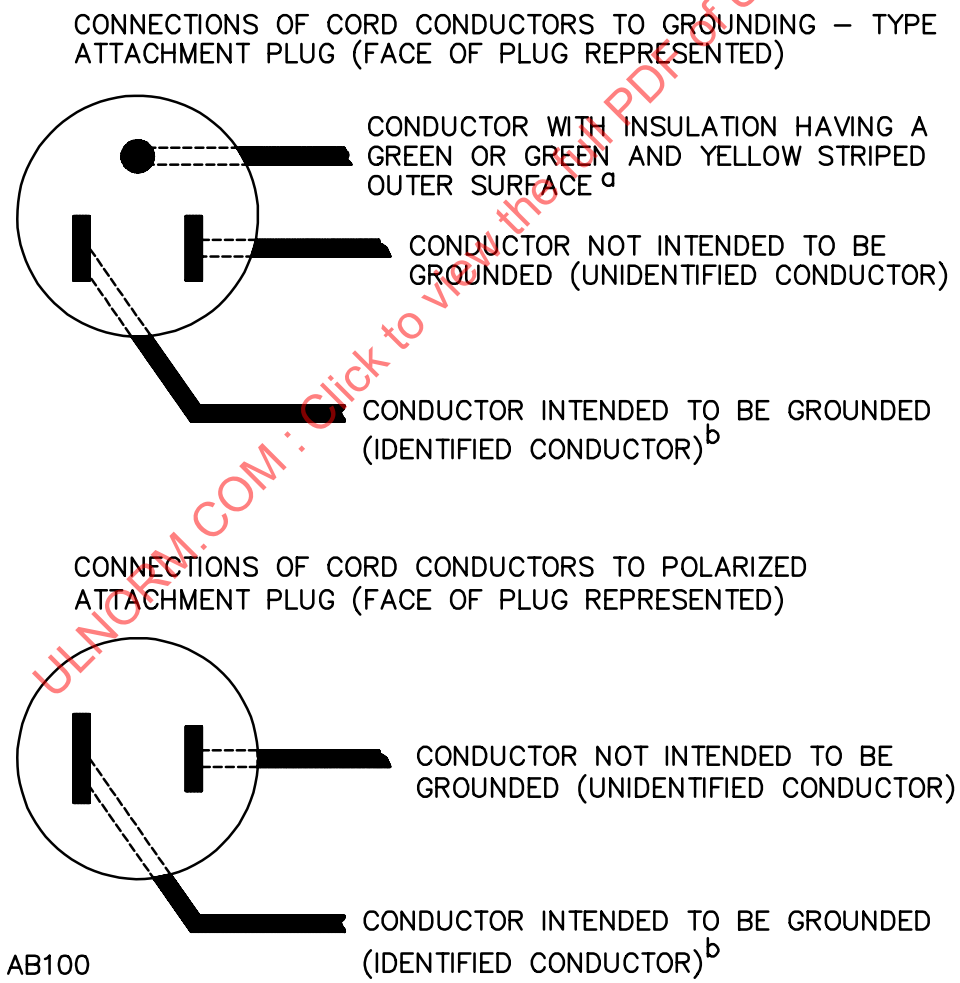
15.1.9 The conductor of the power supply cord that is intended to be grounded shall have the following items connected to it:

a) The screw shell of an Edison-base lampholder; and

b) The terminal or lead receptacle intended to be grounded. Table 15.2 identifies the supply cord conductor intended to be grounded.

Figure 15.1

Connection to attachment plug



[a] The blade to which the green conductor is connected may have a U-shaped or circular cross section.

[b] Signifies a conductor identified in accordance with Table 15.2.

Table 15.2
Polarity identification of flexible cords

Method of polarity identification	Acceptable combinations	
	Wire intended to be grounded[d]	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[b]	Solid white or gray braid with a colored tracer in braid[b]
	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[c]	Solid white or gray[a]	Solid color other than white or gray
	Light blue[d]	Solid color other than light blue, white, or gray[d]
Colored separator[e]	White or gray	Color other than white or gray
Tinned conductors[f]	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[e]	One or more stripes, ridges, or grooves, or a combination of these on the exterior surface of the cord	

[a] 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 15.1 for the connection of conductors to attachment plugs.

[b] Only for Types C and PD cords.

[c] Only for a cord having no braid on any individual conductor.

[d] Only for a cord having a jacket that is not integral with the circuit conductor insulation.

[e] Only for Types SP-1, SP-2, SPE-1, SPE-2, SPT-1, and SPT-2 cords.

[f] Only for Types SPT-1 and SPT-2 cords.

15.1.10 A flexible power supply cord shall not be smaller than 18 AWG (0.82 mm^2).

15.1.11 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. For reference purposes, an abbreviated table showing the ampacities for flexible cord with two current carrying copper conductors is shown in Table 15.3.

Table 15.3
Ampacities for flexible cords

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

15.2 Strain relief

15.2.1 Strain relief shall be provided so that the mechanical stress on the flexible cord is not transmitted to terminals, splices, or internal wiring. See 54.1.