



UL 962

STANDARD FOR SAFETY

Household and Commercial Furnishings

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UL Standard for Safety for Household and Commercial Furnishings, UL 962

Fourth Edition, Dated November 7, 2014

SUMMARY OF TOPICS

This new edition of UL 962 includes the following changes in requirements:

Separation of some product types such as massage tables and chairs and powered table systems into new supplements as these products have requirements unique to their product type; and

Combination of household and commercial requirements into the main body of the standard to improve readability.

The requirements are substantially in accordance with Proposal(s) on this subject dated May 30, 2014. For further information regarding Summary of Requirements, please visit <https://ifs.ul.com/ifr/ifr.nsf>.

THIS FOURTH EDITION REPLACES THE THIRD EDITION. AS OF JANUARY 1, 2016, UL 962, EDITION 3 WILL BE WITHDRAWN.

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that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

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NOVEMBER 7, 2014



ANSI/UL 962-2014

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UL 962

Standard for Household and Commercial Furnishings

First Edition – August, 1996
Second Edition – October, 2003
Third Edition – July, 2008

Fourth Edition

November 7, 2014

This UL Standard for Safety consists of the Fourth Edition.

The most recent designation of ANSI/UL 962 as an American National Standard (ANSI) occurred on November 7, 2014. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or effective date information.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <http://csds.ul.com>.

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PART 1 – ALL FURNISHINGS

INTRODUCTION

1 Scope

1.1 These requirements cover:

- a) Motor-operated furniture, such as motor-operated beds lift, chairs and blood donor chairs;
- b) Electrified and non-electrified furniture;
- c) Non-seasonal electrical decorations such as lava lamps and wave machines;
- d) Home and individual office furnishings, such as study carrels, consoles and desks;
- e) Commercial product and informational retail sale displays such as:
 - 1) Shelving units (Gondolas);
 - 2) Merchandise kiosks (such as the mini-stores in the middle of a mall);
 - 3) Cash station stands (POS – Point of Sale);
 - 4) Motorized carpet displays; and
 - 5) Product platforms
- f) Electrified building components, such as heated and electro-chromatic windows and illuminated mirror and bathroom television cabinets;
- g) Illuminated make-up mirrors;
- h) Other similar miscellaneous furnishings intended for use in residential or commercial environments;
- i) Conference room tables; and
- j) Massage tables.

1.2 These requirements cover products rated 600 V ac or less.

1.3 A furnishing intended to support audio/video equipment shall be evaluated in accordance with one of the following:

- a) If the audio/video support system is an entertainment center, cart, or a stand and it is intended for support or attachment of audio/video equipment, the Standard for Household, Commercial, and Institutional-Use Carts, Stands and Entertainment Centers for Use with Audio and/or Video Equipment, UL 1678 applies;
- b) If the audio/video support system is intended to be mounted to walls, ceilings or another part of a building structure as the primary support means, the Standard for Wall- and Ceiling-Mounts and Accessories, UL 2442, applies;

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c) If a cart, stand or support surface is supplied with the audio or video equipment by the manufacturer of the audio or video equipment, the requirements contained in the Standard for Audio, Video, and Similar Electronic Apparatus-Safety Requirements, UL 60065, or the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1, as applicable to the product applies;

d) Information Technology and Communications Equipment Cabinets, Enclosure and Rack Systems are investigated to the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1 or the Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1;

e) For retail product displays incorporating audio/video equipment to attract attention to the products for sale, UL 962 applies.

1.4 These requirements do not cover products intended for patient care areas. Patient care area products utilized under the supervision of a health care professional are covered by the Standard for Medical Electrical Equipment, Part 1: General Requirements for Safety, UL 60601-1.

1.5 Motorized equipment used for massaging and exercising is covered under the Standard for Motor-Operated Massage and Exercise Machines, UL 1647.

1.6 Office furnishings are covered by the Standard for Office Furnishings, UL 1286.

1.7 Illuminated display cases, showcases and cabinets, such as jewelry display cases, used in commercial applications are covered by the Standard for Wired Cabinets, UL 65.

1.8 Advertising displays may also be covered by the Standard for Electric Signs, UL 48.

1.9 Self-contained, custom-built kiosks that provide information, ticket machines, electronic point-of-sale products, customer self-checkout stands, and business application products are covered by the Outline of Investigation for Custom Built Kiosks, UL 2361.

1.10 These requirements do not cover portable luminaires. The Standard for Portable Electric Luminaires, UL 153, covers portable luminaires.

1.11 A product that employs an electromagnetic interference filter shall also comply with the Standard for Electromagnetic Interference Filters, UL 1283. A product that employs a transient voltage surge suppressor shall also comply with the Standard for Surge Protective Devices, UL 1449. Telephone equipment and communication circuit protectors included in a furnishing shall comply with the requirements in the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1, and the requirements in the Standard for Secondary Protectors for Communications Circuits, UL 497A, respectively. A furnishing that incorporates an antenna discharge unit or provides antenna connections to a television, a high-voltage video product, or antenna shall comply with the applicable requirements in the Standard for Antenna Discharge Units, UL 452, and the Standard for Audio-Video Products and Accessories, UL 1492. A product that employs ground-fault protection shall comply with the requirements in the Standard for Ground-Fault Circuit Interrupters, UL 943.

1.12 Bunk bed structural requirements are covered by the Standard Consumer Safety Specification for Bunk Beds, ASTM F1427. Any electrical components of bunk beds are required to meet the applicable requirements of UL 962.

1.13 Toy chest structural requirements are covered by the Standard Consumer Safety Specification for Toy Chests, ASTM F834. Any electrical components of these products are required to meet the applicable requirements of UL 962.

1.14 These requirements do not cover products that are specifically intended for infants or juveniles. Cribs are covered by Federal Register 16 CFR Parts 1219, 1220, and 1500 Safety Standards for Full-Size Baby Cribs and Non-Full-Size Baby Cribs.

1.15 Furnishings incorporating low pressure inflators are covered by the Standard for Motor-Operated Air Compressors, Vacuum Pumps, and Painting Equipment, UL 1450, and in addition shall comply with the applicable requirements of UL 962.

1.16 These requirements do not cover seasonal (holiday products) – A product painted in colors to suggest a holiday theme such as a snow covering, a figure in a holiday costume, or any decoration associated with a holiday or particular season of the year.

1.17 These requirements do not cover furnishings, equipment or appliances that are covered by requirements that are separate from this standard.

2 Glossary

2.1 For the purpose of this standard the following definitions apply.

2.2 ACCESSIBLE PART – A part located so that it is able to be contacted by a person, either directly or by means of the probe illustrated in Figure 12.1.

2.3 ACCESSORY – An optional part that electrically and/or mechanically interfaces with the basic furnishing and is intended to be attached to the furnishing by the user or installer. Subassemblies field assembled to form the basic furnishing are not accessories.

2.4 APPLIANCE CONNECTOR – The mating part of the appliance coupler integral with, or intended to be attached to, the power supply cord.

2.5 APPLIANCE COUPLER – A means of enabling the connection and disconnection at will, of a cord to an appliance or other equipment. It consists of two parts: an appliance connector and an appliance inlet.

2.6 APPLIANCE INLET – The mating part of the appliance coupler integrated or incorporated in the appliance or equipment or intended to be fixed to it.

2.7 APPURTENANCE – Accessory objects on a furnishing such as a door, drawer, or a sliding work surface.

2.8 CABINET LIGHT – A portable luminaire, see 2.43, intended for final installation into a cabinet (open or enclosed as specified in the installation instructions) such as a china hutch, bookcase, bar, console, bed headboard, or similar furnishing.

2.9 CLASS 2 CIRCUIT – A circuit that complies with the Standard for Low Voltage Transformers – Part 3: Class 2 and 3 Transformers, UL 5085-3 or with the Standard for Class 2 Power Units, UL 1310.

2.10 COMMERCIAL DISPLAY – A furnishing other than a display case or cabinet that is used in a retail establishment to display merchandise.

2.11 COMMERCIAL – A place in which business is transacted, such as an office building, factory, warehouse, or similar location, and which is not a residence.

2.12 CONTROL CIRCUIT – A system of components that may include programmable logic devices other than a thermal protector or a motor current protector that has the ability to detect the condition of a furnishing's operation or that controls a furniture function.

2.13 DISPLAY CASE – A totally enclosed lighted furnishing used to display products.

2.14 ENCLOSURE, ELECTRICAL – That part of the product that:

a) Renders inaccessible all or any parts of the equipment that may otherwise present a risk of electric shock; and/or

b) Retards propagation of flame initiated by electrical disturbances occurring within.

2.15 ENCLOSURE, MECHANICAL – A part of the equipment intended to reduce the risk of injury due to mechanical and other physical hazards.

2.16 FIXED FURNISHING – Intended to be permanently connected electrically to a source of supply.

2.17 FUNCTIONAL LOAD^a – The level of loading or force typical of hard use.

2.18 FURNISHING SUPPORT SYSTEM – A system of components intended to secure a furnishing to the building or other structure.

2.19 FURNITURE POWER DISTRIBUTION UNIT – An outlet assembly that complies with the Standard for Furniture Power Distribution Units, UL 962A.

2.20 GLASS, SHEETS – A glass sheet, usually formed from sheet stock, the overall shape of which is essentially flat. The sheet can have a slight curvature or bend, and the surface may be smooth or textured.

2.21 HOME AND INDIVIDUAL OFFICE FURNISHING – A furnishing used for conducting business either in the home or an office that is intended to stand alone or be mechanically and electrically connected together.

2.22 ISOLATED SECONDARY CIRCUIT – A circuit derived from an isolated secondary winding of a transformer and that has no direct connection back to the line-connected circuit (other than through grounding means). A secondary circuit that has a direct connection back to the line-connected circuit is determined to be part of the line-connected circuit.

2.23 LEAKAGE CURRENT – All currents, including capacitively coupled currents, that flow through a person upon contact between accessible conductive surfaces of a product and ground or other accessible surfaces of the product.

2.24 LIMITED POWER SOURCE (LPS) – A limited power source is as defined in the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1, and shall comply with the requirements of UL 60950-1.

2.25 LOCATION, DAMP – An exterior or interior location that is normally or periodically subject to condensation of moisture in, on, or adjacent to, the furnishing, and includes partially protected locations.

2.26 LOCATION, DRY – A location not normally subject to dampness, but may include a location subject to temporary dampness, as in the case of a building under construction, provided ventilation is adequate to prevent an accumulation of moisture.

2.27 LOCATION, WET – A location in which water or other liquid can drip, splash, or flow on or against the furnishing.

2.28 LOCKED-ROTOR – The armature or rotor is prevented from rotating.

2.29 LOSS OF SERVICEABILITY^a – The failure of any product to carry its intended load or to perform its normal function or adjustment.

2.30 LOW-VOLTAGE CIRCUIT – A circuit involving a potential of not more than 30 volts alternating current (42.4 peak) open circuit.

2.31 MATTRESS – A resilient material or combination of materials enclosed by ticking used alone or in combination with other products intended or promoted for sleeping upon. The term includes but is not limited to adult mattresses, youth mattresses, crib mattresses, bunk beds mattresses, futons, flip chairs without permanent backs or arm rests, sleeper chairs, water or air beds if they contain upholstery material between the ticking and mattress core.

2.32 MATTRESS FOUNDATION – A ticking covered structure used to support a mattress or sleep surface. The structure may incorporate other materials such as foam, springs, and the like used alone or in combination.

2.33 MATTRESS SET – A mattress provided with or without the mattress foundation.

2.34 MOTOR-OPERATED FURNISHING – A furnishing provided with a motor used for sitting, laying, or used for decoration, such as a wave machine.

2.35 NORMAL USE – The intended function applied by the user or operator utilizing the installation and operation instructions for the furnishing.

2.36 OFFICE FURNISHING – Consists of panels, study carrels, work stations and pedestal-style systems that may be mechanically interconnected to form an office furnishing system to be installed in accordance with Article 605 of ANSI/NFPA 70, "National Electrical Code" (NEC). They may be provided with an electrical distribution system, including switches and receptacles. They may contain channels for routing communication cable within the system components separate from power-circuit raceways. The systems may include filing cabinets, desks, work surfaces, shelves, storage units, etc., that have a particular electrical or mechanical function unique to an office furnishing system.

2.37 PANEL – A flat rectangular vertical piece that forms part of or all of a wall or office partition.

2.38 PORTABLE FURNISHING – Meets all of the following:

- a) Not secured to the building structure unless provided with a securement means that allows the furnishing to be removed without the use of tools;
- b) Connected electrically to an electrical source of supply with a power supply cord and plug; and
- c) Likely to be frequently relocated due to size, weight or configuration.

2.39 PORTABLE LUMINAIRE – A portable luminaire is a cord connected luminaire that provides illumination for a room or specific area and is able to be moved to a new location with or without the use of readily available tools.

2.40 PRIMARY SURFACE – A surface that has the apparent potential for the highest loading or a surface on which a person may sit. In cases where more than one horizontal surface exists, there may be more than one primary surface. In cases where all surfaces are intended for equipment there may be no primary surfaces.

2.41 PROOF LOAD^a – The level of loading or force in excess of hard use.

2.42 PRESSURE-RELIEF DEVICES – A device used to control or limit the pressure in a system or vessel.

2.43 PUBLIC OCCUPANCIES – Include but are not limited to health care facilities, old age convalescent and care homes, college dormitories, residence halls, jails, prisons, nursing care homes, public auditoriums, hotels and motels.

2.44 RACEWAY – A completely enclosed channel intended specifically for the holding and routing of wiring, excluding communication and low-voltage wiring. A raceway provides mechanical and electrical protection to the internal wiring.

2.45 RECEPTACLE, TAMPER RESISTANT – A receptacle provided with spring-loaded shutters that close off the contact openings or slots of the receptacles when the receptacle not in use.

2.46 RELOCATABLE POWER TAP (RPT) – An outlet assembly that complies with the Standard for Relocatable Power Taps, UL 1363.

2.47 RESIDENCE – A place where people live (such as a house or apartment). A hotel common area such as the lobby or a restaurant are public occupancy areas. The terms "household" and "residence" are equivalent.

2.48 RISK OF ELECTRIC SHOCK – A risk of shock is considered to exist at parts accessible to the user or operator in a normally dry location during the intended use or servicing if the voltage exceeds 42.4 Vac peak (the peak voltage of a 30-Vac sine wave), 60Vdc and in a normally wet location if the voltage exceeds 21.2 Vac peak (the peak voltage of a 15-Vac sine wave), 30Vdc and the available current exceeds the leakage current levels specified in Leakage Current Test.

2.49 RISK OF FIRE – A risk of fire is considered to exist at a component part or assembly if an investigation shows that the supply for such part or assembly is capable of delivering a power of more than 15 W into an external resistor connected between the point in question and any return to the power supply.

2.50 SAFETY CIRCUIT – A control circuit designed to guard against or mitigate risk of fire, shock or personal injury.

2.51 SECONDARY SURFACE – A surface that is vertically separated from and smaller than the primary work surface(s). It is used for storage (that is, a shelf) or occupied exclusively by the equipment placed on the surface.

2.52 SECURITY LOCKOUT DEVICE – A device that prevents unauthorized users from operating the equipment, such as a lock and key, or a keypad with a code.

2.53 SHOWCASE – A specific type of store fixture identified in the National Electrical Code, NFPA 70. A cabinet provided with a transparent enclosure for displaying or protecting merchandise.

2.54 STATIONARY FURNISHING –

a) Intended to be fastened in place requiring tools for removal and connected electrically to an electrical source of supply with a power supply cord and plug; or

b) Unlikely to be frequently relocated due to size, weight or configuration and connected electrically to an electrical source of supply with a power supply cord and plug.

2.55 SURFACE – A moveable, typically stowable, surface whose primary function is to support office equipment such as printers and scanners.

2.56 TICKING – The outer most layer of fabric or related material of a mattress or mattress foundation.

2.57 TIP OVER^a – The condition where the unrestricted unit will not return to its normal upright position.

2.58 WIRED CABINET – See 2.53.

2.59 WORK SURFACE – A horizontal surface used to perform tasks and/or for storage space.

2.60 WORKING PRESSURE – The maximum system pressure measured during normal operating conditions. When more than one pressurized system is provided the furnishing is capable of having multiple working pressures.

^a With the permission of BIFMA, this definition is reproduced from the BIFMA/ANSI Standard for Small Office/Home Office Furniture Tests, ANSI/SOHO S6.5-2008 (2013). BIFMA shall not be responsible for the manner in which the information is presented, used, nor for any interpretations thereof.

3 Components

3.1 Except as indicated in 3.2, a component of products covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components used in the products covered by this standard, but is not all inclusive.

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

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

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

3.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

3.5 Luminaires used in products covered by this Standard shall comply with one or more of the following requirements:

- a) Standard for Portable Electric Luminaires, UL 153;
- b) Standard for Track Lighting Systems, UL 1574;
- c) Standard for Luminaires, UL 1598;
- d) Standard for Low Voltage Lighting Systems, UL 2108;
- e) The Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products, UL 8750.

3.6 Furnishings which incorporate neon lamps shall comply with the Standard for Neon Transformers and Power Supplies, UL 2161, and shall also comply with the requirements of UL 962.

3.7 Video or audio equipment shall comply with the Standard for Audio, Video, and Similar Electronic Apparatus-Safety Requirements, UL 60065. Video or audio equipment intended for use in a damp or wet locations shall comply with the tropical humidity requirements in UL 60065.

3.8 A fuse shall comply with the Standard for Low Voltage Fuses – Part 1: General Requirements, UL 248-1 and the appropriate Part 2 for the specific fuse type.

3.9 A supplementary overcurrent protector shall comply with the Standard for Supplementary Protectors for Use in Electrical Equipment, UL 1077.

4 Units of Measurement

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

4.2 Values of voltage and current are rms values, unless otherwise stated.

5 Undated References

5.1 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.

6 Assembly

6.1 A furnishing shall be completely wired with all splices and electrical connections before the furnishing leaves the factory. The furnishing itself is not prohibited from being shipped unassembled.

Exception: Electrical connections made by connectors instead of splices are not required to be wired before the furnishing leaves the factory.

6.2 A furnishing shall be shipped from the factory in a carton or as an unpackaged complete assembly. Unassembled parts, when required elsewhere in the standard to accompany the furnishing, shall be included. Glassware is not required to be actually mounted in a frame or holder; it is able to be separately wrapped to protect it from breakage during shipment.

6.3 When wires pass through a joint between sections of a furnishing that are separable for packing purposes, the joint shall be such that rotation of one section with respect to the other during the assembly of the sections is limited to not more than 360 degrees. Friction alone does not meet the intent of the requirement to prevent rotation.

Exception: When all of the following conditions exist, rotation between sections of a furnishing is not limited to 360 degrees:

- a) The internal diameter of the tubing through which the wires pass is 1/2 inch (12.7 mm) or more;*
- b) The rotation during assembly is limited to not more than one revolution for each 3 inches (76 mm) of unobstructed tubing length through which the wires pass, when such rotation does not place any stress on the conductors; and*
- c) The conductors do not involve splices unless the splices are:*
 - 1) Inaccessible during assembly in accordance with Figure 12.1, Articulate Probe; and*

2) Secured and provided with strain relief that has been shown to be reliable and not easily defeated by the user.

6.4 When a splice or an electrical connection is located in a section of a furnishing that is separable for packing purposes, as noted in 6.1, the unit shall be provided with strain relief to reduce the risk of stress being transmitted to the splice or electrical connection during unpackaging and assembly of the furnishing. The strain relief shall be reliable and not easily defeated by the user. See the Strain relief for internal conductors and connectors test, 53.2.

6.5 When wires pass through a joint between sections of a furnishing that are separable for packing purposes the joint or section shall comply with 9.6, Protection of cord and wiring, while unassembled.

6.6 When in any position of adjustment, a spring-loaded or adjustable section of a furnishing shall not transmit stress to a splice or wiring within any section of the unit either during assembly or when completely assembled. For example, the stem of an adjustable height floor-furnishing unit shall raise and lower without binding or crimping the wiring of the unit.

6.7 As specified in 6.2, a carton is a box of cardboard, pasteboard, shrink film, or similar material (but not newspaper, wrapping paper, tissue paper, or similar paper products). It is not required to be rectangular in form, since the "pinch pack" of cardboard wrap with the ends pinched together and stapled is determined to be a carton.

6.8 A part that must be removed to assemble a furnishing in the intended manner to the supply circuit is not required to be fastened, but the construction shall be such, and the hardware shall be provided, to allow field assembly.

6.9 Any furnishing that is not completely assembled shall be provided with assembly instructions.

7 Accessories

7.1 A furnishing having provision for the use of an accessory shall be constructed so that the use of the accessory does not introduce a risk of fire, electric shock, or injury to persons.

7.2 A furnishing shall comply with the requirements in this Standard with or without the accessory installed.

7.3 Installation of an accessory by the user shall be restricted to an arrangement by which the electrical connections are accomplished by means of mating connectors, attachment plugs and receptacles, or attachment plugs and cord connectors that maintain correct polarity.

7.4 Installation of an accessory intended to be made by the installer or service personnel shall be by means of mating connectors, attachment plugs and receptacles, plug-in connectors, pigtail leads and insulated wire connectors, or by connection to existing wiring terminals such as a terminal block or an installed electrical device.

7.5 With reference to 7.4, installation of an accessory shall not require cutting of wiring or the soldering of connections by the installer.

7.6 Strain-relief means shall be provided for the wiring of an accessory where stress may be transmitted to the connections during or after installation.

7.7 The mounting method and location of an accessory shall be specified in the installation instructions for the furnishing. See Section 73, Accessory Instructions.

7.8 Instructions shall be provided with the accessory covering the model number or series of furnishing the accessory is intended for use with. See Section 73, Accessory Instructions.

7.9 An accessory shall be trial-installed to determine that the installation is feasible, that the instructions are detailed and accurate, and that the furnishing complies with the requirements of this standard with the accessory installed.

7.10 An accessory may be shipped with or separately from the basic furnishing.

7.11 A part that is required for the furnishing to perform its basic function is not considered an accessory and shall be supplied with the basic furnishing.

CONSTRUCTION

8 General

8.1 Each electrical device and insulated conductor shall have a voltage rating at least equal to the voltage that is applied to it during intended use.

8.2 Each electrical device shall have an ampere rating and each insulated conductor shall have an ampacity rating for the maximum current to which it is subjected during intended use.

8.3 Means shall be provided to reduce the risk of contact between the surface of a cabinet and a cabinet light other than at the intended mounting means. The means provided shall have strength and rigidity to reduce the risk of distortion which facilitates installation in a manner other than intended.

8.4 When wires pass through a joint between sections of a furnishing the construction shall comply with the requirements in 6.3.

9 Power-Supply Connections

9.1 Permanently connected furnishing

9.1.1 A permanently connected furnishing shall be provided with field-wiring terminals or leads for the connection of conductors having an ampacity rated as intended for the furnishing, and in accordance with the National Electrical Code, ANSI/NFPA 70. A furnishing shall be provided with a splice compartment, junction box or length of raceway to make connections.

9.1.2 A lead that is intended to be connected in the field to a power-supply circuit conductor shall not be smaller than 18 AWG (0.82 mm²), and shall be sized based on the rated current of the furnishing.

9.1.3 A terminal or splice compartment shall be complete and shall enclose all field-wiring terminals and splices to be made in the field.

9.1.4 Each terminal or splice compartment in which power-supply connections are to be made in the field shall be located so that the connections are able to be readily accessible for inspection after installation of the furnishing.

9.1.5 The compartment specified in 9.1.4 shall be located so that, when making conduit connections, internal wiring and electrical components are not exposed to mechanical abuse or strain.

9.1.6 A terminal compartment intended for connection of a supply electrical enclosure shall be attached so as to be prevented from turning with respect to the supporting surface.

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

9.1.8 A wire-binding screw at a wiring terminal shall not be smaller than No. 10 (4.8 mm diameter). If a pre-tapped hole is not provided, a thread-forming screw shall be used.

Exception: A No. 8 (4.2 mm diameter) screw is able to be used at a terminal intended only for connection of a 14 AWG (2.1 mm²) or smaller conductor.

9.1.9 A terminal plate tapped for a wire-binding screw shall be of metal not less than 0.050 inch (1.27 mm) thick.

Exception: A plate not less than 0.030 inch (0.76 mm) thick is able to be used when the tapped threads comply with Section 47, Tightening Torque Test.

9.1.10 A wire-binding screw shall be provided with an upturned lug, cupped washer, or equivalent means that retains a supply conductor of the size intended.

9.1.11 A terminal (for example, a plate and screw) intended for the connection of the grounded supply conductor shall be formed of or plated with metal that is substantially white in color and shall be readily distinguishable from other terminals or shall be clearly identified in some other manner, such as on an attached wiring diagram.

9.1.12 A lead intended for the connection of the grounded power-supply conductor shall be finished to show a white or gray color, and shall be readily distinguishable from other leads.

9.1.13 The free length of a lead located inside an outlet box or field-wiring compartment and intended for field connection to a branch circuit shall not be less than 6 inches (152 mm).

9.1.14 When a terminal block is provided, it shall be suitable for field wiring.

9.1.15 An opening for conduit shall have dimensions as indicated in Table 9.1.

Table 9.1
Dimensions associated with openings for conduit

Nominal trade size of conduit inches	Unthreaded opening diameter ^a		Throat minimum		Diameter maximum		Minimum diameter of flat surface	
	inch	(mm)	inch	(mm)	inch	(mm)	inch	(mm)
1/2	0.875	(22.2)	0.56	(14.2)	0.62	(15.7)	1.15	(29.2)
3/4	1.109	(28.2)	0.74	(18.8)	0.82	(20.8)	1.45	(36.8)
1	1.375	(34.9)	0.94	(23.9)	1.05	(26.7)	1.80	(45.7)
1-1/4	1.734	(44.0)	1.24	(31.5)	1.38	(35.1)	2.31	(58.7)

^a A plus tolerance of 0.031 inch (0.79 mm) and a minimum tolerance of 0.015 inch (0.38 mm) applies to the knockout diameter. Knockout diameters are measured other than at points where a tab remains after removal of knockout.

9.1.16 The minimum unobstructed diameter of the flat surface surrounding the back of an opening for unthreaded conduit shall be as indicated in Table 9.1.

9.1.17 When threads for the connection of threaded conduit are tapped all the way through a hole, there shall be no fewer than 3-1/2 or more than 5 threads. The construction of the hole shall be such that a conduit bushing is able to be properly attached and the minimum unobstructed diameter surrounding the back of the hole shall be as indicated in Table 9.1.

9.1.18 When threads for the connection of threaded conduit are not tapped all the way through a hole, there shall be no fewer than five full threads. The unthreaded parts of the hole and the back edge shall be smooth and well-rounded for protection of the conductors. The unthreaded throat diameter of the hole shall have an internal diameter as noted in Table 9.1.

9.1.19 The minimum usable volume of a field wiring compartment shall be as specified in Table 9.2.

Table 9.2
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	(2.8)	32.77	(2.00)
12	(3.3)	36.87	(2.25)
10	(5.3)	40.97	(2.50)
8	(5.5)	49.2	(3.0)
6	(6.5)	81.9	(5.0)

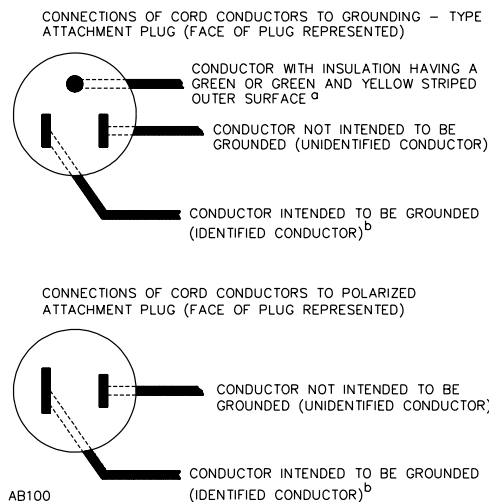
9.2 Cord-connected furnishing

9.2.1 A furnishing intended to be connected to the power-supply source by means of a flexible cord and plug shall be provided with a flexible cord and an attachment plug for connection to the supply source. Furnishings supplied with more than one power supply cord shall comply with 9.3.

9.2.2 When a 3-wire grounding-type or a 2-wire polarized attachment plug is provided, the circuit conductors in the flexible cord shall be connected to the plug and to the wiring in the product so that any of the following devices used in the primary circuit shall be connected in an ungrounded current carrying conductor: the center contact of the Edison-Base lampholder, a single pole switch, an automatic control with a marked off position, a single fuseholder, and any other single-pole overcurrent protective device.

9.2.3 When a 3-wire grounding-type attachment plug or a 2-wire polarized attachment plug is provided, the attachment plug connection shall comply with Figure 9.1 and the polarity identification of the flexible cord shall comply with Table 9.3. See Section 75, Operating Instructions.

Figure 9.1
Connections to attachment plugs



^a In the above illustration, the blade to which the green conductor is connected is able to have a U-shape instead of a circular cross section.

^b Signifies a conductor identified in accordance with Table 9.3. The grounded (identified) conductor is the neutral supply conductor.

Table 9.3
Polarity identification of flexible cords

Method of identification	Usable combinations	
	Wire intended to be grounded ^{a,b}	All other wires ^a
Color of braid on individual conductors	Solid white or gray – without tracer Color other than white or gray, with tracer in braid	Solid color other than white or gray – without tracer Solid color other than white or gray – without tracer
Color of insulation on individual conductors	Solid white or gray ^c Light blue ^d	Solid color other than white or gray Solid color other than light blue, white, or gray
Other means	Tin or other white metal on all strands of the conductor ^e A stripe, ridge or groove on the exterior surface of the cord ^f	No tin or other white metal on the strands of the conductor
^a A wire finished to show a green color with or without one or more yellow stripes or tracers is to be used only as an equipment-grounding conductor. See 14.2.1 and Figure 9.1. ^b The grounded conductor is the neutral supply conductor. ^c Only for cords – other than Types SPE-2 and SPT-2 – having no braid on any individual conductor. ^d For jacketed cords. ^e Only for Type SPT-2 cords. ^f Only for Types SPE-2 and SPT-2 cords.		

9.2.4 A furnishing required to be grounded shall be provided with a grounding-type attachment plug.

9.2.5 If the cord includes an equipment grounding conductor, the grounding conductor shall be connected to all exposed or accessible unenergized metal parts of the furnishing by a mechanical means in accordance with Grounding and Bonding, Section 14 and to the grounding pin of a grounding attachment plug. See Figure 9.1.

9.2.6 The power-supply cord shall be rated for use at a voltage not less than the rated voltage of the product. The power-supply cord shall be sized in accordance with Table 9.4. A furnishing provided with a 20 Amp rated receptacle shall be provided with a minimum 12 AWG (3.3 mm²) conductor cord or when provided with a 15 Amp receptacle with a minimum 14 AWG (2.1 mm²) conductor cord.

Table 9.4
Power supply cord ampacity

Cord size AWG (mm ²)	Furniture maximum rating (Amperes) per cord	
	3 current-carrying conductors	2 current-carrying conductors
6 (13.3)	45	55
8 (8.4)	35	40
10 (5.3)	25	30
12 (3.3)	20	25
14 (2.1)	15	18
16 (1.3)	10	13
18 (0.82)	7	10

9.2.7 The flexible cord shall be of a type indicated in Table 9.5 or shall have properties such that it will be at least equally as serviceable for the particular application.

Table 9.5
Acceptable types of cord and applicable limitations on their use

Product on which the cord is to be used	Cords acceptable where temperatures are more than 121°C (250°F) are attained on any surface the cord can contact	Cords acceptable where 121°C (250°F) or lower temperatures are attained on any surface the cord can contact
Household use products	HPN, HSJ, HSJO	NISP-2, NISPT-2 SP-2, SPE-2, SPT-2, SPT-3, SV, SVE, SVO, SVT, SVTO, SJ, SJE, SJO, SJT, SJTO or equivalent.
Commercial use counter top and table top use products ^a	HSJ, HSJO, HSJOW	NISPT-2, SP-2, SPE-2, or SPT-2, SPT-3, SV, SVE, SVO, SJ, SJT, SJE, SJEO, S, SO, SOW, SOO, SOOW, STO, STOW, STOO, STOOW, SEO or SEOW or equivalent.
Other Commercial products	HSJ, HSJO, HSJOW	SJ, SJT, SJE, SJEO, S, SO, SOW, SOO, SOOW, STO, STOW, STOO, STOOW, SEO or SEOW or equivalent
^a A cord that is protected by the physical construction of the furnishing such as being recessed in a cord channel, routed within a passageway or the like and exits the commercial furnishing such that the cord cannot contact the floor due to the intended location of the commercial furnishing such as a shelf or rack mounted display (refer to the installation instructions 72.8 – 72.9).		

9.2.8 SV, SVE, SVO and equivalent power supply cords shall have the individual conductors provided with supplementary insulation where the conductors exit the jacket of the cord.

9.2.9 A direct plug-in power supply with a Class 2 or LPS output shall comply with the output cord conductor requirements specified for the power supply.

9.2.10 A power supply with a supply cord input and a secondary load side power output in excess of Class 2 shall comply with 9.2.6 – 9.2.8 or Supplement SA for a SELV power level output.

9.2.11 When a furnishing employs a direct plug-in power supply the length of the output conductors shall be in compliance with Table 9.6 requirements.

9.2.12 When a furnishing employs a power supply with a supply cord input and output conductors the combined length of the supply cord and the output conductors shall be in compliance with Table 9.6 requirements.

9.2.13 The length of a power supply cord shall be within the limits specified in Table 9.6.

Table 9.6
Length of power supply cord

Type of furnishing	Minimum acceptable length		Maximum acceptable length	
	Feet	(mm)	Feet	(mm)
Table, or shelf (Rack, Gondola) supported	4.0	(1219)	10	(3048)
Floor supported with a cord exit point lower than 3 feet from the floor	5.0	(1524)	25	(7620)
Floor supported with a cord exit point greater than 3 feet from the floor	9.0	(2743)	25	(7620)

9.2.14 When the intended means of mounting or other features or constructions of a furnishing warrants other than the required length of power-supply cord, a shorter cord (or no cord) is able to be provided. An example of an application where a shortened cord is able to be used is when several furnishings are interconnected in the field to form one unit. Instructions shall be provided in accordance with 72.12.

9.2.15 The current rating of the attachment plug of a furnishing shall not be less than 125 percent of the maximum current input of the furnishing or the marked rating when no electrical load is provided as part of the furnishing.

9.2.16 Means shall be provided to support the cord to reduce risk of contact with a cabinet light at a location other than the cord exit.

9.2.17 The furnishing shall be constructed so that neither the cord nor plug is damaged when the furnishing is placed against a wall. Examples of constructions include, but are not limited to wood blocks to hold the furnishing out from the wall and right angle (flat) cord/plugs.

9.2.18 Power supply cords and interconnecting cords that constitute a risk of injury from damage shall be protected from moving parts of a furnishing.

9.3 Multiple power supply cords

9.3.1 Cord connected furnishings shall not be provided with more than one power supply cord unless all of the following conditions are met:

- a) Not more than two cords are provided;
- b) Each flexible cord is of the type, size, and rating required for the type of product and the load supplied;
- c) Each attachment plug cap's rating is:
 - 1) Not less than that of the furnishing and not less than the maximum current input of the furnishing when tested in accordance with the Input Test, Section 51.
 - 2) The current rating of the attachment plug of a furnishing rated more than 15 amperes shall not be less than 125 percent of the maximum current input of the furnishing when tested in accordance with the Input Test, Section 51, and not less than 125 percent of the rated current of the furnishing.
- d) The total current input per Section 51, Input Test, (including current through all cords) is not more than 80 percent of the branch circuit supply for the single branch circuit to which it is connected (based on the plug configuration);

Exception No. 1: The current is not required to be less than 80 percent of the single branch circuit when the plugs are supplied by separate branch circuits, evidenced by any of the following:

- a) The attachment plugs are not the same configuration or rating and the instructions contain the information in 74.6 (a) and (b);*
- b) The rating of either or both plugs is greater than 20 Amps; or*
- c) The product is marked in accordance with 67.13, and the instructions contain the information in 74.6 (a) and (c).*

Exception No. 2: The current is not required to be less than 80 percent of the branch circuit rating when:

- a) Both attachment plugs are rated 15 Amps or less; and*
- b) The total current input is equal to or less than the attachment plug rating.*
- e) With reference to Exception No. 1(a) of 9.3.1(d), where detachable power supply cords are used, both the attachment plugs and the inlets shall have different configurations.
- f) The product is provided with a single accessible control or switch with a marked "off" position that disconnects all ungrounded conductors of the product;

Exception: The furnishing is not required to have a single disconnect when multiple disconnect means are provided in accordance with any of the following:

- a) There is a control or switch for each of the two power supply cords, and the controls or switches are grouped and identified;*

b) Both power supply cords are of the detachable type, the only supplied loads are receptacles, and the cord attachment points are grouped and identified;

c) The product is provided with a mechanical or electrical interlock system that results in all ungrounded conductors of the supply being disconnected in the event that either cord is disconnected; or

d) A marking is provided and located adjacent to each switch in accordance with 67.14.

g) The furnishing is rated in accordance with 66.3;

h) The product contains the markings in 67.13; and

i) The furnishing is provided with instructions as indicated in 74.6.

9.4 Detachable power supply cords

9.4.1 Shall comply with the following:

a) Shall either be provided with an ANSI/NEMA WD-6 configuration mating attachment cord connector body and inlet; or

b) Be provided with a Standard for Appliance Couplers for Household and Similar General Purposes – Part 1: General Requirements, UL 60320-1 configuration mating appliance attachment cord connector body and inlet.

9.4.2 The power supply cord ampacity shall be rated for the maximum current rating of the appliance inlet configuration provided.

9.4.3 Adjacent to the inlet shall be marked the maximum voltage and current rating of the furnishing and a WARNING statement as specified in 67.22.

9.5 Strain relief

9.5.1 A strain-relief means shall be provided so that mechanical stress placed on a flexible cord or flexible conduit is not transmitted to terminals, splices, or internal wiring. When a clamp is employed with a cord, auxiliary insulation is required when the clamp is able to damage the cord insulation.

9.5.2 Insulating bushings serving as strain relief shall comply with the Standard for Insulating Bushings, UL 635. 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 parts are suitable in combination.

9.5.3 If wood, pressed board, or other fibrous material is used to secure the strain-relief assembly, the fibrous material shall be secured to the furnishing by a positive means.

9.5.4 Means shall be provided to reduce the likelihood of an attached supply cord or lead from being pushed into the enclosure of a furnishing through the cord-entry hole if damage to cord could result from contact with internal mechanical and electrical components or systems.

9.5.5 To determine compliance with 9.5.1, a strain relief means is to be subjected to the applicable tests described in Section 53, Strain Relief Tests.

9.5.6 A metal strain relief clamp or band shall not be used unless it has been evaluated to the Standard for Conduit, Tubing, and Cable Fittings, UL 514B, for the size of, number of and type of cord or conductor.

9.6 Protection of cord and wiring

9.6.1 The point where a flexible cord passes through an opening in a wall, barrier, or enclosure, shall be an opening that is free from sharp edges, burrs, and fins that are able to damage the conductor insulation.

9.6.2 The cord shall be provided with mechanical means that prevent the cord being pushed inside the enclosure and contacting:

- a) A lamp or heated surface;
- b) A sharp edge; or
- c) A moving part.

9.6.3 An insulating bushing shall be provided where the flexible cord or wiring enters a pendant lampholder or the base or stem of a furnishing, and at the ends of metal tubing where the cord or wiring are pulled during the adjustment of the unit.

Exception No. 1: A smooth, metal bushing is able to be used when Type SPT-2, SJ, SV, or heavier cord is used.

Exception No. 2: An insulating bushing is not required with Integral Type SPT-2 cord when:

- a) The metal through which the cord passes is not less than 0.042 inch (1.07 mm) thick and the surface is smooth, or the edge of the metal is rolled not less than 120 degrees; or*
- b) The cord at the point where it passes through the hole is provided with additional insulation that is:*
 - 1) Not less than 1/32 inch (0.8 mm) thick;*
 - 2) Molded to the cord; and*
 - 3) Of thermoplastic for Type SPT-2 cord.*

9.6.4 Cord or wiring that passes through tubing or contacts the edge of a sheet-metal wall 0.042 inch (1.07 mm) or less thick shall be reliably held away from the edges of the metal or shall be protected by a non-rubber bushing or a grommet or by rolling the edge of the metal not less than 120 degrees.

9.6.5 When cords or wires pass through or contact the edges of sheet metal thicker than 0.042 inch (1.07 mm), the metal shall be treated by reaming or the equivalent to remove burrs, fins, or sharp edges that are able to damage insulation.

9.6.6 When the material through which the cord or wiring passes is wood, porcelain, phenolic composition, or other insulating material, not less than 3/64 inch (1.2 mm) thick, a smoothly rounded surface is determined to be equivalent to a bushing.

9.6.7 Ceramic materials and molded urea, phenolic, and melamine compositions are determined to meet the intent of the requirement for insulating bushings; a bushing of wood or rubber is not usable. Other compositions are able to be used when they have been investigated and found usable for the application.

9.6.8 A hard-fiber bushing or grommet form is able to be employed when the bushing is not less than 3/64 inch (1.2 mm) thick. A rubber bushing is not suitable for use.

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

9.6.10 Polymeric sleeving shall not be used for reducing the risk of cutting or abrasion of wiring. Fiberglass sleeving not less than 0.010 inch (0.25 mm) thick is capable of being used.

9.6.11 A bushing shall be securely held in place.

9.6.12 A cord shall be supported through an individual furnishing and between mechanically contiguous furnishings. The supports shall be such that the cord, has a maximum unsupported distance of 16 inches (406 mm).

9.6.13 When a power supply cord is routed internally or externally along a furnishing or a cord is utilized for the interconnection of electrical components provided with the furnishing the cord shall be protected from damage by any of the following means:

- a) Recessing the cord in a channel or a complete enclosure;
- b) Providing projections extending out from the furnishing at least equivalent to the depth of the diameter of the cord;
- c) Providing a removable protective cover.

10 Frame and Enclosure

10.1 General

10.1.1 A furnishing shall be formed and assembled so that it has the strength, stability, and rigidity required to resist the abuses during normal use and maintenance to which it is subjected without increasing the risk of fire, electric shock, or injury to persons.

10.1.2 Among the factors taken into consideration in determining the acceptability of an enclosure are its:

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

For a nonmetallic enclosure, all of these factors are to be considered with respect to thermal aging.

10.1.3 A part such as a splice, tap, wire, transformer, capacitor, ballast, current-carrying part, or device with an exposed live part shall be contained in an enclosure constructed of metal, glass, ceramic, porcelain, or polymeric material. Such parts shall be contained in the enclosure during normal maintenance and use.

Exception No. 1: A current-carrying part of a wiring device (such as the screw shell and center contact of a lampholder, the lampholder contacts, starter holder contacts, or similar components of a fluorescent luminaire) that are normally fitted with a functional component (a lamp, a starter, or similar component) during use of the furnishing is not required to be additionally enclosed.

Exception No. 2: A component, such as a ballast, that has an integral outer housing that has been evaluated as an enclosure is not required to be additionally enclosed.

Exception No. 3: A power-supply cord is not required to be contained within the furnishing other than at the connection point to internal components.

10.1.4 A frame, guard, handle, or similar part; or an exposed portion of an enclosure, such as an edge, projection, or corner, shall be smooth and rounded. Such components shall not be so sharp as to constitute a risk of injury to persons during intended use and maintenance of a product, when investigated in accordance with the Standard for Tests for Sharpness of Edges on Equipment, UL 1439.

10.2 Mechanical enclosures and guards – Mechanical considerations

10.2.1 When the operation and maintenance of a furnishing by the user or bystanders involves the risk of injury to persons, protection shall be provided to reduce the risk.

10.2.2 When investigating a furnishing with respect to the requirement in 10.2.1, conditions of foreseeable misuse shall be evaluated.

10.2.3 A functional attachment that is made available or specified for use with a furnishing shall be included in the investigation of the furnishing. Unless the instructions specify the use of two or more attachments at the same time, only one attachment at a time is to be investigated with the furnishing.

10.2.4 Whether a guard, a release, an interlock, or similar device is required and whether such a device is adequate shall be determined from an investigation of the complete furnishing, its operating characteristics, its intended installation location, the intended user group (youth, adult, persons with diminished capacity, elderly), trained or untrained users and the potential risk of injury to persons. The investigation shall include evaluation of the results of breakdown or malfunction of any one component, and not more than one component at a time, unless one event contributes to another. When the investigation shows that breakdown or malfunction of a particular component results in a risk of injury to persons, that component shall be investigated for reliability.

10.2.5 A moving part, lifting or reclining mechanism, the rotor of a motor, a pulley, belt, gear, fan, or other part that constitutes a risk of injury shall be enclosed or provided with means to reduce the risk of injury. Such a part shall not be able to be contacted by the probe illustrated in Figure 12.1 unless the furnishing is provided with a safety system and complies with 10.2.6.

10.2.6 Furnishings that present a risk of injury as described in 10.2.5 shall be provided with either an active safety circuit or passive guard to prevent injury.

10.2.7 A mechanical safety system, such as a guard, shall comply with 10.2.10.

10.2.8 During the investigation of a furnishing to determine compliance with 10.2.5, a part of the enclosure that is removable without the use of a tool shall be removed.

Exception: A part that is removable without the use of a tool is not required to be opened or removed when the furnishing is marked in accordance with 67.10.

10.2.9 Among the factors to be evaluated with respect to both intended operation of the furnishing and any foreseeable misuse in investigating an exposed moving part are:

- a) The degree of exposure required to perform the intended function;
- b) The sharpness of the moving part;
- c) The risk of unintentional contact;
- d) The speed of the moving part;
- e) The risk that a part of the body is endangered or that clothing is able to be entangled by the moving part, resulting in a risk of injury to persons; and

f) A motorized or otherwise powered moving part, as specified in 10.2.5, shall not exert a force greater than 40 pounds between the moving part and any object that can be entrapped by the moving part. The furnishing shall be subjected to the Entrapment Force Measurement Test, Section 45. Figures 45.1 – 45.4 provide examples of typical entrapment areas and concerns.

Exception: A furnishing that when installed or placed in its intended location and its highest point of travel is 84 inches (2130 mm) above the floor is not required to meet the 40 lb force limitation in the upper direction of travel. Installation and operation instructions shall warn against placing a fixed structure at a point less than 85 inches (2159 mm) above the movable component of the furnishing.

10.2.10 Guards shall:

- a) Require the use of tools for their removal;
- b) Be removable for servicing;
- c) Have sufficient strength and rigidity;
- d) Be complete;
- e) Not present a risk of injury to persons such as a pinch point, during additional handling because of required service, such as cleaning, unjamming, or similar service; and
- f) Be self-restoring.

10.2.11 An enclosure or guard over a rotating part shall retain a part that, because of breakage or other reasons, becomes loose or separates from a rotating part, and shall retain a foreign object that is able to be struck and propelled by the rotating part.

10.2.12 When breakage or deterioration of material adjacent to a moving part results in an increased risk of injury, the material shall have such properties as to withstand the loads it is subjected to during use of the furnishing.

10.2.13 A portable furnishing that does not incorporate a shade as specified in the Standard for Portable Electric Luminaires, UL 153, for portable lamps shall comply with Section 61, Lamp Drape Test, and shall be marked with the maximum wattage lamp intended for use with the furnishing in accordance with the requirements of UL 153.

10.2.14 When unintentional operation of a switching device results in a risk of injury to persons, the actuator of the switch shall be located or guarded so that such unintentional operation does not occur. A switch that is located or guarded so that it cannot be turned on by moving a 2 inch (51 mm) diameter sphere at any angle to the switch or actuator complies with this requirement.

10.3 Metallic electrical enclosures

10.3.1 A furnishing shall be formed and assembled so that it will have the strength and rigidity necessary to resist the abuses to which it is likely to be subjected, without increasing the risk of fire, electric shock or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

10.3.2 For unreinforced, flat surfaces in general, cast metal shall not be less than 1/8 inch (3.2 mm) thick, except that malleable iron may be not less than 3/32 inch (2.4 mm) and die cast metal may be not less than 5/64 inch (2.0 mm) thick. Corresponding thicknesses of not less than 3/32 inch (2.4 mm), 1/16 inch (1.6 mm), and 3/64 inch (1.2 mm), respectively, may be acceptable if the surface under consideration is curved, ribbed, or otherwise reinforced, or if the shape or size, or both, of the surface is such that the necessary mechanical strength is provided.

10.3.3 An enclosure of sheet metal shall be judged with respect to its size, shape, thickness of metal, and its application, considering the intended use of the complete furnishing. The use of sheet steel having a thickness of less than 0.026 inch (0.66 mm) if uncoated or 0.029 inch (0.74 mm) if galvanized or of nonferrous sheet metal having a thickness of less than 0.036 inch (0.91 mm) is not recommended, except for relatively small areas or for surfaces that are curved or otherwise reinforced.

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

10.4 Electrical enclosures of polymeric material

10.4.1 A polymeric material enclosure of electrical parts shall comply with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, as applicable to polymeric enclosures.

10.5 Barriers

10.5.1 The enclosure of a motor-operated furnishing shall reduce the risk of molten metal, burning insulation, flaming particles, or similar materials falling on combustible materials, including the surface upon which the furnishing is supported.

10.5.2 The requirement in 10.5.1 necessitates that a switch, a relay, a solenoid, or similar device be individually and completely enclosed, except for terminals, unless it is shown that malfunction of the component does not result in a risk of fire, or there are no openings in the bottom of the furnishing enclosure. It also necessitates the use of a barrier:

a) Under a motor unless:

- 1) The structural parts of the motor or of the furnishing provide the equivalent of such a barrier;
- 2) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the furnishing when the motor is energized under each of the following fault conditions:
 - i) Open main winding;
 - ii) Open starting winding;

iii) Starting switch short-circuited; and

iv) Capacitor of permanent-split capacitor motor short-circuited – the short circuit is to be applied before the motor is energized, and the rotor is to be locked.

3) A motor complying with the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1 and

i) The Standard for Impedance Protected Motors, UL 1004-2; or

ii) The Standard for Thermally Protected Motors, UL 1004-3.

as appropriate for the over temperature protection incorporated with the motor construction.

b) Under wiring, unless rated VW-1.

10.5.3 The barrier specified in 10.5.2 shall be of noncombustible material or shall comply with the Internal Barriers Section in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and shall have a comparative tracking index (CTI) of:

a) 4 for furnishings for household use; and

b) 3 for furnishings for commercial applications.

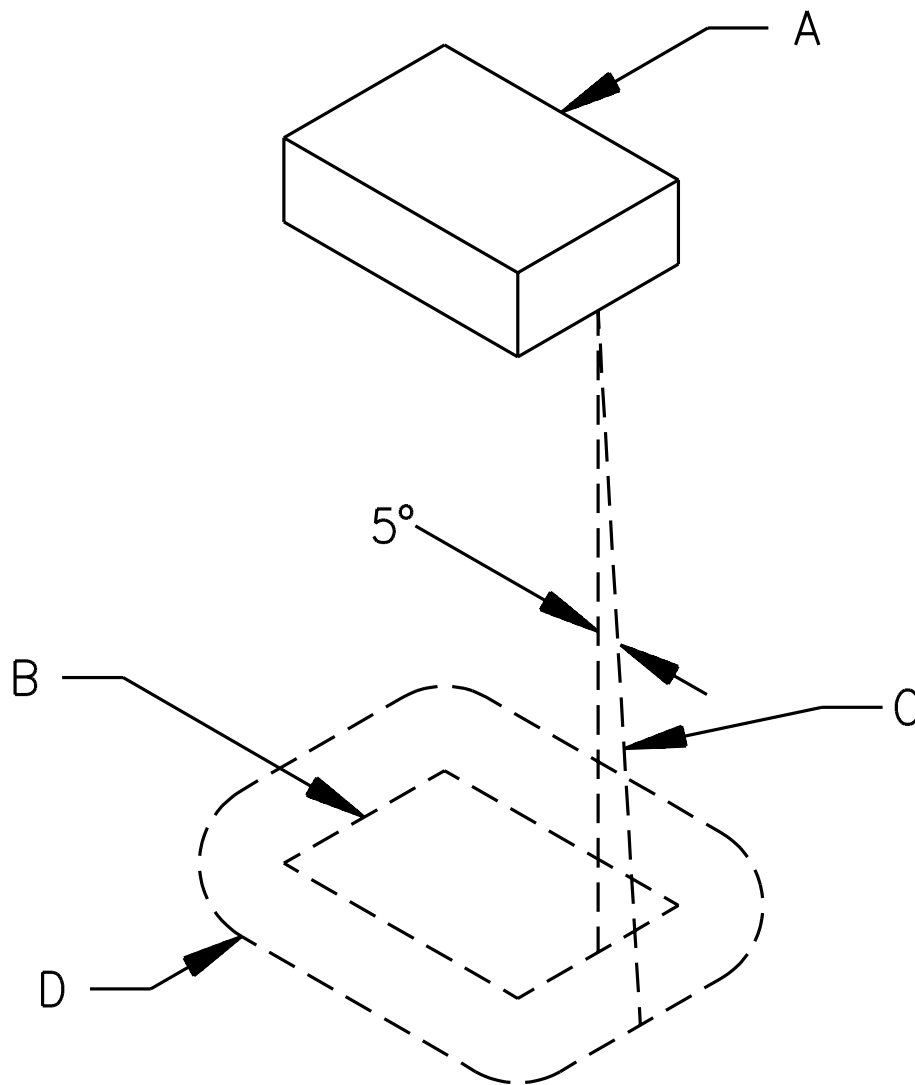
10.5.4 The barrier specified in 10.5.2 shall be horizontal, shall be located as illustrated in Figure 10.1, and shall not have an area less than that described in Figure 10.1. Openings for drainage, ventilation, or similar condition, are not prohibited from being employed in the barrier, when such openings do not allow molten metal, burning insulation, or similar materials to fall on combustible material.

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Figure 10.1
Location and extent of barrier



SA0604-1

A – Region to be shielded by barrier. This consists of the entire component when it is not otherwise shielded and consists of the unshielded portion 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 tangent to the component, 5 degrees from the vertical, and oriented so that the area traced out on a horizontal plane is maximum.

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

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10.6 Doors or covers

10.6.1 A door or a cover of an enclosure that provides access to any overload protective device requiring resetting or renewal shall be hinged or otherwise attached in an equivalent manner.

10.6.2 Means shall be provided for holding the door or cover over a fuseholder in a closed position, and the door or cover shall be tight-fitting.

10.7 Mounting means

10.7.1 An opening provided for mounting shall be located or guarded so that a nail, hook, or similar part does not reduce spacings, displace a part that creates a risk of fire or electric shock, and does not contact one of the following:

- a) An uninsulated live part;
- b) Magnet wire;
- c) Internal wiring; or
- d) Any other part that creates a risk of fire or electric shock.

10.7.2 A furnishing intended to be mounted shall employ a mechanical means of mounting that does not rely on friction.

10.7.3 An adhesive used as the sole means of support to secure a furnishing or part of a furnishing which if displaced could cause a risk of injury shall be investigated to determine that it reliably secures the product. General – Adhesives, Function Analysis, and Program of Investigation, in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, shall be used when performing the investigation. The maximum force as defined in UL 746C shall be four times the weight of the part or loaded furnishing under investigation as received and two times the weight of the part or furnishing after the adhesive has been subjected to the environmental conditioning.

10.8 Polymeric supporting devices

10.8.1 A polymeric device which provides mechanical support or electrical insulation or separation whose deterioration would reduce spacings between uninsulated live parts or could result in a risk of injury created due to softening or melting of the support means shall comply with mechanical RTI temperature limits (with and without impact) for the material in the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B.

10.9 Glass components

10.9.1 Edges of glass accessible during normal use or maintenance shall be seamed, swiped, fire-polished, or similarly treated to eliminate sharpness.

10.9.2 Glass components less than or equal to 1 foot² (0.09 m²) or that are irregular shaped and fit within a 1 foot³ (0.03 m³) box do not have minimum thickness, securement or impact resistance requirements.

10.9.3 Glass components larger than specified in 10.9.2 but less than 9 feet² (0.84 m²) shall have a minimum thickness as required in Table 10.1 and shall meet the requirements of the Standard Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings, ANSI Z97.1, Class A or comply with Table 10.1 and perform according to the requirements specified in the Impact test, 38.1 and the Glass Retention Test, 38.2.

10.9.4 Glass components larger than or equal to 9 feet² (0.84 m²) shall meet ANSI Z97.1 Class A requirements.

10.9.5 In accordance with 10.9.3 the minimum thickness of glass components shall be as specified in Table 10.1.

Table 10.1
Glass components
(10.9.3)

Length or width	Min glass thickness
> 12 inches (305 mm)	1/8 inch (3.2 mm)

11 Protection Against Corrosion

11.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, powder coating, or other equivalent means, when corrosion of such parts results in a risk of fire, electric shock, or injury to persons.

Exception: This requirement does not apply to bearings, laminations, or minor parts of iron or steel, such as washers, screws, or similar parts.

11.2 Copper, aluminum, and alloys of copper and aluminum, stainless steel, and similar materials having inherent resistance to atmospheric corrosion may be used without additional corrosion protection.

11.3 All exposed, exterior and interior, surfaces of ferrous metal parts shall be protected by one of the following:

- a) A coating of nonferrous metal applied by the hot dip process method;
- b) A plating of nonferrous metal applied either by electro-deposition or by chemical means;
- c) A coating of vitreous enamel;
- d) Baked paint, powder coating or similar type of coating; or
- e) Air-dry paint.

11.4 When deterioration of a liquid container provided as a part of a furnishing results in a risk of fire or electric shock, the container shall be of a material that is resistant to corrosion by the liquid with which it is intended to be used.

12 Accessibility of Uninsulated Live Parts and Film-Coated Wire

12.1 To reduce the risk of unintentional contact that results in a risk of electric shock from an uninsulated live part or film-coated wire, an opening in an enclosure shall comply with either:

- a) For an opening that has a minor dimension (see 12.5) less than 1 inch (25.4 mm), such a part or wire shall not be contacted by the probe illustrated in Figure 12.1.
- b) For an opening that has a minor dimension of 1 inch (25.4 mm) or more, such a part or wire shall be spaced from the opening as specified in Table 12.1.

Exception: A motor is not required to comply with these requirements when it complies with the requirements in 12.2.

Technical drawing of a PA100A probe tip, showing three views: front view, side view, and cross-sectional view.

Front View (Left): Shows the tip's profile. Key dimensions include a 3.5 mm radius at the top, a 78 mm base width, and a total height of 97 mm. The tip features a central channel with a 16 mm width at its base and a 25.4 mm width at the base of the main body. The base of the main body has a 50 mm width and a .05 mm thickness. The tip is divided into sections by horizontal lines, with dimensions of .05 mm, .05 mm, .05 mm, .05 mm, and .05 mm indicating the thickness of these sections. Section A-A is indicated at the top of the tip.

Side View (Right): Shows the side profile of the tip. Key dimensions include a 30° angle at the top, a 5.8 mm radius at the top, and a total height of 234 mm. The side view shows the tip's taper and the location of the central channel. Dimensions of 5.0, 30, 60, 90, 96, 100, 136, 154, and 234 mm are shown along the right side, indicating the height of various features. A 15 mm width is shown at the base of the tip, and a 19 mm width is shown at the base of the main body.

Cross-sectional View (Bottom): Shows the internal structure of the tip. It features a central channel with a 25 mm radius at the top and a 25 mm radius at the bottom. The base of the main body has a 78 mm width. The cross-section shows the tip's internal structure, including the central channel and the base of the main body.

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Table 12.1
Minimum required distance from an opening to a part involving a risk of electric shock

Minimum dimension ^a of opening		Minimum distance from opening to part	
inches	(mm) ^b	inches	(mm) ^b
3/4 ^c	(19.1)	4-1/2	(114)
1 ^c	(25.1)	6-1/2	(165)
1-1/4	(31.8)	7-1/2	(191)
1-1/2	(38.1)	12-1/2	(318)
1-7/8	(47.6)	15-1/2	(394)
2-1/8	(54.0)	17-1/2	(445)
d	d	30	(762)

^a See 12.5.
^b Between 3/4 and 2-1/8 inches (19.1 and 54.0 mm), interpolation is to be used to determine a value between values specified in the table.
^c Any dimension less than 1 inch (25.4 mm) applies to a motor only.
^d More than 2-1/8 inches (54.0 mm), and not more than 6 inches (152 mm).

12.2 With respect to a part or wire as specified in 12.1, in an integral enclosure of a motor as specified in the Exception to 12.1:

a) An opening that has a minor dimension (see 12.5) less than 3/4 inch (19.1 mm) is able to be used when:

- 1) Film-coated wire is not able to be contacted by the probe illustrated in Figure 12.3;
- 2) In a directly accessible motor (see 12.6), an uninsulated live part is not able to be contacted by the probe illustrated in Figure 12.1; and
- 3) In an indirectly accessible motor (see 12.6), an uninsulated live part is not able to be contacted by the probe illustrated in Figure 12.2.

b) An opening that has a minor dimension of 3/4 inch (19.1 mm) or more is able to be used when a part or wire is spaced from the opening as specified in Table 12.1.

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Figure 12.2
Straight probe

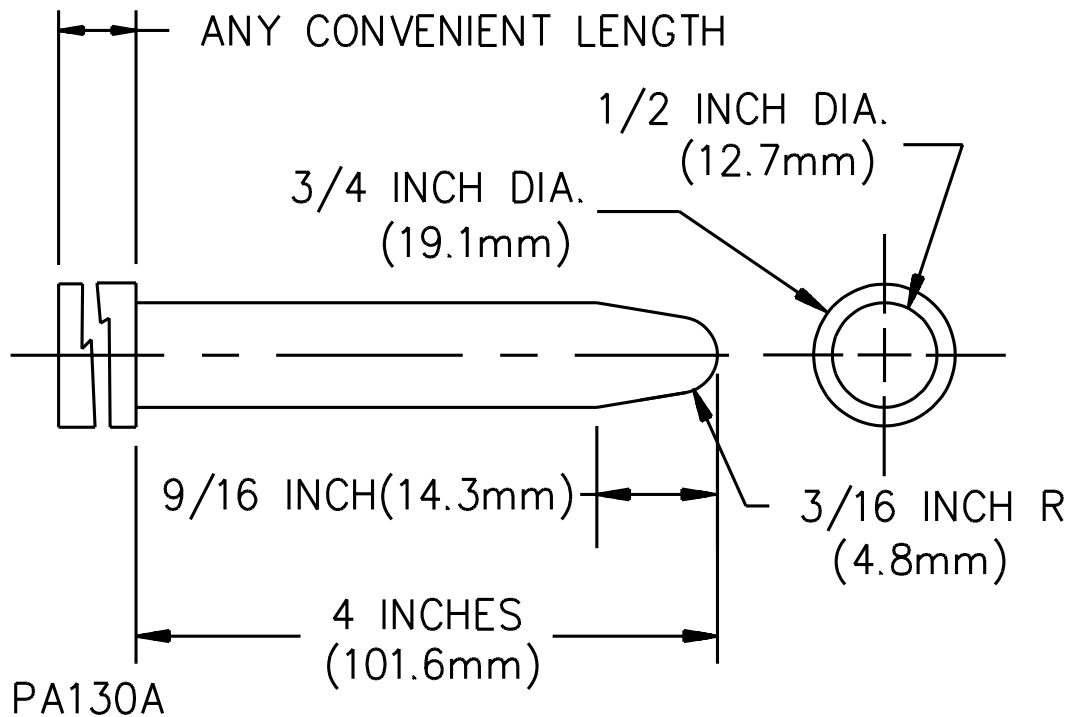
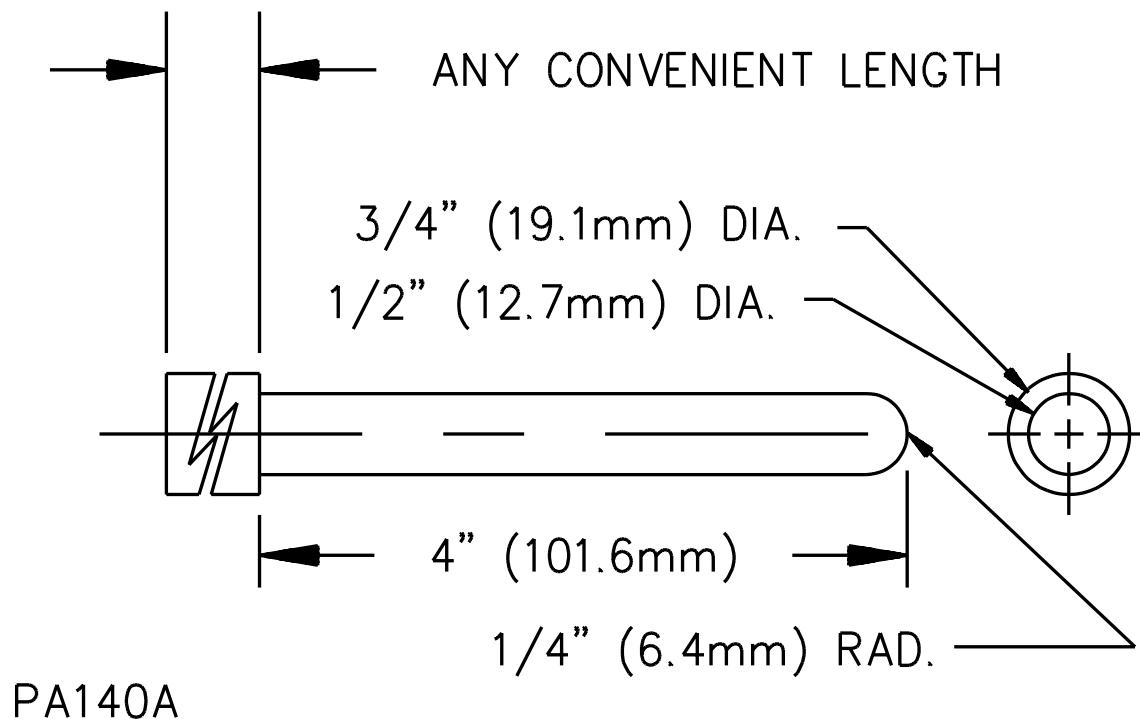


Figure 12.3
Straight probe



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12.3 The probes specified in 12.1 and 12.2 and illustrated in Figures 12.1 – 12.3 shall be applied to any depth that the opening allows, and shall be rotated or angled before, during, and after insertion through the opening to any position required to examine the enclosure. The probe illustrated in Figure 12.1 shall be applied in any configuration allowed by the construction; and, when required, the configuration shall be changed after insertion through the opening.

12.4 The probes specified in 12.2 and 12.3 shall be used as measuring instruments to investigate the accessibility provided by an opening, and not as instruments to investigate the strength of a material: they shall be applied with the minimum force required to determine accessibility.

12.5 With reference to the requirements in 12.1 and 12.2, the minor dimension of an opening is the diameter of the largest cylindrical probe having a hemispherical tip that is able to be inserted through the opening.

12.6 With reference to the requirements in 12.2, an indirectly accessible motor is a motor that is accessible only by opening or removing a part of the outer enclosure (such as a guard or panel) that is able to be opened or removed without using a tool, or that is located at such a height or is otherwise guarded or enclosed so that it is not contacted during normal use of the furnishing. A directly accessible motor is one that is able to be contacted without opening or removing any part or that is located so as to be accessible to contact during normal use of the furnishing.

12.7 During the examination of a furnishing to determine compliance with 12.1 or 12.2, a part of the enclosure that is able to be opened or removed by the user without a tool (such as an accessory, the cover over an opening for an operating adjustment, or similar components) is to be opened or removed.

12.8 With reference to the requirements in 12.1 and 12.2, an insulated brush cap is not required to be additionally enclosed.

13 Resistance to Liquid Damage

13.1 In addition to the requirements in 13.2 – 13.5, wet location furnishings shall be investigated in accordance with Part 2, Outdoor Furnishings.

13.2 A furnishing that requires or has the provision for the user to add water or that automatically refills a vessel shall comply with the Flooding Test, Section 63.

13.3 A damp location cord and plug connected furnishing (such as a lighted planter or lighted make-up mirror) shall have electrical insulation material with moisture-resistant properties equivalent to treated cellulosic or vulcanized fiber, phenolic, urea, or ceramic and shall be investigated in accordance with the Humidity Conditioning Test (Damp and Wet Location Furnishings), Section 58, followed by the Leakage Current Test, Section 49.

13.4 A damp location permanently connected furnishing shall have electrical insulation material with moisture-resistant properties equivalent to treated cellulosic or vulcanized fiber, phenolic, urea, or ceramic and shall be investigated in accordance with the Humidity Conditioning Test (Damp and Wet Location Furnishings), Section 58, followed by the Insulation Resistance Test (Damp and Wet Locations Furnishings), Section 59.

13.5 A furnishing provided with a vessel factory filled with a liquid or a combination liquid and solid material, other than water, shall comply with the following:

- a) The vessel shall be sealed at the factory and the sealing system shall require a tool for removal.
- b) If the product is portable or if the vessel is separable from the product without the use of tools, the whole portable product and also the separable vessel shall be subjected to the Portable Furnishing Drop Test, Section 48, individually and in combination.
- c) If the product is stationary or fixed and the vessel is accessible without the use of tools the vessel shall be subjected to the Impact test, 40.1.
- d) A polymeric vessel shall be subjected to the Conditioning of polymeric components test, 34.1, prior to the drop test.

14 Grounding and Bonding

14.1 Grounding

14.1.1 A furnishing of one or more of the following types shall have provision for grounding:

- a) A furnishing intended to be used on a circuit operating at more than 150 volts to ground;
- b) A furnishing intended for permanent connection to the electrical supply;
- c) A cord-connected motor-operated furnishing; and
- d) A furnishing having a metal part not intended to be electrically energized that is accessible using the probe in Figure 12.1 and that is able to be inadvertently energized.

Exception No. 1: A furnishing provided with a means of double insulation in accordance with the applicable requirements in the Standard for Double Insulation Systems for Use in Electrical Equipment, UL 1097 or the Reference Standard for Double Insulation Systems for Use in Electronic Equipment, UL 2097, shall not be provided with grounding. A furnishing that complies with the requirements for double insulation shall also be marked with the double insulation symbol. See 67.9.

Exception No. 2: A cord and plug-connected portable, indoor, household/residential use furnishing that operates at less than 150 Volts to ground and does not incorporate a motor does not need to be provided with grounding provisions. The furnishing shall be marked "For Household/Residential Use Only" in accordance with 67.18.

14.1.2 When a grounding means is provided, whether required or not, it shall be in accordance with 14.1.4. When the furnishing is cord connected, the grounding means shall also comply with the requirements in 14.1.7. All exposed unenergized metal parts and all unenergized metal parts within the enclosure that are exposed to contact during user servicing and are able to become energized during or after a fault condition shall be reliably connected to the means for grounding.