



UL 962

STANDARD FOR SAFETY

Household and Commercial Furnishings

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

Fifth Edition, Dated October 21, 2022

SUMMARY OF TOPICS

This revision of ANSI/UL 962 dated April 18, 2024 includes the following changes in requirements:

- Revisions to Clarify Horizontal Surface Loading Test Requirements; [Table 46.1](#) and [86.30](#)
- Revisions to Allow Cords to Be Used for Internal Wiring Interconnection in Rooms and Booths; [19.2.1](#) and [19.2.2](#)
- Addition of Construction, Entrapment Test, and Instruction Requirements for Storage Bed Units; [2.84A](#), Section [33A](#), [61.1.1](#), Section [61.3](#), [87.7](#) and Section [101A](#)
- Revision to Loading Test Requirements for Video Display Mounts to Reflect Consistent Testing; [5.2](#) and [43.2](#)
- Revisions to Requirements for Tamper-Resistant Receptacles; [26.2](#)
- Addition of Alternative Means to Evaluate Electromechanical and Electronic Controls; [35.5.1](#) and Section [36A](#)
- Revisions to Add Exception to Ceiling Support Test Requirements; [52.2](#) and [86.42](#)
- Revisions to Flammability Requirements for Non-Electrical Parts; [37.4.1](#) and [D10.3](#)
- Addition of Exception to Required PTC Endurance Cycles; [35.10.3](#)
- Revisions to Clarify Entrapment Prevention Requirements for Usage Area III Furnishings; [11.2.1](#), [11.2.3](#) and [32.1](#)
- Addition of Requirements for Receptacles or Coverplates With Integral Shelves; [5.2](#) and [26.12](#)
- Addition of UL 62368-1 to Annex A; [2.30A](#), [11.5.2](#), [24.1.1](#), Annex [A](#) title, [A1.1](#), [A1.2](#), [A2.2A](#) – [A2.2C](#), [Table A2.1](#), [Figure A2.1](#) and [Table A6.1](#)
- Addition of Test Requirements for Unsecured Glass Worksurfaces; [5.2](#), [11.10.6](#) and Section [56A](#)
- Revisions to Requirements for Furnishings Where the User May Contact Water; Section [15](#)
- Revisions to Clarify Required Properties for Glass Components; [11.10.3](#)
- Revisions to Replace References to UL Standards That Have Been Withdrawn; [1.7](#), [5.2](#) and [35.7.1](#)
- Revisions to Update Electrical Ratings; [85.2](#)
- Revisions to Update Definitions Of Booth and Room-In-Room; [1.1](#), [2.11](#), [2.62A](#) and [2.77](#)
- Addition Of A New Annex To Specify Requirements Specific To Chemical Disinfecting Equipment; [5.2](#) and Annex [G](#)
- Addition Of A New Annex To Specify Requirements Specific To UV Radiation Disinfecting Equipment; [5.2](#) and Annex [H](#)
- Revision to [61.2.1](#) to Adjust Stopping Distance

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 November 24, 2023 and March 15, 2024.

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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, chairs, audio/video motorized carts/stands and blood donor chairs as well as the motorized drives for these units;
- b) Electrified and non-electrified furniture;
- c) Non-seasonal electrical decorations such as lava lamps and wave machines;
- d) Home office furnishings, such as consoles, tables, and desks;
- e) Electrified building components, such as heated and electro-chromatic windows and illuminated mirror and bathroom cabinets;
- f) Illuminated mirrors, which may include heaters and/or monitors;
- g) Commercial tables, lab benches, and similar furnishings not provided with work surfaces, which includes secondary surfaces (shelves);
- h) Commercial work surfaces, which include secondary surfaces (shelves) intended to be used with the furnishings covered in (g);
- i) Massage tables and chairs;
- j) Laboratory benches with and without sinks;
- k) Enclosed rooms, also known as pods, booths, or rooms with ceilings (these are not considered furnishings); and
- l) Other similar miscellaneous furnishings intended for use in residential or commercial environments.

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 not motorized and an entertainment center, cart, or a stand and it is intended for support or attachment of audio/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 (it is not touching the floor), UL 2442 applies.
- 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 specified in UL 62368-1 applies;
- d) Information technology and communications equipment cabinets, enclosure and rack systems are investigated to UL 62368-1;
- e) For retail product displays and all other type of furnishings incorporating audio/video equipment to attract attention to the products for sale, this Standard 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 UL 60601-1.

1.5 Motorized equipment used for massaging and exercising is covered under UL 1647.

1.6 Office furnishing systems (panel systems) are covered by UL 1286 and individual commercial office furnishings are covered by UL 2999.

1.7 Illuminated display cases, showcases and cabinets, such as jewelry display cases, used in commercial applications are covered by UL 970.

1.8 Advertising displays may also be covered by 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 UL 2361.

1.10 These requirements do not cover portable luminaires. UL 153 covers portable luminaires.

1.11 A product that employs an electromagnetic interference filter shall also comply with UL 1283. A product that employs a transient voltage surge suppressor shall also comply with UL 1449. 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 UL 452 and UL 1492. A product that employs ground-fault protection shall comply with the requirements in UL 943.

1.12 Bunk bed structural requirements are covered by ASTM F1427. Any electrical components of bunk beds are required to comply with the applicable requirements of UL 962.

1.13 Toy chest structural requirements are covered by ASTM F963. Any electrical components of these products are required to comply with 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.

1.15 Furnishings incorporating low pressure inflators are covered by 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 retail case goods or merchandise displays. These displays are covered by UL 970.

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 13.1](#).

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 ADVERTISING DISPLAYS – Advertising displays are intended to draw attention, demonstrate, or advertise products, but do not hold the products.

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

2.6 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.

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

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

2.9 ATTENDED FURNISHING – A furnishing that only preforms its intended function when the user is present to operate the furnishing.

2.10 BELLOWS – A telescoping guard that hinders someone from contacting a part that could create a risk of fire, electric shock, or injury to persons.

2.11 BOOTH – An area less than 24-foot square (2.23 square m) provided with a ceiling and means of access and egress.

2.12 BUNK CAPSULE CABIN – Box-like sleeping compartments secured one on top commonly equipped with an alarm, fan, radio/tv, and similar equipment.

2.13 CABINET LIGHT – A portable luminaire, see [2.68](#), 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.

2.14 CART – A stand provided with casters, wheels, or rollers intended to make it easily mobile.

2.15 CATHODE RAY TUBE (CRT) – A vacuum tube containing an electron gun used to create images on the screen.

2.16 CEILING, ADJUSTABLE – Ceilings that have electrically adjustable louvers that allow the ceiling to be completely closed, partially closed, or completely opened.

2.17 CEILING, OPEN-GRID – A ceiling that has sufficient openings so that the ceiling does not interfere with the sprinkler system in the event of a fire. This includes ceilings that have electrically adjustable louvers that allow the ceiling to be completely closed or open.

2.18 CEILING, DROP-OUT – A suspended ceiling with ceiling tiles that distort under heat to the extent that it drops from the ceiling grid system in the event of a fire and the sprinkler system discharges.

2.19 CLASS 2 CIRCUIT – A circuit that complies with UL 5085-3 or with UL 1310.

2.20 COMMERCIAL – A place in which business is transacted, such as an office building, factory, warehouse, or similar location, and which is not a residence. It also includes institutions, health care facilities, old age convalescent board and care homes, college dormitories, schools, residence halls, jails, prisons, nursing care homes, and public auditoriums.

2.21 CONTROL – A device responsible for overseeing, regulating and altering the operation of an electronic system.

2.22 CONTROL, AUTOMATIC ACTION – A control in which at least one aspect is non-manual.

2.23 CONTROL, AUXILIARY – A control that provides a functional utility, is not relied upon as an operational or protective control, and therefore is not relied upon for safety. For example, an efficiency control not relied upon to reduce the risk of electric shock, fire, or injury to persons during normal or abnormal operation of the end product is considered an auxiliary control.

2.24 CRITICAL COMPONENTS – Any component that if changed may have an effect on the safety and/or performance of the furnishing or that is restricted by the construction requirements.

2.25 CONTROL, MANUAL – A device that requires direct human interaction to activate or reset the control.

2.26 CONTROL, OPERATING – A control, the operation of which starts or regulates the end product during normal operation. For example, a thermostat, the failure of which a thermal cutout/limiter or another layer of protection would reduce the risk of electric shock, fire, or injury to persons, is considered an operating control.

2.27 CONTROL, PROTECTIVE (LIMITING) – A control, the operation of which is intended to reduce the risk of electric shock, fire or injury to persons during normal and reasonably anticipated abnormal operation of the appliance. For example, a thermal cutout/limiter, or any other control/circuit relied upon for normal and abnormal conditions, is considered a protective control. (During the testing of the protective control/circuit, the protective functions are verified under normal and single-fault conditions of the control.) For example, a thermal cutout/limiter, a control used to sense abnormal temperatures of components within the appliance; an interlock function to de-energize a motor; temperature protection of the motor due to locked rotor, running overload, or loss of phase or any other control/circuit relied upon for normal and abnormal conditions, is considered a protective control. (During the testing of the protective control/circuit, the protective functions are verified under normal and single-fault conditions of the control.)

2.28 CONTROL, TYPE 1 ACTION – The actuation of an automatic control for which the manufacturing deviation and the drift (tolerance before and after certain conditions) of its operating value, operating time, or operating sequence has not been declared and tested under this standard.

2.29 CONTROL, TYPE 2 ACTION – The actuation of an automatic control for which the manufacturing deviation and the drift (tolerance before and after certain conditions) of its operating value, operating time, or operating sequence have been declared and tested under this standard.

2.30 CONTROL, REMOTE – A device used to operate a product that is not physically connected to the product.

2.30A CORD, INTERCONNECTING – A conductor or cable running between two furnishings.

2.31 DIRECT AND INDIRECT CONTACT WITH LIVE PARTS – A non-metallic part is considered in direct contact with a live part when it is touching the live part or within 1/32 inch (0.8 mm) of the live part. Indirect contact is when a non-metallic part is supporting a material that is in direct contact with the live part.

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

2.33 DRIVE – Motor and other components that provide the force to move parts of the furnishings.

2.34 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.

2.35 ENCLOSURE, MECHANICAL – A part of the equipment intended to reduce the risk of injury that could be caused by mechanical and other physical parts.

2.36 ENTRAPMENT ENVIRONMENTS:

Usage Area I – An area where children or people with cognitive disabilities are anticipated to be present and likely not constantly supervised. Examples include residences, hotel rooms, and retail stores.

Usage Area IA – An area where children under the age of 8 or people with cognitive disabilities are anticipated to be present and likely directly supervised by a care giver and older children will be indirectly supervised by adults in the area, such as theaters, restaurants, and classrooms. Situations where someone would be underneath the furnishing are unlikely.

Usage Area II – An area where children or people with cognitive disabilities are anticipated to be present, but the furnishings are locked out and only operated by a trained person. Examples include medical exam rooms, customer service areas, and retail sales areas, such as carpet dispensers.

Usage Area III – An area where it is anticipated adults with normal cognitive abilities are present, trained to use the furnishings present, and children or people with cognitive disabilities are rarely present or if present are closely supervised, such as in a commercial office.

2.37 ENTRAPMENT FORCE – The amount of force that has the potential for causing injury.

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

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

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

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

2.41 FURNITURE POWER DISTRIBUTION UNIT – An outlet assembly that complies with UL 962A.

2.42 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.

2.43 HAZARD OCCUPANCY – Relates to the following types of area where a sprinkler system is used:

- a) Light: The quantity of combustibles and the combustibility is low. It is expected that there will be low rates of heat release. Examples include: office areas and dwellings.

b) Ordinary, Group 1: The quantity of combustibles is moderate and the combustibility is low. It is expected that there will be moderate rates of heat release. Examples include: kitchens and storage rooms with a height equal to or less than 8.0 feet (2.44 m).

c) Ordinary, Group 2: The quantity of combustibles and the combustibility is moderate. It is expected that there will be moderate to high rates of heat release. Examples include: retail and storage rooms with a height equal to or less than 12.0 feet (3.66 m).

2.44 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.

2.45 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.

2.46 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.

2.47 LIMITED POWER SOURCE (LPS) – A limited power source is as defined in UL 62368-1 and shall comply with the requirements of UL 62368-1.

2.48 LIVE PART – Any part where current is flowing.

2.49 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.

2.50 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.

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

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

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

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

2.55 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.

2.56 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.

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

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

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

2.60 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. 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.

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

2.62 PINCH POINTS – Accessible locations on a furnishing where two parts of the furnishing may come together or a part of the furnishing and an external object coming together could cause personal injury. Also, see Entrapment Force, [2.37](#). Examples include:

- a) A powered adjustable table with a modesty panel and the floor, or a chair, or another object.
- b) A powered adjustable chair or sofa between the footrest, backrest, arms, and other chair parts or a chair or sofa and a wall.

2.62A POD – A booth or room-in-room.

2.63 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 its small size and weight or configuration. (A product that allows an average person to pick up without tools or equipment.) A mass exceeding 40 lbs (18 kg) is not generally considered to be portable.

2.64 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.

2.65 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.

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

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

2.68 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.

2.69 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.

2.70 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.

2.71 RECEPTACLE, DEDICATED – A female contact device intended to supply current to utilization equipment that is provided with the furnishing when built and is not accessible to the user.

2.72 RELOCATABLE POWER TAP (RPT) – An outlet assembly that complies with UL 1363.

2.73 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.

2.74 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.

2.75 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.

2.76 RFID – Radio-frequency identification.

2.77 ROOM-IN-ROOM – A room that may have electrical components field or factory installed and is hard wired or cord and plug connected to the building electrical system. It is provided with a ceiling and means of access and egress. The total area is equal to or greater than 24 square feet (2.23 m²).

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

2.79 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.

2.80 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.

2.81 SHOWCASE – A specific type of store fixture identified in ANSI/NFPA 70. A cabinet provided with a transparent enclosure for displaying or protecting merchandise.

2.82 SIGN – An electrically operated product that through illumination or mechanical means uses words, symbols, numbers, art, or other advertisement intended to convey information, attracts attention, provides information, or serves as decoration. A sign does not have shelving or storage to display merchandise.

2.83 STAND – A structure on or in which audio and/or video equipment and accessories are intended to be placed, contained, or mounted for support.

2.84 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.

2.84A STORAGE BED UNIT – A bed or mattress platform which opens/raises to access storage beneath the bed, which does not otherwise manipulate the mattress such as for adjustment of sleeping position. Note that such units are intended to be opened/closed only when the bed is unoccupied.

2.85 SUB-ASSEMBLY – An individual component or a group of components that when combined form the complete furnishing. Sub-Assemblies are shipped from different manufacturing locations and are assembled in the field to form a complete product.

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

2.87 TALL CART –

a) A cart where the television or apparatus supporting surface is more than 39.4 inches (1 m) above the floor and the cart is recommended by the manufacturer to be used in areas where children, or people with diminished capacity are likely to move or may be asked to move the cart; or

b) A cart where the television when mounted to the mounting surface of the cart places the center line of the television surface more than 39.4 inches (1 m) above the floor and the cart is recommended by the manufacturer to be used in areas where children, or people with diminished capacity are likely to move or may be asked to move the cart.

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

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

2.90 WIRED CABINET – See [2.81](#).

2.91 WIRING, INTERNAL – Wiring that is totally within an appropriate electrical and mechanical enclosure.

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

2.93 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.

3 Components

3.1 A component of a product covered by this Standard shall:

a) Comply with the requirements for that component as specified in this Standard;

- b) Be used in accordance with its rating(s) established for the intended conditions of use; and
- c) Be used within its established use limitations or conditions of acceptability.

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 the requirements in one or more of the following standards: UL 153, UL 1574, UL 1598, UL 2108 or UL 8750.

3.6 Furnishings which incorporate neon lamps shall comply with UL 2161 and shall also comply with the requirements of UL 962.

3.7 Video or audio equipment shall comply with UL 62368-1. Video or audio equipment intended for use in a damp or wet locations shall comply with the tropical humidity requirements in these Standards.

3.8 A fuse shall comply with UL 248-1 and the appropriate Part 2 for the specific fuse type.

3.9 A supplementary overcurrent protector shall comply with UL 1077.

3.10 Wireless charging pad shall comply with UL 2738.

3.11 All plumbing parts shall comply with the appropriate standards, such as ASME A112.18.1.

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 Referenced Publications

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.

5.2 The following publications are referenced in this Standard:

ANSI Z97.1, *Safety Glazing Materials Used In Buildings – Safety performance Specifications And Methods Of Test*

ASME A112.18.1, *Plumbing Supply Fittings*

ASME B1.20.3, *Dryseal Pipe Threads (Inch)*

ASME B16.1, *Gray Iron Pipe Flanges and Fittings Classes 25, 125 and 250*

ASME B16.5, *Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard*

ASME B16.9, *Factory-Made Wrought Buttwelding Fittings*

ASME B16.11, *Forged Fittings, Socket-Welding and Threaded*

ASME B16.18, *Cast Copper Alloy Solder Joint Pressure Fittings*

ASME B16.22, *Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings*

ASME B16.26, *Cast Copper Alloy Fittings for Flared Copper Tubes*

ASTM A653/A653M, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*

ASTM B209/B209M, *Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate*

ASTM B555, *Standard Guide for Measurement of Electrodeposited Metallic Coating Thicknesses by the Dropping Test*

ASTM C62, *Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)*

ASTM C90, *Specification for Loadbearing Concrete Masonry Units*

ASTM E28, *Standard Test Methods for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus*

ASTM E162, *Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source*

ASTM E230/E230M, *Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples*

ASTM F963, *Standard Consumer Safety Specification for Toy Chests*

ASTM F1427, *Standard Consumer Safety Specification for Bunk Beds*

BIFMA X5.5, *Desk and Table Products*

CFR 16 – Part 1219, *Safety Standard for Full-Size Baby Cribs*

CFR 16 – Part 1220, *Safety Standard for Non-Full-Size Baby Cribs*

CFR 16 – Part 1500, *Hazardous Substances and Articles Administration and Enforcement Regulations*

CFR 16 – Part 1632, *Flammability of Mattresses and Mattress Pads*

CFR 16 – Part 1633, *Standard for the Flammability (Open Flame) of Mattress Sets*

CFR 21 – Part 1000, *General*

CFR 21 – Part 1002, *Records and Reports*

CFR 21 – Part 1003, *Notification of Defects or Failure to Comply*

CFR 21 – Part 1004, *Repurchase, Repairs, or Replacement of Electronic Products*

CFR 21 – Part 1005, *Importation of Electronic Products*

IEC 60335-1, *Household and Similar Electrical Appliances – Safety – Part 1: General Requirements*

IEC 61000-4-5, *Electromagnetic Compatibility (EMC) – Part 4-5: Testing and Measurement Techniques – Surge Immunity Test*

IEC 62471, *Photobiological Safety of Lamps and Lamp Systems*

ISO 16030, *Pneumatic Fluid Power – Connections – Ports and Stud Ends*

ANSI/NFPA 70, *National Electrical Code (NEC)*

NFPA 289, *Standard Method of Fire Test for Individual Fuel Packages*

NFPA 701, *Standard Test Methods of Fire Tests for Flame Propagation of Textiles and Films*

SAE J512, *Automotive Tube Fittings*

SAE J513, *Refrigeration Tube Fittings – General Specifications*

SOHO S6.5, *Small Office/Home Office Furniture – Tests*

Technical Bulletin 117 (March 2013), *State of California Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation – Requirements, Test Procedure and Apparatus for Testing the Flame Retardance of Resilient Filling Materials Used in Upholstered Furniture*

Technical Bulletin 129, *State of California Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation – Flammability Test Procedure for a Mattress for use in Public Buildings*

UL 33, *Heat Responsive Links for Fire-Protection Service*

UL 48, *Electric Signs*

UL 94, *Test for Flammability of Plastic Materials for Parts in Devices and Appliances*

UL 111, *Outline of Investigation for Multioutlet Assembly*

UL 130, *Electric Heating Pads*

UL 153, *Portable Electric Luminaires*

UL 244A, *Solid-State Controls for Appliances*

UL 248-1, *Low Voltage Fuses – Part 1: General Requirements*

UL 248-14, *Low-Voltage Fuses – Part 14: Supplemental Fuses*

UL 353, *Limit Controls*

UL 452, *Antenna – Discharge Units*

UL 489, *Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures*

UL 498, *Attachment Plugs and Receptacles*

UL 498A, *Current Taps and Adapters*

UL 499, *Electric Heating Appliances*

UL 508, *Industrial Control Equipment*

UL 514B, *Conduit, Tubing, and Cable Fittings*

UL 514D, *Cover Plates for Flush-Mounted Wiring Devices*

UL 521, *Heat Detectors for Fire Protective Signaling Systems*

UL 635, *Insulating Bushings*

UL 723, *Test for Surface Burning Characteristics of Building Materials*

UL 723S, *Outline of Investigation for Drop-Out Ceilings Installed Beneath Automatic Sprinklers*

UL 746A, *Polymeric Materials – Short Term Property Evaluations*

UL 746B, *Polymeric Materials – Long Term Property Evaluations*

UL 746C, *Polymeric Materials – Use in Electrical Equipment Evaluations*

UL 796, *Printed Wiring Boards*

UL 810, *Capacitors*

UL 817, *Cord Sets and Power-Supply Cords*

UL 840, *Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment*

UL 864, *Control Units and Accessories for Fire Alarm Systems*

UL 867, *Electrostatic Air Cleaners*

UL 873, *Temperature-Indicating and -Regulating Equipment*

UL 943, *Ground-Fault Circuit Interrupters*

UL 962A, *Furniture Power Distribution Units*

UL 964, *Electrically Heated Bedding*

UL 969, *Marking and Labeling Systems*

UL 970, *Retail Fixtures and Merchandise Displays*

UL 991, *Tests for Safety-Related Controls Employing Solid-State Devices*

UL 1004-1, *Rotating Electrical Machines – General Requirements*

UL 1004-2, *Impedance Protected Motors*

UL 1004-3, *Thermally Protected Motors*

UL 1012, *Power Units Other Than Class 2*

UL 1030, *Sheathed Heating Elements*

UL 1077, *Supplementary Protectors for Use in Electrical Equipment*

UL 1097, *Double Insulation Systems for Use in Electrical Equipment*

UL 1278, *Movable and Wall- or Ceiling-Hung Electric Room Heaters*

UL 1283, *Electromagnetic Interference Filters*

UL 1286, *Office Furnishing Systems*

UL 1310, *Class 2 Power Units*

UL 1363, *Relocatable Power Taps*

UL 1434, *Thermistor Type Devices*

UL 1439, *Tests for Sharpness of Edges on Equipment*

UL 1449, *Surge Protective Devices*

UL 1450, *Motor-Operated Air Compressors, Vacuum Pumps, and Painting Equipment*

UL 1481, *Power Supplies for Fire-Protective Signaling Systems*

UL 1492, *Audio-Video Products and Accessories*

UL 1557, *Electrically Isolated Semiconductor Devices*

UL 1574, *Track Lighting Systems*

UL 1577, *Optical Isolators*

UL 1598, *Luminaires*

UL 1647, *Motor-Operated Massage and Exercise Machines*

UL 1678, *Household, Commercial, and Institutional-Use Carts, Stands and Entertainment Centers for Use with Audio and/or Video Equipment*

UL 1975, *Fire Tests for Foamed Plastics Used for Decorative Purposes*

UL 1977, *Component Connectors for Use in Data, Signal, Control and Power Applications*

UL 1989, *Standby Batteries*

UL 1998, *Software in Programmable Components*

UL 2054, *Household and Commercial Batteries*

UL 2097, *Reference Standard for Double Insulation Systems for Use in Electronic Equipment*

UL 2108, *Low Voltage Lighting Systems*

UL 2161, *Neon Transformers and Power Supplies*

UL 2361, *Outline of Investigations for Custom Built Kiosks*

UL 2442, *Wall- and Ceiling-Mounts and Accessories*

UL 2459, *Insulated Multi-Pole Splicing Wire Connectors*

UL 2738, *Induction Power Transmitters and Receivers for Use with Low Energy Products*

UL 2999, *Individual Commercial Office Furnishings*

UL 5500, *Remote Software Updates*

UL 5085-3, *Low Voltage Transformers – Part 3: Class 2 and 3 Transformers*

UL 8750, *Light Emitting Diode (LED) Equipment for Use in Lighting Products*

UL 8802, *Ultraviolet (UV) Germicidal Equipment and Systems*

UL 60320-1, *Appliance Couplers for Household and Similar General Purposes – Part 1: General Requirements*

UL 60335-1, *Household and Similar Electrical Appliances, Part 1: General Requirements*

UL 60601-1, *Medical Electrical Equipment, Part 1: General Requirements for Safety*

UL 60691, *Thermal-Links – Requirements and Application Guide*

UL 60730-1, *Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements*

UL 60730-2-6, *Automatic Electrical Controls – Part 2-6: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements*

UL 60730-2-7, *Automatic Electrical Controls for Household and Similar Use, Part 2-7: Particular Requirements for Timers and Time Switches*

UL 60730-2-9, *Automatic Electrical Controls – Part 2-9: Particular Requirements for Temperature Sensing Controls*

UL 60730-2-12, *Automatic Electrical Controls for Household and Similar Use; Part 2-12: Particular Requirements for Electrically Operated Door Locks*

UL 60730-2-15, *Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Air Flow, Water Flow and Water Level Sensing Controls*

UL 60947-4-1, *Low-Voltage Switchgear and Controlgear – Part 4-1: Contactors and Motor-Starters – Electromechanical Contactors and Motor-Starters*

UL 60947-5-2, *Low-voltage Switchgear and Controlgear – Part 5-2: Control Circuit Devices and Switching Elements – Proximity Switches*

UL 60950-1, *Information Technology Equipment – Safety – Part 1: General Requirements*

UL 61010-1, *Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements*

UL 61131-2, *Programmable Controllers – Part 2: Equipment Requirements and Tests*

UL 61800-5-1, *Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy*

UL 62368-1, *Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements*

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 that are made by connectors instead of splices are not required to be made before the furnishing leaves the factory, if the connections made by the connectors maintain polarity and grounding, when grounding is provided.

6.2 Furnishings shipped unassembled from the same manufacturing location 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 Furnishings shipped unassembled from different manufacturing locations to the field for assembly shall be constructed so that each sub-assembly is incorporated into the final assembly without requiring alteration by the installer. Subassemblies that must bear a definite relationship to each other for the intended operation of the product shall be arranged and constructed to permit them to be incorporated into

the complete assembly only in the correct relationship with each other, without requiring alteration or realignment. See Section [95](#), Instructions for Sub-Assemblies.

6.4 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°. 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°:

- 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 13.1](#), Articulate Probe; and*
 - 2) Secured and provided with strain relief that has been shown to be reliable and not easily defeated by the user.*

6.5 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, [69.2](#).

6.6 When wires pass through a joint between sections of a furnishing that are separable for packing purposes the joint or section shall comply with [10.6](#), Protection of cord and wiring, while unassembled.

6.7 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.

6.8 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.

6.9 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.

6.10 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 [94](#), 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 [94](#), 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 [6.4](#).

9 Ventilation for Utilization Equipment

9.1 Each enclosed area of a furnishing intended to accommodate electrical utilization equipment shall be provided with natural convection openings or a mechanical ventilation system for the equipment installed within the enclosed area. Installation and use instructions shall be used to determine the intended use of an enclosed area.

10 Power-Supply Connections

10.1 Permanently connected furnishing

10.1.1 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 ANSI/NFPA 70. A furnishing shall be provided with a splice compartment, junction box or length of raceway to make connections.

10.1.2 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 mm^2), and shall be sized based on the rated current of the furnishing.

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

10.1.4 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.

10.1.5 The compartment specified in [10.1.4](#) shall be located so that, when making conduit connections, internal wiring and electrical components are not exposed to mechanical abuse or strain.

10.1.6 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.

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

10.1.8 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 mm^2) or smaller conductor.

10.1.9 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 [63](#), Tightening Torque Test.

10.1.10 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.

10.1.11 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.

10.1.12 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.

10.1.13 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).

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

10.1.15 An opening for conduit shall have dimensions as indicated in [Table 10.1](#).

Table 10.1
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.

10.1.16 The minimum unobstructed diameter of the flat surface surrounding the back of an opening for unthreaded conduit shall be as indicated in [Table 10.1](#).

10.1.17 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 10.1](#).

10.1.18 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 10.1](#).

10.1.19 The minimum usable volume of a field wiring compartment shall be as specified in [Table 10.2](#).

Table 10.2
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)

Table 10.2 Continued on Next Page

Table 10.2 Continued

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)
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)

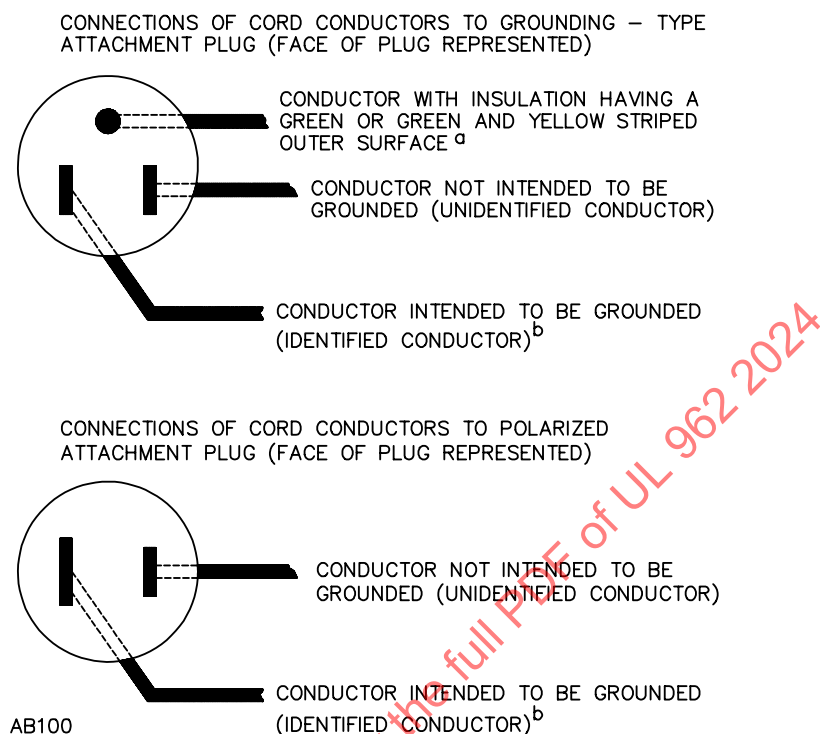
10.2 Cord-connected furnishing

10.2.1 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 [10.3](#).

10.2.2 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.

10.2.3 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 10.1](#) and the polarity identification of the flexible cord shall comply with [Table 10.3](#). See [Section 97](#), Operating Instructions.

Figure 10.1
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 10.3](#). The grounded (identified) conductor is the neutral supply conductor.

Table 10.3
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 [16.2.1](#) and [Figure 10.1](#).

^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.

Table 10.3 Continued on Next Page

Table 10.3 Continued

Method of identification	Usable combinations	
	Wire intended to be grounded ^{a,b}	All other wires ^a
^d For jacketed cords. ^e Only for Type SPT-2 cords. ^f Only for Types SPE-2 and SPT-2 cords.		

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

10.2.5 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 16 and to the grounding pin of a grounding attachment plug. See Figure 10.1.

10.2.6 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 10.4. 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 10.4
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

10.2.7 The flexible cord shall be of a type indicated in Table 10.5 or shall have properties such that it will be at least equally as serviceable for the particular application.

Table 10.5
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,

Table 10.5 Continued on Next Page

Table 10.5 Continued

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
		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 92.8 – 92.9).		

10.2.8 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.

10.2.9 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.

10.2.10 A power supply with a supply cord input and a secondary load side power output in excess of Class 2 shall comply with [10.2.6](#) – [10.2.8](#) or Annex A for a SELV power level output.

10.2.11 When a furnishing employs a direct plug-in power supply the length of the output conductors shall be in compliance with [Table 10.6](#) requirements.

10.2.12 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 10.6](#) requirements.

10.2.13 The length of a power supply cord shall be within the limits specified in [Table 10.6](#).

Table 10.6
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)

10.2.14 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 [92.12](#).

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

10.2.16 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.

10.2.17 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.

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

10.2.19 A power cord run through the interior structure of a furnishing, room-in-room, or booth shall be visible along its length or be able to be visually inspected by removing a cover without the use of tools. The product shall meet the requirements for wiring protection in [19.1.2](#) and [19.1.3](#).

10.3 Multiple power supply cords

10.3.1 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;

Exception: Furnishings intended for use in commercial or institutional occupancies may be equipped with more than two cords. Also, see [86.16](#).

- 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 [67](#), and
 - 2) The current rating of the attachment plug of a furnishing rated more than 15 amperes shall not be less than 125 % of the maximum current input of the furnishing when tested in accordance with the Input Test, Section [67](#), and not less than 125 % of the rated current of the furnishing.
- d) The total current input in accordance with Section [67](#), Input Test, (including current through all cords) is not more than 80 % 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 % 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 [96.6](#) (a) and (b);*
- b) The rating of any plugs is greater than 20 Amps; or*
- c) The product is marked in accordance with [86.15](#), and the instructions contain the information in [96.6](#) (a) and (c).*

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

- a) All 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 [10.3.1](#)(d), where detachable power supply cords are used, all 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) All 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 any cord is disconnected; or

d) A marking is provided and located adjacent to each switch in accordance with [86.17](#).

g) The furnishing is rated in accordance with [85.3](#);

h) The product contains the markings in [86.15](#); and

i) The furnishing is provided with instructions as indicated in [96.6](#).

10.4 Detachable power supply cords

10.4.1 A detachable power supply cord shall be provided with:

a) A ANSI/NEMA WD-6 configuration mating attachment cord connector body and inlet; or

b) A UL 60320-1 configuration mating appliance attachment cord connector body and inlet.

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

10.4.3 Adjacent to the inlet shall be marked the maximum voltage and current rating of the furnishing and a WARNING statement as specified in [86.25](#).

10.5 Strain relief

10.5.1 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.

10.5.2 Insulating bushings serving as strain relief shall comply with UL 635. Tests specified in this Standard (e.g. Strain Relief Test) may still be required to be performed to confirm the combination of the insulating bushing and the supporting parts are suitable in combination.

10.5.3 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.

10.5.4 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.

10.5.5 To determine compliance with [10.5.1](#), a strain relief means is to be subjected to the applicable tests specified in Section [69](#), Strain Relief Tests.

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

10.6 Protection of cord and wiring

10.6.1 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.

10.6.2 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.

10.6.3 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°; 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.*

10.6.4 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°.

10.6.5 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.

10.6.6 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.

10.6.7 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.

10.6.8 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.

10.6.9 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.

10.6.10 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.

10.6.11 A bushing shall be securely held in place.

10.6.12 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).

10.6.13 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; and/or
- c) Providing a removable protective cover.

11 Frame and Enclosure

11.1 General

11.1.1 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.

11.1.2 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.

11.1.3 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.

Exception No. 4: Components in a Class 2 or LPS circuit are not required to be in an enclosure, but if one is provided it shall comply with Section [A3](#).

11.1.4 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 UL 1439.

11.2 Personal injury, entrapment, pinch points, and shear considerations

11.2.1 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 based on the Usage Area of the furnishing. All moving parts shall be made inaccessible by guards or bellows, or, if accessible, not present any risk of injury based on the requirements for the Usage Area; see Section [31](#), [32](#), or [33](#).

11.2.2 When investigating a furnishing with respect to the requirement in [11.2.2](#), conditions of foreseeable misuse shall be evaluated.

11.2.3 Among the factors, which shall be considered simultaneously, 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. Moving parts shall have accessible edges rounded to a radius of 0.8 mm (0.03 inches) and accessible corners to 1.6 mm (0.06 inches)^b;
- c) The risk of unintentional contact by the user or someone in the area. A furnishing that when installed or placed in its intended location and its highest point of travel is 84 inches (2,130 mm) above the floor is not considered a risk of unintentional contact. Installation and operation instructions shall warn against placing a fixed structure at a point less than 85 inches (2,159 mm) above the movable component of the furnishing;

d) The speed of the moving part. Usage Area III: Moving parts that may cause entrapment are not considered a risk of entrapment provided the requirements for Commercial Operator Attended Products – Usage Area III, Section 32 are followed. If two parts are in motion, the combined speed of the parts shall be considered. The speed for rotating parts shall be measured at the fastest moving point. Space around accessible pinch points shall not be constrained such that a user is unable to retract a body part with sufficient speed from the space to avoid injury;

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;

f) The force involved when loaded with the rated load; and

g) A force of 2 lbs (9 Newtons) or greater is required for the person to become dislodged.

^b Copyright © International Labour Organization 1980

11.2.4 When considering entrapment or pinch points, consideration shall be given to the body part(s) that may become trapped. See [Table 11.1](#) for dimension requirements for spacing to prevent entrapment.

Table 11.1
Entrapment Space Requirements

Body part	Child Inches (cm)		Adult Inches (cm)	
	Less than	Equal to or more than	Less than	Equal to or more than
Arm	0.16 (0.41)	5.0 (12.7)	0.16 (0.41)	5.0 (12.7)
Body	None	20.0 (50.8)	None	20.0 (50.8)
Finger	0.16 (0.41)	1.0 (2.5)	0.32 (0.8)	1.0 (2.5)
Foot	1.0 (2.5)	4.72 (12.7)	1.4 (3.5)	5.0 (12.7)
Hand	0.16 (0.41)	4.0 (10.2)	0.16 (0.41)	4.0 (10.2)
Head	2.4 (6.1)	12.0 (30.5)	4.8 (12.0)	12.0 (30.5)
Leg	0.16 (0.41)	7.0 (17.8)	0.16 (0.41)	7.0 (17.8)
Toes	0.16 (0.41)	2.0 (5.1)	0.16 (0.41)	2.0 (5.1)

11.2.5 When considering entrapment or pinch points, consideration shall be given to the ability to reach the potential entrapment area. See [Table 11.2](#). Potential entrapment areas that are beyond the dimensions given are not considered a risk of injury to the user or person near the furnishing.

Table 11.2
Entrapment Reach Requirements

Body Part	Inches (cm)	Comment
Height	84 (213)	Measured from the floor
Arm	59 (150)	Measured from hip and presumes individual may move upper body
Leg	43 (110)	Measured from crotch

11.2.6 A mounting system used with a cart, stand or entertainment center that is intended to support a video display with a weight greater than 15 lbs (6.8 kg) shall be constructed to prevent the video display

from being inadvertently dislodged or removed from the mounting system. Gravity shall not be the sole means of securement for the video display.

11.2.7 Supporting surfaces on a tall cart which are located more than 39.4 inches (1 m) above the floor shall be provided with a mechanical means for securing equipment. Acceptable means for securement include screws, straps and similar securement means. The assembly of the equipment to the supporting surface shall comply with the Instructions, Section [92](#).

11.2.8 A tall cart shall be provided with casters having a minimum diameter of 4 inches (101.6 mm).

11.2.9 A furnishing provided with two or more mounting surfaces for video displays shall be provided with instructions specifying the order in which the video displays are to be installed; unless installation in any order does not cause the product to become unstable. The product shall be tested for stability in accordance with [43.2](#).

11.2.10 A furnishing provided with two or more mounting surfaces for video displays shall specify both the maximum and minimum weight of the equipment or maximum weight and allowable percent difference to be supported if equipment that is less than the maximum weight when mounted will cause the product to become unstable. The product shall be tested for stability in accordance with [43.2](#).

11.2.11 A furnishing provided with two or more mounting surfaces where removal of one or more pieces of video displays could cause the product to become unstable shall be permanently marked as specified in [86.41](#).

11.3 Mechanical enclosures and guards – Mechanical considerations

11.3.1 Bellows shall:

- a) Require the use of tools for their removal;
- b) Be removable for servicing;
- c) Have sufficient strength and rigidity to avoid the articulate probe with web stop ([Figure 13.1](#)) from being inserted to a depth that causes entrapment or damages the guard, when pressed with a force of 10 lbs (44.5 N); and
- d) Be complete so that there are no opens that would allow an appendage to enter, such as an arm for leg. See [Table 11.1](#).

11.3.2 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.

11.3.3 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.

11.3.4 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 user or someone in the area. Compliance shall be

determined by the probe illustrated in [Figure 13.1](#) unless the furnishing is provided with a safety system and complies with [11.3.5](#). A force greater than 40 pounds between a moving part and any object that can be entrapped by the moving part is considered a risk of injury. The furnishing shall be subjected to the Entrapment Test, Section [61](#), if there is a possibility that the force may be less than 40 lb. When using the probe to determine if a potential entrapment area can be reached, there are several items to be considered:

- a) If the entrapment area beyond the distances specified in [Table 11.2](#);
- b) That children may go into places that an adult would not, such as crawling on the floor; and
- c) The probe shall be adjusted in any position that it can be manipulated along with the probe users arm.

Exception: Instead of the 40 lbs (178 N) force, the maximum dynamic force shall not exceed 90.0 lbs (400 N) during the first 0.75 seconds. The static force shall not exceed 34.0 lbs (150 N) from 0.75 to 5.00 seconds and shall not exceed 5.6 lbs (25 N) force after 5.00 seconds. See [61.1](#), Entrapment Force Measurement Test.

11.3.5 Furnishings that present a risk of injury as specified in [11.3.4](#) shall be provided with either an active safety circuit or passive guard to prevent injury.

11.3.6 A mechanical safety system, such as a guard, shall comply with [11.3.8](#).

11.3.7 During the investigation of a furnishing to determine compliance with [11.3.4](#), 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 [86.12](#).

11.3.8 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.

11.3.9 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.

11.3.10 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.

11.3.11 A portable furnishing that does not incorporate a shade as specified in UL 153, for portable lamps shall comply with Section [77](#), 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.

11.3.12 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.

11.4 Metallic electrical enclosures

11.4.1 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.

11.4.2 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.

11.4.3 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.

11.4.4 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.

11.5 Electrical enclosures of polymeric material

11.5.1 A polymeric material enclosure of electrical parts shall comply with the requirements in UL 746C, as applicable to polymeric enclosures. For Damp Locations, the Resistance to Impact Test of UL 746C, preconditioning shall be at a temperature of 0 ± 2.0 °C (32 ± 3.6 °F). For wet locations, the UV Light Exposure and Cold Impact Test of UL 746C, preconditioning shall be at a temperature of minus 35.0 ± 2.0 °C (minus 31.0 ± 3.6 °F).

Exception No. 1: The Crush Resistance Test of UL 746C is not required on a portable component when it is mounted inside another mechanical enclosure that complies with [11.4](#), Metallic Electrical Enclosures or [11.5](#), Electrical Enclosures of Polymeric Material, or when it is located so that it is not likely to be subjected to a crush force, such as when secured to the underside of a work surface.

Exception No. 2: A portable component used inside or on a furnishing may have a flame classification of V-2 or better in accordance with UL 94, when all of the following conditions are met:

- a) The component is easily accessible without the use of tools;*
- b) The component is not secured to the furnishing where tools are required to remove it; and*
- c) The power supply cord and plug are readily accessible.*

Exception No. 3: A portable component used inside or attached to an attended furnishing may have a flame classification of V-2 or better in accordance with UL 94, when one of the following conditions are met:

a) *The component is enclosed within another mechanical enclosure, the component has an air gap switch or an electronic switch to turn off all power to the unit, and the unit is marked in accordance with [86.44](#). The electronic switch must not provide power when a fault analysis is performed (see [76.4](#), Abnormal – Controls and Safety Circuit Tests – Electronic Components,) and it shows that a single fault will not provide power to the product;*

b) *An enclosure material that complies with [11.4](#), Metallic Electrical Enclosures or [11.5](#), Electrical Enclosures of Polymeric Material, shall be placed between the portable component and any combustible part of the furnishing. A barrier is not required if a side of the component other than the top is not touching the furnishing and not within 6 inches (2.4 cm). The component shall have a flame classification of not less than V-1 in accordance with UL 94; or*

c) *When the portable component is a power supply intended for portable use on alternating-current branch circuits with a maximum potential of 150 V to ground and are:*

1) *Portable and semi-permanent-mounted direct-plug-in units provided with NEMA 15 Amp blade configurations for use on nominal 120 or 240 Volt branch circuits; or*

2) *Cord-and-plug-connected units provided with a 15 or 20 Amp NEMA attachment plug configuration.*

11.5.2 A polymeric electrical enclosure powered by or enclosing only low voltage powered components shall comply with the requirements in Annex A, Low Voltage Circuits in Furnishings.

11.6 Barriers

11.6.1 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.

11.6.2 The requirement in [11.6.1](#) 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 UL 1004-1 and UL 1004-2 or UL 1004-3 as appropriate for the over temperature protection incorporated with the motor construction.

b) Under wiring, unless rated VW-1.

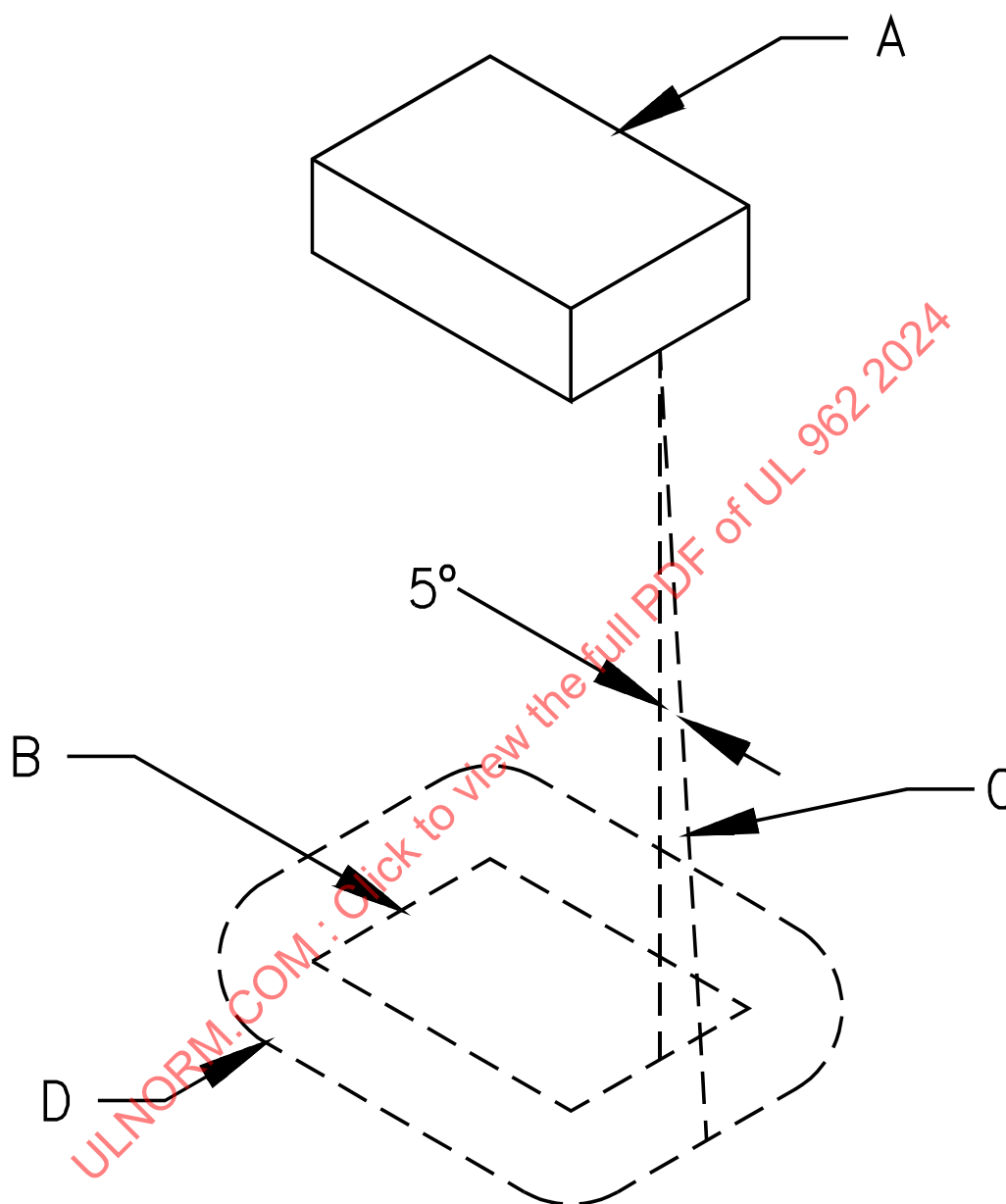
11.6.3 The barrier specified in [11.6.2](#) shall be of noncombustible material or shall comply with the Internal Barriers Section in UL 746C, and shall have a comparative tracking index (CTI) of:

- a) 4 for furnishings for household use; and
- b) 3 for furnishings for commercial applications.

11.6.4 The barrier specified in [11.6.2](#) shall be horizontal, shall be located as illustrated in [Figure 11.1](#), and shall not have an area less than that specified in [Figure 11.1](#). 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 11.1
Location and Extent of Barrier



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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° 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.

11.7 Doors or covers

11.7.1 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.

11.7.2 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.

11.8 Mounting means

11.8.1 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.

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

11.8.3 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, 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.

11.9 Polymeric supporting devices

11.9.1 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 UL 746B.

11.10 Glass components

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

11.10.2 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.

11.10.3 Glass components larger than specified in [11.10.2](#) but less than 9 feet² (0.84 m²) shall:

- a) Comply with the requirements of ANSI Z97.1, Class A; or
- b) Comply with minimum thickness requirements in [Table 11.3](#) and perform according to the requirements specified in the Impact test, [55.1](#), and the Glass Retention test, [55.2](#).

11.10.4 Glass components larger than or equal to 9 feet² (0.84 m²) shall comply with ANSI Z97.1, Class A requirements.

Exception: Mirror glass that does not comply with ANSI Z97.1, Class A requirements, complies with the intent of the requirements [11.10.4](#) if the glass is constructed using laminate, and the combination glass and laminate construction complies with the tests in Section [56](#), Tests On Mirrors Using Glass And Laminate Construction.

11.10.5 In accordance with [11.10.3](#) the minimum thickness of glass components shall be as specified in [Table 11.3](#).

Table 11.3
Glass Components

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

11.10.6 Unsecured glass used as a worksurface or on top of a worksurface (glass held in place only by friction) shall be subjected to the test of Section [56A](#), Tests for Unsecured Glass Worksurfaces.

12 Protection Against Corrosion

12.1 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.

12.2 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.

12.3 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.

12.4 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.

13 Accessibility of Uninsulated Live Parts and Film-Coated Wire

13.1 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 [13.5](#)) less than 1 inch (25.4 mm), such a part or wire shall not be contacted by the probe illustrated in [Figure 13.1](#).
- 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 13.1](#).

Exception No. 1: A motor is not required to comply with these requirements when it complies with the requirements in [13.2](#).

Exception No. 2: Does not apply to circuits in Class 2/LPS circuits.

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Figure 13.1
Articulate Probe with Web Stop

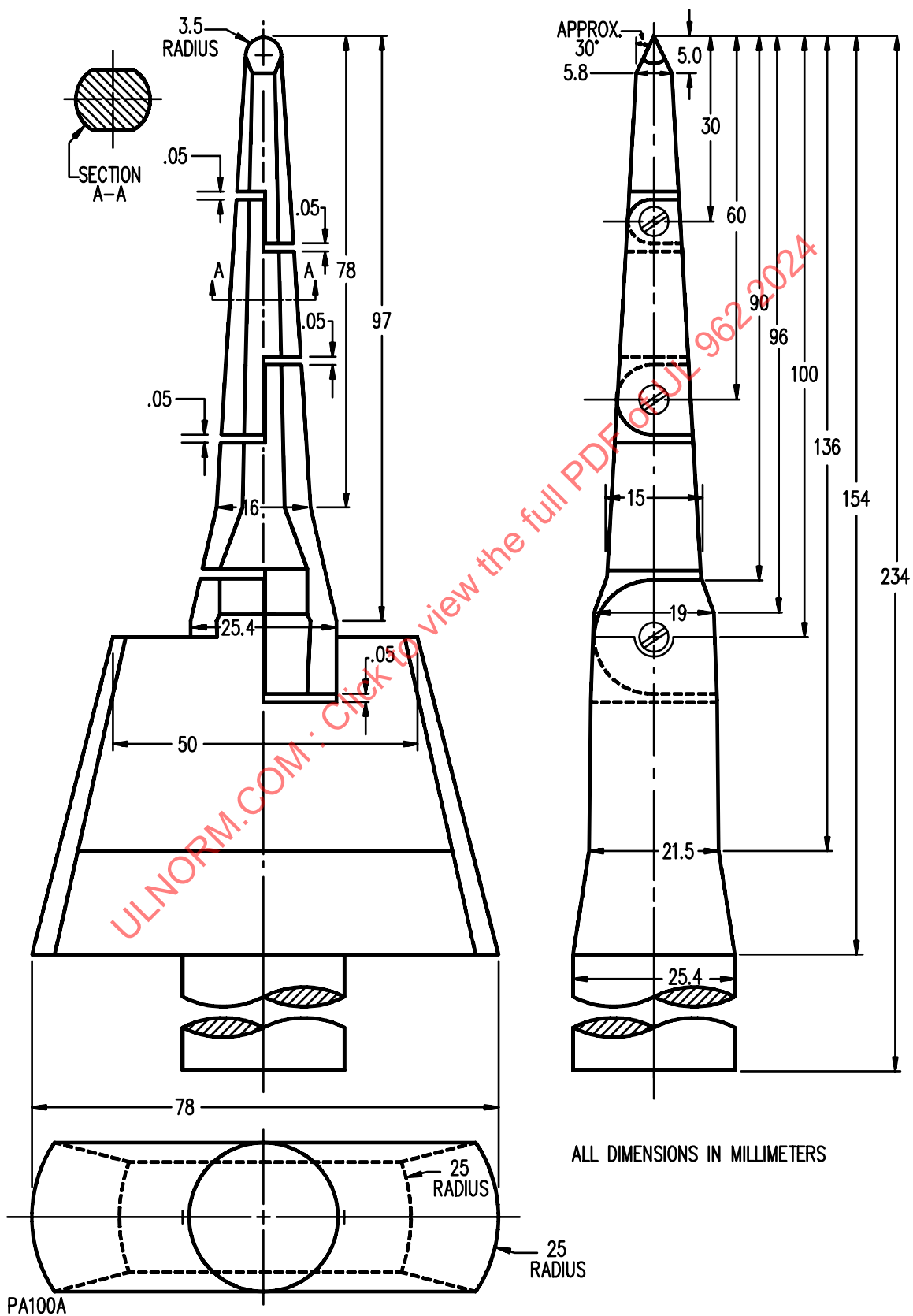


Table 13.1
Minimum Required Distance From an Opening to a Part Involving a Risk of Electric Shock

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 [13.5](#).
^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).

13.2 With respect to a part or wire as specified in [13.1](#), in an integral enclosure of a motor as specified in the Exception to [13.1](#):

a) An opening that has a minor dimension (see [13.5](#)) 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 13.3](#);
- 2) In a directly accessible motor (see [13.6](#)), an uninsulated live part is not able to be contacted by the probe illustrated in [Figure 13.1](#); and
- 3) In an indirectly accessible motor (see [13.6](#)), an uninsulated live part is not able to be contacted by the probe illustrated in [Figure 13.2](#).

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 13.1](#).

Figure 13.2
Straight Probe

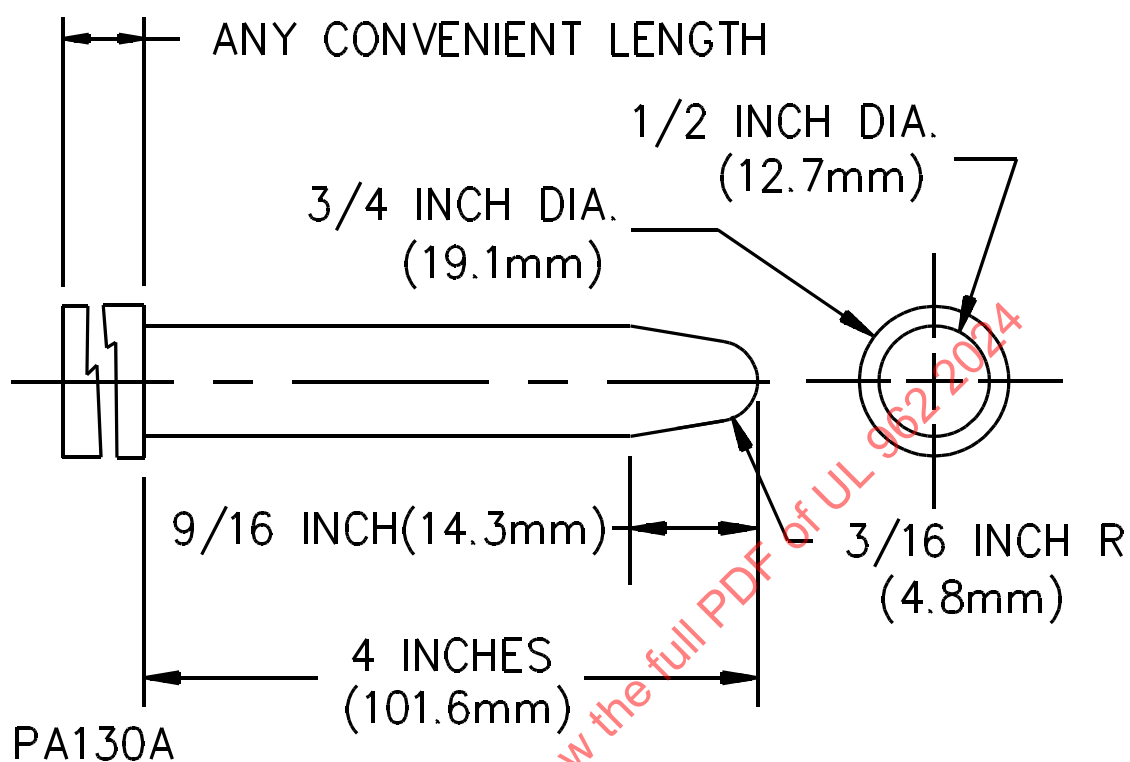
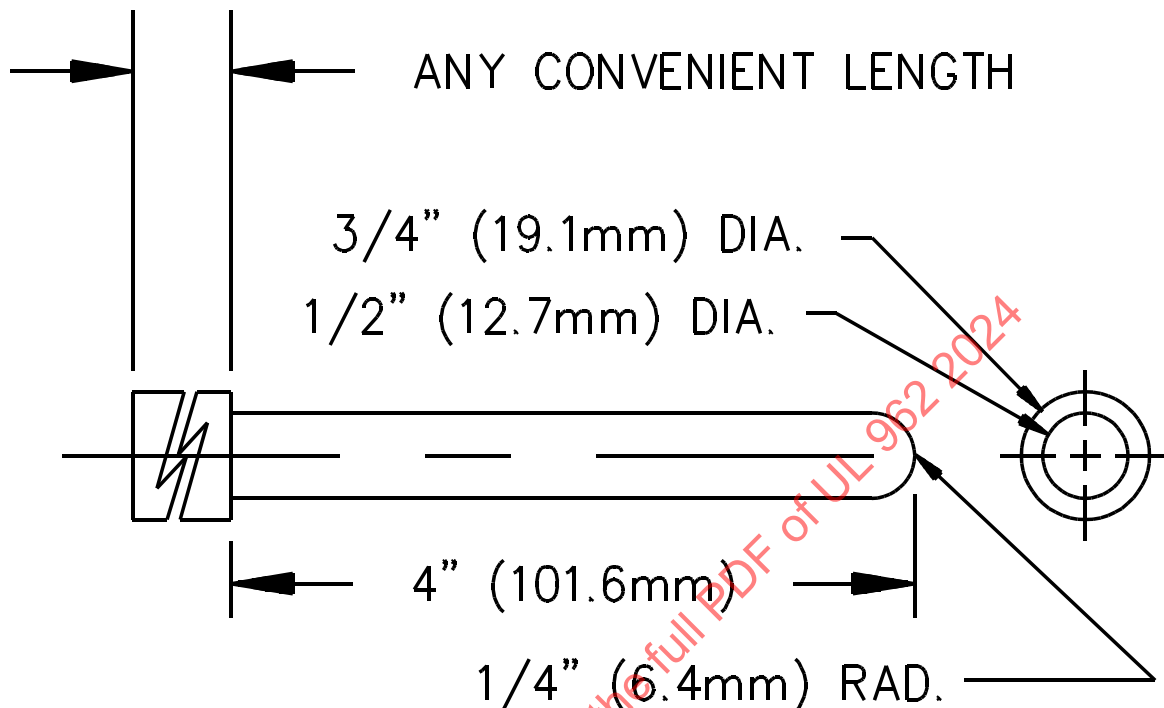


Figure 13.3
Straight Probe



PA140A

13.3 The probes specified in [13.1](#) and [13.2](#) and illustrated in [Figure 13.1](#) – [Figure 13.3](#) 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 13.1](#) shall be applied in any configuration allowed by the construction; and, when required, the configuration shall be changed after insertion through the opening.

13.4 The probes specified in [13.2](#) and [13.3](#) 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.

13.5 With reference to the requirements in [13.1](#) and [13.2](#), 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.

13.6 With reference to the requirements in [13.2](#), 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.

13.7 During the examination of a furnishing to determine compliance with [13.1](#) or [13.2](#), 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.

13.8 With reference to the requirements in [13.1](#) and [13.2](#), an insulated brush cap is not required to be additionally enclosed.

14 Resistance to Moisture and Liquid Damage

14.1 In addition to the requirements in [14.2](#) – [14.5](#), wet location furnishings shall be investigated in accordance with Part 2, Outdoor Furnishings.

14.2 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 [79](#).

14.3 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 [74](#), followed by the Leakage Current Test, Section [65](#).

14.4 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 [74](#), followed by the Insulation Resistance Test (Damp and Wet Locations Furnishings), Section [75](#).

14.5 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 [64](#), 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, [55.1](#).
- d) A polymeric vessel shall be subjected to the Conditioning of polymeric components test, [44.1](#), prior to the drop test.

15 Furnishings with Plumbing Fixtures Where the User May Contact Water

15.1 Furnishings with plumbing fixtures where the user may contact water shall be considered wet locations and investigated in accordance with Part 2, Outdoor Furnishings.

15.2 Cord-connected or remote controls provided with furnishings as described in [15.1](#) shall comply with the requirements for Class 2 circuits where wet contact is likely.

16 Grounding and Bonding

16.1 Grounding

16.1.1 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 13.1](#) 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 UL 1097 or 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 [86.11](#).

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 [86.21](#).

16.1.2 When a grounding means is provided, whether required or not, it shall be in accordance with [16.1.4](#). When the furnishing is cord connected, the grounding means shall also comply with the requirements in [16.1.7](#). 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.

16.1.3 The following are able to be used as a means for grounding:

- a) In a furnishing intended to be permanently connected, an equipment-grounding terminal or lead. See [16.1.8](#) and [16.1.9](#); or
- b) In a cord-connected furnishing, an equipment-grounding conductor in the power-supply cord.

16.1.4 The grounding conductor of a supply cord shall be secured to the frame or enclosure of the furnishing by means of a screw that is not removed during any servicing operation not involving the power-supply cord, or by other equivalent means. Servicing includes repair of the furnishing by a qualified service person. The grounding connection shall penetrate nonconductive coatings, such as paint or power coating.

16.1.5 The grounding conductor of a cord-connected furnishing shall be connected to the grounding member of an attachment plug. The grounding member shall be fixed.

16.1.6 A separable connection, such as that provided by an attachment plug and a mating connector or receptacle, shall be such that the equipment-grounding connection is made before or at the same time as the connection to and broken after or at the same time as the disconnection from the supply conductors.

Exception: Interlocked plugs, receptacles, and connectors that are not energized when the equipment-grounding connection is made or broken are able to be used without the grounding connection specified above.

16.1.7 When a furnishing is intended to be grounded and is provided with means for separate connection to more than one power supply, each separate connection shall be provided with a means for grounding. The means for grounding shall be bonded together.

16.1.8 A terminal intended solely for the connection of an equipment-grounding conductor shall be capable of securing a conductor of the size required for the application.

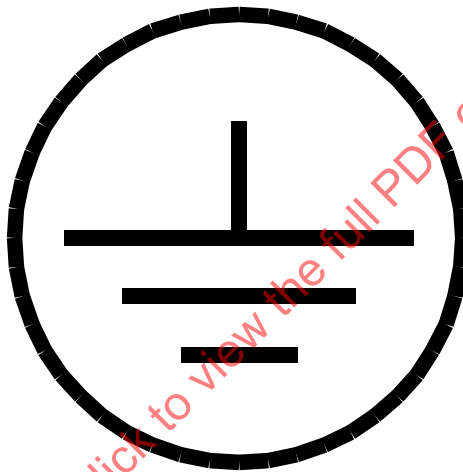
16.1.9 A connection device that depends on solder alone shall not be provided for connecting the equipment-grounding conductor.

16.2 Grounding identification

16.2.1 The surface of an insulated lead intended solely for the 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.

16.2.2 A wire-binding screw intended for the connection of an equipment-grounding conductor shall have a green-colored head that is hexagonal or slotted, or both. A pressure wire connector intended for connection of such a conductor shall be plainly identified, such as by being marked with the grounding symbol in [Figure 16.1](#), "G", "GR", "GRD", "Green", "Ground", or "Grounding", or by a marking on a wiring diagram provided on the furnishing.

Figure 16.1
Grounding Symbol



16.3 Bonding

16.3.1 Accessible non energized metal or other conductive parts that may become energized and are not connected directly to the grounding conductor shall be bonded to the ground connection point.

16.3.2 A ground path for electrical current shall be provided between all parts of a metal electrical enclosure containing electrical parts or wiring. See Section [70](#), Grounding-Impedance Test.

16.3.3 Flexible metal conduit longer than 6 feet (1.8 m) in total length shall not be relied upon for the ground path through an individual furnishing or between furnishings that are connected during installation.

16.3.4 The grounding means through an individual furnishing and between furnishings that are connected during installation shall have an ampacity at least equivalent to that of the supply conductors.

16.3.5 A furnishing that employs quick-connect means for electrically connecting the branch-circuit power supply from furnishing to furnishing shall be constructed so that the grounding connection is made prior to all other supply connections.

16.3.6 A non-energized metal part that is able to become energized shall be bonded to the ground return path by means of a conductor not smaller than the supply wires of the furnishing.

17 Polarity and Identification

17.1 A supply cord conductor that is intended to be grounded shall be marked in accordance with [Table 10.3](#) and shall be connected to the wide blade of a 2-wire attachment plug, or the left-hand blade of a 3-wire attachment plug when looking at the face of the plug with the grounding pin up. See [Figure 10.1](#).

17.2 The screwshell or screwshell contact of each Edison-Base lampholder shall be connected to the grounded supply conductor.

17.3 A switch, fuse or other protective device shall not be connected to the grounded supply conductor.

Exception: When the switch, fuse or other protective device simultaneously interrupts all non grounded conductors of the supply circuit, it is not prohibited from also being connected to the grounded supply conductor.

17.4 Any portion of a furnishing that is able to be detached, thereby breaking electrical connections – such as a detachable power supply cord, interlocking connectors, or cord a connector – shall be constructed such that it is only able to be assembled in the manner that maintains correct electrical polarity.

18 Separation of Circuits

18.1 Conductors of circuits operating at different voltage potentials shall be reliably separated from each other unless they are each provided with insulation acceptable for the highest voltage potential involved.

18.2 An insulated conductor shall be reliably retained so that it cannot contact an uninsulated energized part of a circuit operating at a different potential.

18.3 In a compartment that is intended for the field installation of conductors, and that contains provision for connection of Class 2, Class 3, Class 1, power, or lighting circuit conductors, a barrier shall be provided to separate the conductors operating at different circuit voltage potentials, or the arrangement of the compartment shall be such that a minimum spacing of 1/4 inch (6.4 mm) can be maintained between the conductors of the different circuits including the conductors to be field installed.

19 Internal Wiring

19.1 Conductors

19.1.1 The wiring and connection between parts within a furnishing shall be enclosed. See Section [13](#), Accessibility of Uninsulated Live Parts and Film-Coated Wire.

19.1.2 A passage in a sheet metal wall through which insulated wires are routed, shall be provided with provision to avoid contact with sharp edges or burrs, screw threads, sharp fins, moving parts, drawers, or similar components that are able to abrade or otherwise damage the wire insulation in accordance with [10.6](#), Protection of cord and wiring.

19.1.3 A metal clamp used for routing or securing internal wiring shall be provided with smooth, rounded edges. Auxiliary non-conducting mechanical protection shall be provided under a clamp at which pressure is exerted on an insulated conductor.

19.1.4 Internal wiring shall consist of wires of a type or types that are determined to meet the requirements for the intended use with respect to flexibility, mechanical abuse, temperature, ampacity, and

voltage. Conductors of any cross-sectional-area are permitted when the conductors are in Class 2 or LPS circuits.

19.1.5 Conductors that provide electrical connection between furnishings or sectionalized furnishings that are subject to flexing shall be stranded.

Exception: Solid conductors are able to be employed between furnishings when they form fixed angles and the raceway allows for inspection and replacement of the wiring when configurations are changed.

19.1.6 Conductors operating at different voltage potentials shall be separated from each other by one or more of the following:

- a) Enclosing the different voltage conductors in a separate wiring channel;
- b) Providing a partition of grounded metal or material that complies with the requirements for internal barriers in UL 746C, between the conductors of the different voltages;
- c) Providing reliable physical separation of at least 1/4 inch (6.4 mm) between conductors of the different voltages; or
- d) Insulation provided on all conductors rated for the highest voltage potential of any conductor.

19.1.7 A splice or connection shall be mechanically secured and provide electrical continuity. A soldered connection shall be mechanically secured before being soldered. A splice shall not be made in an area other than a specified wiring compartment. For example, a splice shall not be located inside conduit.

19.1.8 A splice shall be provided with insulation equivalent to that of the conductors involved.

19.1.9 In determining when splice insulation consisting of fabric, thermoplastic, or other type of tubing is able to be used, factors to be evaluated include its dielectric properties, use temperature, and similar conditions. Thermoplastic tape wrapped over a sharp edge shall not be used.

19.1.10 Stranded internal wiring that is connected to a wire-binding screw shall be provided with a means to restrict loose strands of wire from contacting other uninsulated energized parts not always of the same polarity or non energized metal parts. This is able to be accomplished by use of a pressure-type spade terminal connector with turned-in or turned-up ends, by a closed loop connector, or other equivalent means.

19.1.11 Internal conductors and connectors provided for wiring between components shall be subjected to the Strain Relief Test, Section [69.2](#).

Exception: This test is not required if the conductors and connectors are provided with a suitable electrical enclosure such that they are not subject to mechanical strain.

19.1.12 Class 2 or LPS wiring not contained within a metal or polymeric enclosure that is intended to be routed within a furnishing shall be of a type suitable for the application (e.g. CL2, CL2P, CL3, CL3P, CL3R, CM, CMP, CMR, or PLTC) or other jacketed type cord with a minimum 0.013 inch (0.33 mm) jacket thickness).

19.2 Cord used for internal wiring for furnishings

19.2.1 Cord may be used for internal wiring if a strain relief is provided where the cord enters or exits the interior of the furnishing.

19.2.2 Cord may be routed within a furnishing provided that it has one or more removable covers that allow visual inspection of the cord. Each such removable cover shall be removable without the use of tools.

19.2.3 When cord is provided for internal wiring it shall comply with the requirements of Conductors, [19.1](#), for the protection of conductors.

19.2.4 When cords are used for internal wiring, the compartment in which they are located is not required to comply with the requirements of mechanical or electrical enclosure.

19.3 Conductors subject to flexing

19.3.1 Individual conductors or conductors assembled into groups that are subject to flexing in the normal use of the furnishing shall be stranded.

19.3.2 Conductors subject to flexing in the normal use of the furnishing shall comply with the Conductor cycling endurance test, [69.3](#).

Exception No. 1: Conductors utilized in a decorative portable luminaire or a personal make-up mirror shall comply with the performance and construction requirements specified in UL 153. This exception applies only to constructions in which the wire or cord is capable of being bent, as in an enclosed swivel joint, or where a sharp bend occurs in a wire or cord between two points of restraint that are 6 inches (152 mm) or less apart.

Exception No. 2: Conductors utilized in a Class 2 or LPS circuit are not required to be subjected to the conductor cycling endurance test unless the circuit is relied upon for the safe operation of the furnishing.

19.3.3 Cords subject to flexing are not required to be subjected to the Conductor cycling endurance test, [69.3](#), provided the following conditions are met:

- a) The cord is not flexed to a radius less than 10 times the maximum diameter or cross section of the cord;
- b) The cord is provided with a strain relief at each end of the cord where it enters an enclosure; and
- c) The cord is not subject to a twisting motion along its longitudinal axis.

20 Spacings

20.1 Other than at wiring terminals, the spacing between uninsulated energized parts of opposite polarity and between an uninsulated energized part and a non energized metal part that is exposed to contact by persons or that is able to be grounded shall not be less than the value specified in [Table 20.1](#).

Exception No. 1: The inherent spacings of a component, such as a snap switch, are investigated on the basis of the requirements for the component.

Exception No. 2: This requirement does not apply when a spacing complies with the requirements in [20.4](#).

Table 20.1
Spacings at Other Than Field-Wiring Terminals

Potential involved Volts	Over surface		Through air	
	inch	(mm)	inch	(mm)
0 – 125	1/4	(6.4) ^a	1/8	(3.2) ^a
126 – 250	1/4	(6.4) ^a	1/4	(6.4) ^a
251 – 600	1/2	(12.7)	3/8	(9.5) ^a

^a Film-coated wire is identified as an uninsulated energized part. However, a spacing of not less than 3/32 inch (2.4 mm) over surface and through air between film-coated wire, rigidly supported and held in place on a coil, and a non energized metal part is able to be used.

20.2 When an uninsulated energized part is not rigidly fixed in position by means other than friction between surfaces, or when a movable non energized metal part is in proximity to an uninsulated energized part, the construction shall be such that the required minimum spacing is maintained with the part in any position.

20.3 When an isolated non energized metal part is interposed between or is in close proximity to energized parts of opposite polarity, to an energized part and an exposed non energized metal part, or to an energized part and a non energized metal part that is able to be grounded, the spacing shall not be less than 3/64 inch (1.2 mm) between the isolated non energized metal part and any one of the other parts previously specified, when the total spacing between the isolated non energized metal part and the two other parts complies with the value specified in [Table 20.1](#).

20.4 An insulating lining or barrier of vulcanized fiber employed to maintain required spacings shall not be less than 1/32 inch (0.8 mm) thick, and shall be so located that it is not adversely affected by arcing.

Exception No. 1: Vulcanized fiber not less than 1/64 inch (0.4 mm) thick is able to be used in conjunction with an air spacing of not less than 50 % of the spacing required for air alone.

Exception No. 2: Thinner vulcanized fiber or other insulating material is able to be used, when it complies with the Internal Barriers section of UL 746C.

20.5 All uninsulated energized parts connected to different voltage potential circuits shall be spaced from one another as though they were parts of opposite polarity, in accordance with the requirements in [20.1](#) and [20.8](#) and shall be investigated on the basis of the highest voltage involved.

20.6 The spacing between uninsulated energized parts of opposite polarity and between such parts and non energized metal that is able to be grounded in service is not specified for parts of low-voltage circuits.

20.7 The spacing between wiring terminals of opposite polarity, and between a wiring terminal and any other uninsulated metal part not of the same polarity, shall not be less than that specified in [Table 20.2](#).

Table 20.2
Spacings at Wiring Terminals

Potential involved, volts	Minimum spacings, inch (mm)			
	Between wiring terminals, through air, or over surface	Between terminals and other uninsulated metal parts not always of the same polarity ^a		
		Over surface	Through air	
250 or less	1/4 (6.4)	1/4 (6.4)	1/4 (6.4)	
More than 250	1/2 (12.7) ^b	1/2 (12.7) ^b	3/8 (9.5)	

^a Applies to the sum of the spacings involved where an isolated dead part is interposed.

^b A spacing of not less than 3/8 inch (9.5 mm), through air and over surface, is able to be used at wiring terminals in a wiring compartment or terminal box when the compartment or box is integral with a motor.

20.8 At terminal screws and studs to which connections are made in the field by means of wire connectors, eyelets, or similar devices, spacings shall not be less than those specified in [Table 20.1](#) when these devices are positioned at the minimum spacing.

20.9 As an alternative to the spacing requirements of [Table 20.1](#), the spacing requirements in UL 840, are able to be used. The spacing requirements of UL 840 shall not be used for field wiring terminals and spacings to a non energized metal enclosure.

20.10 It is anticipated that the level of pollution for indoor use equipment is pollution degree 2. Hermetically sealed or encapsulated enclosures, or coated printed wiring boards in compliance with UL 840, are identified as pollution degree 1.

20.11 It is anticipated the equipment is rated overvoltage category II as defined in UL 840.

20.12 In order to apply Clearance B (controlled overvoltage) clearances, control of overvoltage shall be achieved by providing an overvoltage device or system as an integral part of the product.

20.13 All printed wiring boards are identified as having a minimum comparative tracking index (CTI) of 100 without further investigation, for evaluation to UL 840.

21 Ballasts

21.1 A fluorescent luminaire shall use a Class P ballast.

21.2 A fluorescent luminaire utilizing more than one ballast shall have the ballasts spaced more than or equal to 1 inch (25 mm) end to end or 4 inches (100 mm) side to side.

Exception: Ballasts may be placed closer together providing the assembly including the ballasts are temperature tested and determined to be suitable for the temperatures attained.

21.3 A Type 1 outdoor ballast is suitable for use in outdoor equipment, luminaires intended for wet or damp locations if the ballasts are within an overall electrical enclosure. These ballasts are also suitable for indoor use.

21.4 A Type 2 outdoor ballast is suitable for use in outdoor equipment, luminaires intended for wet or damp locations, if the ballasts, in addition to their own enclosure, are within an overall enclosure. These ballasts are also suitable for indoor use.

21.5 A weatherproof ballast is suitable for use where completely exposed to the weather without an additional enclosure. These ballasts are suitable for indoor and outdoor use.

22 Capacitors

22.1 A capacitor provided as a part of a capacitor motor and a capacitor connected across-the-line, such as a capacitor for radio-interference elimination or power-factor correction, shall be housed within an enclosure or container that protects the plates against mechanical damage and that reduces the risk of the emission of flame or molten material resulting from malfunction or breakdown of the capacitor. The container shall be of metal providing strength and protection not less than that of uncoated steel having a thickness of 0.020 inch (0.51 mm).

Exception: The individual container of a capacitor is able to be of sheet metal less than 0.020 inch (0.51 mm) thick or is able to be of material other than metal when the capacitor is mounted in an enclosure that houses other parts of the furnishing. The enclosure must be rated for use in enclosing live parts.

22.2 When the malfunction or breakdown of a capacitor results in a risk of fire, electric shock, or injury to persons, thermal or overcurrent protection shall be provided in the furnishing to reduce the risk of such a condition.

22.3 A capacitor connected from one side of the line to the frame or enclosure of a furnishing shall have a capacitance rating of not more than 0.10 microfarad.

22.4 A furnishing that is intended to be controlled by or operated in conjunction with a capacitor or a combination capacitor-and-transformer unit shall be supplied with such capacitor or unit.

22.5 Under both normal and abnormal conditions of use, a capacitor employing a dielectric medium more combustible than askarel shall not result in a risk of electric shock or fire and shall be protected against expulsion of the dielectric medium. A capacitor complying with the requirements for protected oil-filled capacitors in UL 810, complies with the intent of this requirement.

23 Lampholders

23.1 General

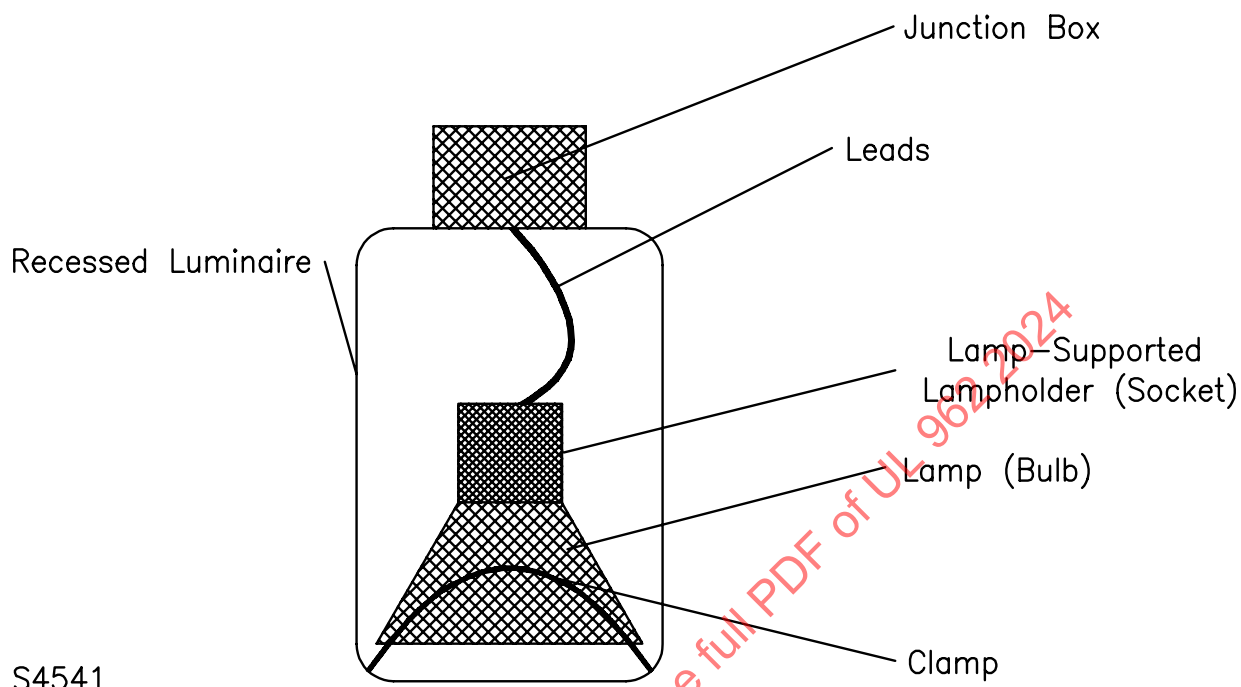
23.1.1 Lampholders shall have all wiring terminations and connections enclosed within the insulating body of the lampholder.

Exception No. 1: A lampholder whose wiring terminations are not accessible as determined by application of the Section [13](#), Accessibility of Uninsulated Live Parts and Film-Coated Wire.

Exception No. 2: A lampholder located in a low voltage circuit shall comply with the applicable lighting standard for the technology employed.

23.1.2 A lamp-supported lampholder, see [Figure 23.1](#), shall be provided with stranded wiring.

Figure 23.1
Example of a Lamp Supported Lampholder



23.1.3 The screwshell or screwshell contact of an Edison-based lampholder shall be connected to the terminal or lead that is intended to be connected to the grounded conductor (Neutral) of the power-supply circuit or the grounded conductor of the supply cord.

23.2 Fluorescent

23.2.1 A fluorescent lampholder shall have a voltage rating not less than any marked output-voltage rating on the ballast with which it is used or 250 volts, whichever is higher.

Exception: When the ballast is also marked with a secondary voltage to ground that is less than the marked output voltage, the rating of the lampholder may be equal to the marked secondary voltage to ground rating.

24 Motors

24.1 Overload protection

24.1.1 A motor shall comply with UL 1004-1; and shall be provided with overload protection by one of the following methods:

- a) As specified in UL 1004-2;
- b) As specified in UL 1004-3;
- c) The use of a fuse;

d) A combination motor(s) and motor(s) safety controller (see Protective Controls, [35.4](#) for safety controls) shall comply with the requirements in UL 60335-1; UL 60730-1; or

Exception: For motors in a Class 2, LPS, or SELV circuit, when the alternate method in [A10.3](#) and [A10.4](#) is performed, the locked-rotor protection is not required to be in combination with the motor controller.

e) The use of a circuit that disconnects power or reduces power from the motor in a sufficiently short time to prevent a risk of fire as determined by Protective Controls, [35.4](#).

The methods specified in (c), (d), and (e) shall comply with the requirements in Abnormal Locked-Rotor Test, Section [A10](#). Refer to Annex [A](#), Low Voltage Circuits In Furnishings, for low voltage motor requirements.

24.1.2 When a requirement in this standard refers to the horsepower rating of a motor and the motor is not rated in horsepower, use is to be made of the appropriate table of ANSI/NFPA 70, that gives the relationships between horsepower and full-load currents for motors. For a universal motor, the table applying to a single-phase, alternating-current motor is to be used when the furnishing is marked for use on alternating current only; otherwise the table applying to direct-current motors is to be used.

24.1.3 The functioning of a motor-protective device provided as part of a furnishing, whether such a device is required or not, shall not result in an increase in the risk of fire, electric shock, or injury to persons.

24.1.4 Overload devices, including types used for running overload protection, other than those that are inherent in a motor, shall be located in each ungrounded current carrying conductor of a single-phase supply system and in each current carrying ungrounded conductor of a 3-phase supply system.

24.1.5 With reference to [24.1.1](#), an overload-protective device that complies with ANSI/NFPA 70, is identified as an overload device that is responsive to motor current and is rated or set as specified in column A of [Table 24.1](#). When the rating of the motor-running overload protection determined to comply with the foregoing does not correspond to a standard size or rating of a fuse, nonadjustable circuit breaker, thermal cutout, thermal relay, or heating element of a thermal-trip motor switch, the next higher size, rating, or setting is able to be used, and is not able to be more than that specified in column B of [Table 24.1](#). For a multispeed motor, each winding connection is to be evaluated separately.

Table 24.1
Maximum Rating or Setting of Overload-Protective Device

Type of motor	Ampere rating of device as a percentage of motor full-load current rating	
	A	B
Motor with marked service factor of 1.15 or more	125	140
Motor with marked temperature rise of 40 °C (72 °F) or less	125	140
Any other motor	115	130

24.1.6 Motor-overload protection in which contacts control a relay coil in a motor starter shall comply with the requirements in [24.1.1](#).

25 Printed Wiring Boards

25.1 A printed wiring board shall comply with the requirements in UL 796, and shall be classed V-0, V-1, or V-2 in accordance with the requirements in UL 94.

Exception No. 1: A printed wiring board containing only circuitry not exceeding Class 2 limits shall be rated minimum HB in accordance with the requirements in UL 94.

Exception No. 2: A printed wiring board comprised of non-combustible materials is not required to comply with UL 94 flammability requirements.

25.2 A furnishing that has a receptacle grounding path through traces on a printed wiring board shall comply with the PWB Ground Path Test, Section [72](#), and the PWB Conductor Overcurrent Test, Section [73](#).

25.3 A trace on a PWB providing a current path to an external load operating in excess of Class 2 power levels shall comply with the PWB Conductor Overcurrent Test, Section [73](#).

26 Receptacles

26.1 A 15- or 20-ampere, nominal 120 volt receptacle in a furnishing shall be of the grounding type. The grounding contact of the receptacle shall be bonded in accordance with [16.3](#), Bonding.

Exception: A portable, indoor, household/residential use furnishing may be provided with a 15 ampere ungrounded (ANSI/NEMA 1-15R configuration) receptacle when a 2-conductor non-grounded power supply cord and a polarized attachment plug (ANSI/NEMA 1-15P) is provided. The furnishing shall be marked "For Household/Residential Use Only" and shall comply with the following:

- a) A convenience receptacle shall be wired such that it provides the same polarized supply as the attachment plug of the unit;*
- b) The area surrounding a convenience receptacle shall be free of any projection that prevents full insertion of the blades of an attachment plug having a face diameter of 1-15/16 inches (49.2 mm) and rectangular attachment plug having a face of 1-1/2 by 1-5/8 inch (38.1 by 41.3 mm);*
- c) An ANSI/NEMA 5-15P plug configuration shall not be able to be inserted into the ANSI/NEMA 1-15R receptacle;*
- d) The identified grounded supply conductor shall be connected to the wide terminal of ungrounded polarized receptacle.*

26.2 A non-locking type 125-volt, 15 and 20 ampere receptacle (ANSI/NEMA 5-15R or 5-20R) used in areas identified in Article 406.12 of NFPA 70 shall be a Tamper-Resistant type.

Exception No. 1: This requirement does not apply when receptacles are located more than 5-1/2 feet (1.7m) above the floor.

Exception No. 2: This requirement does not apply when receptacles are part of a luminaire or appliance.

Exception No. 3: This requirement does not apply when the receptacle is located behind a keyed and locked cover secured to the furnishing.

26.3 A receptacle shall:

- a) Be flush with or project beyond a nonconductive surrounding surface; or
- b) Project at least 0.015 inch (0.38 mm) beyond a conductive surrounding surface.

26.4 Receptacles shall comply with the Spill Test, Section [78](#).

Exception No. 1: This requirement does not apply to a receptacle that is oriented in a position so its face is in a vertical plane $\pm 5^\circ$.

Exception No. 2: This requirement does not apply to a receptacle that is covered or otherwise protected from spillage when not in use.

Exception No. 3: This requirement does not apply to a receptacle that is located at least 3 inches (76 mm) above the work surface, measured from the lower edge of the receptacle, when the work surface is adjusted to its highest position.

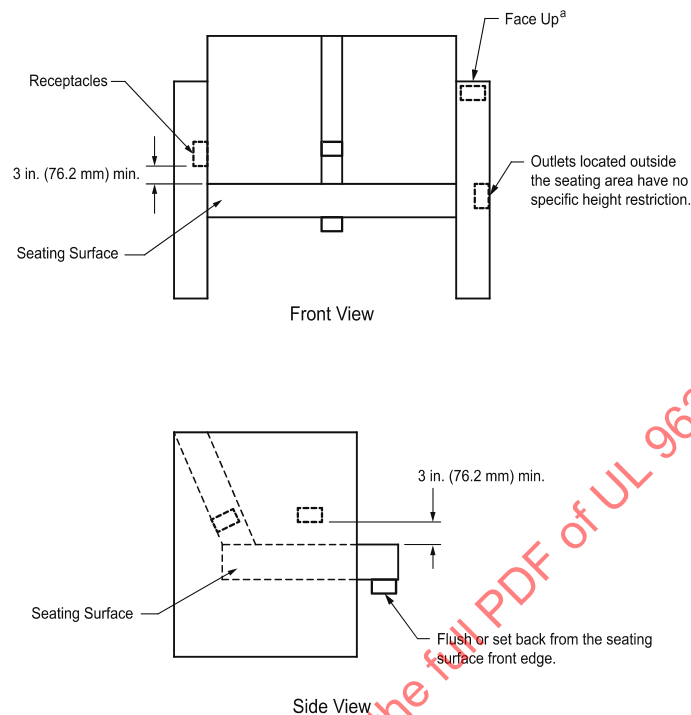
Exception No. 4: This requirement does not apply to a receptacle that is located adjacent to a seating surface and the receptacle is oriented in a position so its face is in a vertical plane $\pm 5^\circ$ and located at least 3 inches (76 mm) above the uncompressed seating surface.

26.5 A furnishing intended to be permanently wired and provided with a receptacle installed within 6 feet (1.8 m) of a sink shall either be protected by an installed Class A type GFCI receptacle protecting all receptacles mounted within 6 feet (1.8 m) of the sink or shall specify in the installation instructions to connect the receptacle circuit to a branch circuit protected with a Class A GFCI device. See [92.15](#).

26.6 A receptacle provided in a furnishing with a seating surface shall comply with one or more of the following. See [Figure 26.1](#):

- a) Be located at least 3 inches (76 mm) above the uncompressed seating surface;
- b) The receptacle shall be located underneath the bottom edge of the seating surface flush with or recessed from the edge; or
- c) A receptacle mounted face up in an upholstered furnishing shall comply with [26.4](#).

Figure 26.1
Receptacle Locations for Seating Surfaces



su1731a

^a See [26.4](#).

26.7 A receptacle shall not be provided within any storage area of a furnishing that is intended to store or hold liquids or containers holding liquids.

26.8 For a cord and plug connected furnishing provided with one or more convenient receptacles overcurrent protection shall be provided in accordance with [Table 26.1](#). For a furnishing that has a convenience receptacle and an additional load such as lighting or a fan, OCP must be provided, such that the total rating of the furnishing is not exceeded. (For example, a furnishing rated 12 amps and provided with a light that draws 2 amps shall either have the overall furnishing protected with a 12 amp OCP or the receptacle shall be provided with a 10 amp OCP.)

Exception: Additional OCP is not required when the receptacle is a part of a furniture power distribution unit which complies with UL 962A.

Table 26.1
Guide to Construction Requirements for Convenience Receptacles in Furnishings

Furniture rating (Amp)	Minimum power supply cord size (AWG)	Number of receptacles	Supplementary OCP required? ^a	Supplementary OCP rating ^a (Amps)	Temperature test load (Amps)	Minimum internal wiring size (AWG)
13 – 16	12	<6	NO	20 ^c	20	12
13 – 16	12	≥6	YES	20	20	12

Table 26.1 Continued on Next Page

Table 26.1 Continued

Furniture rating (Amp)	Minimum power supply cord size (AWG)	Number of receptacles	Supplementary OCP required? ^e	Supplementary OCP rating ^a (Amps)	Temperature test load (Amps)	Minimum internal wiring size (AWG)
12	14 ^d	<4	NO	15 ^c	15	14 ^d
12	14 ^d	≥4	YES ^{c, d}	15	15	14 ^d
<12	14 ^d	<4	NO	15 ^b	15	14 ^d
<12	14 ^d	≥4	YES ^d	15 ^d	15	14 ^d

^a OCP shall not trip when the furniture is operated at the marked rated current.

^b When provided with an OCP.

^c An OCP is not required for a 12 Amp rated furnishing with four receptacles as long as:

- a) Internal wiring is 12 AWG;
- b) The power-supply cord is 12 AWG;
- c) All other components are evaluated for use at 20 A; and
- d) The Temperature Test load is 20 A.

^d An OCP is not required and/or the power supply cord is permitted to be 16 AWG and/or the internal wiring is permitted to be 16 AWG for a household (residential) FPDU as long as:

- a) Furniture is not rated higher than 12 amps;
- b) Either one, two, three or four receptacles are provided;
- c) All other components are evaluated for use at 15 A;
- d) The Temperature Test load is 15 A; and
- e) The FPDU is marked for Household Use Only in accordance with [86.13](#).

^e OCP is required for a furnishing that has a convenience receptacle and an additional load.

26.9 Required overcurrent protection shall either be a supplementary overcurrent protector or a replaceable fuse.

26.10 A user replaceable fuse shall not allow the user to contact an electrically energized part during the replacement of the fuse.

26.11 A fuseholder shall be of the lock out type and prevent insertion of a fuse larger than that specified.

26.12 A receptacle or cover plate that includes an integral shelf or ledge for support of other devices such as a speaker, cell phone, tablet or the like shall comply with the construction, performance and marking requirements for current tap with shelf, except the term current tap is replaced by receptacle as identified in UL 498A.

27 Switching Devices

27.1 General

27.1.1 These requirements apply to controls that perform any electrical switching function, either automatically or manually controlled, such as switches, relays, contactors, thermostats, thermal cutoffs, and circuit breakers.

Exception: The requirements in [27.1.1](#) do not apply to a switching device in secondary circuits when:

- a) The circuit in which the switching device is located is not a safety circuit; or*

b) The switching device does not have a marked "off" position and is not used as part of the circuit to disconnect power when a switch with a marked "off" position is turned to the "off" position.

27.1.2 All manually operated or adjustable switching devices shall be of the indicating type. The indicating means shall be incorporated on the device or knob, on an attached plate, or on the panel on which the device is mounted.

27.1.3 With reference to [27.1.2](#) a switching device that has only "on" and "off" positions is not prohibited from being provided with the international symbols "I" and "O" to signify "on" and "off" when the significance of these symbols is explained in the instructions packaged with the furnishing.

27.1.4 When a switching device with a marked "off" position is mounted such that movement of the operating handle is vertical, the lower position shall be the "off" position.

Exception: This requirement does not apply to a switching device having two or more positions in addition to the "off" position, such as a double-throw switch.

27.1.5 A switching device shall be judged with respect to the temperature limitations of the materials employed.

27.1.6 A manually-operated motor-control switch shall be provided in a cord-connected motor-operated furnishing that employs a motor rated more than 1/3 horsepower (250 W output).

27.2 Switch electrical ratings

27.2.1 A switching device shall have a current and voltage rating not less than that of the load that it controls when the furnishing is operated as specified in the normal Temperature Test, Section [68](#).

27.2.2 The current rating of a switching device that controls a solenoid, a magnet, a transformer, an electric-discharge-lamp (such as fluorescent and HID) ballast, or any inductive load other than a motor shall be at least twice the rated full-load current of the component that it controls, unless the switch has been found acceptable for the control of an inductive load at least equal to the rated full-load current of the component.

27.2.3 A switching device that controls a motor load shall have a motor rating (full-load/locked rotor amps or horsepower) at least equivalent to the load.

27.2.4 A switching device that controls a screwshell-type lampholder or another tungsten-filament load shall:

- a) Have a tungsten-filament lamp rating at least equivalent to the rating of the anticipated load, but not less than 25 W; or
- b) Have a current rating equivalent to at least six times the rating of the anticipated load, but not less than 150 W, for alternating-current circuits; or
- c) Have a current rating equivalent to at least ten times the rating of the anticipated load, but not less than 250 W, for direct-current circuits.

Exception: This requirement does not apply to pilot or indicating lamps, or to lampholders for pilot or indicating lamps.

27.2.5 A switching device controlling any combination of a tungsten-filament load, a motor or other inductive load, and a resistive load, shall have a current rating at least equal to the sum of any ratings required by [27.2.1](#) – [27.2.4](#), as applicable, and the rated current of the resistive load.

27.2.6 A switching device provided as part of a furnishing intended to be connected to a power-supply circuit involving a potential to ground of more than 150 volts shall be acceptable for the maximum potential to ground of the circuit.

27.3 Specific applications

27.3.1 A switching device in a fixed or stationary furnishing that controls a heating element and has a marked "off" position shall open all ungrounded conductors of the heating-element circuit or cause the conductors to be opened.

27.3.2 An automatically reset protective device shall not be employed when automatic resetting results in injury to a person.

28 Semiconductors and Small Electronic Components

28.1 A power switching semiconductor device that is relied upon to provide isolation to ground shall comply with UL 1557. It shall have been evaluated for a minimum 1500 volts isolation.

28.2 An optical isolator that is relied upon to provide isolation between primary and secondary circuits or between other circuits as required by this end product standard shall comply with UL 1577. It shall have been evaluated for a minimum 1500 volts isolation.

29 Interconnection of Furnishings

29.1 An interconnected unit with a shortened power-supply cord as specified in [10.2.12](#) shall be marked in accordance with [88.1](#) and the instructions shall comply with [92.12](#).

29.2 An interconnected unit shall be provided with markings in accordance with Section [88](#), Interconnected Units.

29.3 An interconnected unit shall be provided with instructions in accordance with Section [100](#), Interconnected Units Instructions.

30 Furnishings with Extendable Elements

30.1 A drawer or other pullout component shall incorporate a stop to reduce the likelihood of unintentional dislocation from the furnishing.

31 Commercial Operator Attended Products – Usage Area II

31.1 A commercial furnishing that requires the operator to be present to perform the intended function complies with Mechanical enclosures and guards – Mechanical considerations, [11.3](#), when all of the following conditions are met:

a) A furnishing that is accessible to the public when the trained operator is not present shall be provided with a security lockout device that disables operation of the furnishing to prevent non-qualified persons from operating the furnishing;

1) A trained operator is considered present when they are within sight of the furnishing and are within 20 feet (6.1 meter) of the furnishing.

2) The lockout device may be a passcode, proximity sensor that requires a unique sensor to activate (such as RFID), a physical key, a two-step process (such as pressing 2 keys in the correct order, or other means that would prevent an untrained person from operating the furnishing.

3) Where multiple furnishings are located within the same space and a proximity activation device is used as the access to allow movement of the furnishing, each furnishing shall have a separate code or equivalent restriction to allow movement of only the intended furnishing within the specified proximity.

4) A lockout (electronic or mechanical) system shall automatically reset and lockout the movement of the furnishing after a maximum of 2 minutes of inactivity. Inactivity is when the operator is no longer present.

b) Any point or part of the furnishing that is considered to present an entrapment or risk of personal injury shall be visible to the operator such that they can determine the proximity of an individual to the entrapment area when positioned at the operator controls while performing the intended function;

c) Where the operation of the exposed movable part is controlled by a switch the switch shall be a momentary contact type that when released all moving parts of the device that constitute a risk of injury are stopped;

d) A switch that controls the direction of travel shall be capable of being stopped and the direction of travel reversed at any point in the operation of the furnishing;

e) A switch that is used to control a movable part that can result in personal injury shall be guarded or located to prevent unintentional movement of the part; and

f) Upon power failure the furnishing shall remain in the existing position. Upon reinstatement of power the furnishing shall not move until the operator activates the switch controlling movement.

31.2 A product that complies with [31.1](#) shall be provided with installation and operation instructions in accordance with Section [101](#), Operator Attended Products Instructions.

31.3 A product covered by this section shall have the marking specified in [87.4](#).

32 Commercial Operator Attended Products – Usage Area III

32.1 Furnishings in Usage Area III shall comply with Commercial Operator Attended Products – Usage Area II, Section [31](#), with the following differences:

a) A security lockout is not necessary;

b) Any point or part of the furnishing that is considered to present a risk of injury to persons shall be visible to the operator, except that when the speed is less than 1 inch/second (2.54 cm/second), the entrapment area does not have to be visible to the operator;

c) The switch referred to in [31.1\(c\)](#) may be a memory type switch that allows the furnishing to adjust to a preset position when the operator is present at the control on the furnishing;

d) A switch that is used to control a movable part that is considered to present a risk of injury to persons shall be guarded, except that when the speed is less than 1 inch/second (2.54 cm/second), the switch, [31.1\(e\)](#), is not required to be guarded. This supersedes the requirement in [11.3.12](#); and

e) Shall have the marking specified in [87.5](#).

33 Operator Attended Products – Usage Area IA

33.1 A commercial furnishing that requires the operator to be present to perform the intended function complies with Mechanical Enclosures and Guards – Mechanical Considerations, [11.3](#), when all of the following conditions are met:

a) Any point or part of the furnishing that is considered to present an entrapment or risk of personal injury shall be visible to the operator such that they can determine the proximity of an individual to the entrapment area when positioned at the operator controls while performing the intended function;

Exception: If the speed is less than 1 inch / second (2.54 cm/second), the entrapment area does not have to be visible to the operator.

b) Where the operation of the exposed movable part is controlled by a switch, the switch shall be a momentary contact type that when released all moving parts of the device that constitute a risk of injury are stopped;

c) A switch that controls the direction of travel shall be capable of being stopped and the direction of travel reversed at any point in the operation of the furnishing;

d) A switch that is used to control a movable part that can result in personal injury shall be guarded or located to prevent unintentional movement of the part; and

Exception: If the speed is less than 1 inch / second (2.54 cm/second), the switch, [31.1\(c\)](#), is not required to be guarded. This supersedes the requirement in [11.3.12](#).

e) Upon power failure the furnishing shall remain in the existing position. Upon reinstatement of power the furnishing shall not move until the operator activates the switch controlling movement.

33.2 A furnishing that complies with [33.1](#) shall be provided with installation and operation instructions in accordance with Section [101](#), Operator Attended Products Instructions.

33.3 A product covered by this section shall have the marking specified in [87.6](#).

33A Storage Bed Units – Usage Area I

33A.1 A storage bed unit is considered to comply with Mechanical Enclosures and Guards – Mechanical Considerations, [11.3](#), when all of the following conditions are met:

a) Any point or part of the furnishing that is considered to present a risk of entrapment or personal injury shall be visible to the operator such that they can determine the proximity of an individual to the entrapment area when positioned at the operator controls while performing the intended function; and

b) The storage bed unit with motorized lift mechanism shall be provided with a momentary-contact switch with a security lockout device that disables operation of the furnishing to deter playing with the control by children or persons with cognitive disabilities;

1) The lockout device may be a passcode, proximity sensor that requires a unique sensor to activate (such as RFID), a physical key, a two-step process (such as pressing 2 keys in the correct order), or other means that would deter use by a child;

2) A lockout (electronic or mechanical) system shall automatically reset and lockout the movement of the furnishing after a maximum of 2 minutes of inactivity. Inactivity is when the operator is no longer actuating any switches;

3) A switch that controls the direction of travel shall be capable of being stopped and the direction of travel reversed at any point in the operation of the furnishing; and

4) Upon power failure the furnishing shall remain in the existing position. Upon reinstatement of power the furnishing shall not move until the operator activates the switch controlling movement.

33A.2 Storage bed unit shall be provided with installation and operation instructions in accordance with Storage Bed Unit Instructions – Usage Area I, Section [101A](#).

33A.3 Bed storage units shall be marked in accordance with [87.7](#).

34 Parts Subject to Pressure

34.1 Factory sealed systems

34.1.1 A component or system that is pressurized with fluids or gasses from the factory shall be subjected to the normal and abnormal test series for that furnishing without rupture of the system or resulting in a risk of fire, shock or injury to persons.

34.1.2 A component or system with a polymeric containment part such as a hose, tubing, enclosure and the like, relied upon to contain the pressure, shall be subjected to the Conditioning of polymeric components, [44.1](#), before subjecting the component or system to the normal and abnormal test series for the furnishing.

34.2 Open systems and systems with pumps

34.2.1 A system other than specified in [34.1](#) or one that is intended to move the fluid or gas with a pump shall withstand, without rupture, a hydrostatic pressure equivalent to five times the maximum working pressure in accordance with Section [60](#). Hydrostatic Pressure Test.

Exception: The use of a pressure relief device is acceptable to release pressure before rupture provided the pressure relief device is determined to be reliable and the device shall relieve the pressure without presenting a risk of fire, shock or injury to persons.

35 Controls

35.1 General

35.1.1 Controls shall not introduce a risk of electric shock, fire, or personal injury.

35.1.2 Where reference is made to declared deviation and drift, this indicates the manufacturer's declaration of the control's tolerance before and after certain conditioning tests.

35.1.3 A controller designed to manage power or signaling to single or multiple loads shall operate so that upon any single component failure the system does not result in a risk of fire, electric shock, or injury to persons.

35.1.4 Controls that may rely on remote software updates shall comply with UL 5500. After the software has been downloaded, the furnishing shall be operated to confirm the it operates as intended function and all testing related to the control functions shall be repeated.

35.2 Auxiliary controls

35.2.1 Auxiliary controls shall be evaluated using the applicable requirements of this end product standard unless otherwise specified in this end product standard.

Exception: An auxiliary control that complies with a component standard(s) specified in Section 35, Controls, is considered to comply with this requirement.

35.3 Operating controls

35.3.1 Operating (regulating) controls shall be evaluated using the applicable component standard requirements specified in 35.5 – 35.11 and the parameters in 35.3.3, unless otherwise specified in this end product standard.

35.3.2 Operating controls that rely upon software for the normal operation of the end product where deviation or drift of the operating parameters of the control may result in an increased risk of electric shock, fire, or injury to persons, shall comply with:

- a) UL 991 and UL 1998;
- b) UL 60730-1; or
- c) UL 60335-1, if motorized.

35.3.3 The following test parameters shall be among the items considered when judging the acceptability of an operating control, except for (c), if using a standard other than UL 60730-1 or UL 60335-1, if motorized:

- a) Control action Types 1 or 2;
- b) Unless otherwise specified this standard, manual and automatic controls shall be tested for 6,000 cycles with under maximum normal load conditions, and 50 cycles under overload conditions;
- c) Installation class 2 in accordance with IEC 61000-4-5;
- d) For the applicable Overvoltage Category, see Table 35.1;
- e) For the applicable Material Group, see Table 35.2; and
- f) For the applicable Pollution Degree, see Table 35.3.

Table 35.1
Overvoltage Categories

Furnishing type	Overvoltage category
Intended for fixed wiring connection	III
Portable and stationary cord-connected	II
Control located in low-voltage circuit	I
NOTE – Applicable to low-voltage circuits if a short circuit between the parts involved may result in operation of the controlled equipment that would increase the risk of fire or electric shock.	

Table 35.2
Material Group

CTI PLC value of insulating materials	Material group
CTI $\geq$ 600 (PLC = 0)	I
400 $\leq$ CTI < 600 (PLC = 1)	II
175 $\leq$ CTI < 400 (PLC = 2 or 3)	IIIa
100 $\leq$ CTI < 175 (PLC = 4)	IIIb
NOTE – PLC stands for Performance Level Category, and CTI stands for Comparative Tracking Index as specified in UL 746A.	

Table 35.3
Pollution Degrees

Furnishing control microenvironment	Pollution degree
No pollution or only dry, nonconductive pollution. The pollution has no influence. Typically, a hermetically sealed or encapsulated control without contaminating influences, or printed-wiring boards with a protective coating can achieve this degree.	1
Normally, only nonconductive pollution. However, a temporary conductivity caused by condensation may be expected. Typically, indoor appliances for use in household or commercial clean environments achieve this degree.	2
Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation that is expected. Typically, controls located near and may be adversely affected by motors with graphite or graphite composite brushes, or outdoor use appliances achieve this degree.	3

35.4 Protective controls

35.4.1 Protective (limiting) controls shall be evaluated using the applicable component standard requirements specified in [35.5](#) – [35.11](#), and as applicable, the parameters in [35.4.2](#) – [35.4.7](#).

35.4.2 Solid-state protective controls that do not rely upon software as a protective component shall comply with:

- a) UL 991;
- b) UL 60730-1, except Controls Using Software; or
- c) UL 60335-1, if motorized.

35.4.3 Solid-state protective controls that rely upon software as a protective component shall comply with:

- a) UL 991 and UL 1998; or
- b) UL 60730-1.
- c) UL 60335-1, if motorized.

35.4.4 An electronic control that performs a protective function shall comply with the applicable requirements in this Section (Controls) while tested using the parameters in [35.4.5](#) – [35.4.7](#).

35.4.5 The following test parameters shall be among the items considered when determining the acceptability of an electronic protective control investigated using UL 60730-1 and UL 60335-1, if motorized:

- a) Failure-Mode and Effect Analysis (FMEA) or equivalent Risk Analysis method;
- b) Power Supply Voltage Dips, Variation and Interruptions within a temperature range of 10 °C (18 °F) and the maximum ambient temperature determined by conducting the Temperature Test, Section [68](#);
- c) Surge Immunity Test – installation class 3 shall be used;
- d) Electrical Fast Transient/Burst Test, a test level 3 shall be used;
- e) Electrostatic Discharge Test;
- f) Radio-Frequency Electromagnetic Field Immunity:
 - 1) Immunity to conducted disturbances – When applicable, test level 3 shall be used; and
 - 2) Immunity to radiated electromagnetic fields; field strength of 3 V/m shall be used;
- g) Thermal Cycling Test shall be conducted at ambient temperatures of 10.0 ± 2 °C (50.0 ± 3 °F) and the maximum ambient temperature determined by conducting the Temperature Test, Section [68](#). The test shall be conducted for 14 days;
- h) Overload shall be conducted based on the maximum declared ambient temperature (T_{max}) or as determined by conducting the Temperature Test, Section [68](#); and
- i) If software is relied upon as part of the protective electronic control, it shall be evaluated as software class B.

35.4.6 The test parameters and conditions used in the investigation of the control circuit covered by [35.4.2](#)(a) and [35.4.3](#)(a) shall be as specified in UL 991, using the following test parameters:

- a) Supervised safety circuits as defined by UL 991 may not rely on a trouble signal or indicator to prevent the risk of injury;
- b) A field strength of 3 V/m is to be used for the Radiated EMI Test;
- c) The Composite Operational and Cycling Test is to be conducted for 14 days at temperature extremes of 0 °C (32 °F) and 49 °C (120 °F) for outdoor furnishings;
- d) The Humidity Class (see [Table 35.4](#)) is to be based on the appliance's intended end use and is to be used for the Humidity Test;
- e) When a Computational Investigation is conducted, I_p shall not be greater than 6 failures/106 hours for the entire system. For external secondary entrapment protection devices that are sold separately, I_p shall not be greater than 0 failures/106 hours. For internal secondary entrapment protection devices whether or not they are sold separately, I_p shall not be greater than 0 failures/106 hours. The Operational Test is to be conducted for 16 days;
- f) The Endurance Test is to be conducted concurrently with the Operational Test. The control shall perform its intended function while being conditioned for 14 days in an ambient air temperature of 60 °C (140 °F), or 10 °C (18 °F) greater than the operating temperature of the control, whichever is higher. During the test, the control is to be operated in a manner representing normal use;
- g) For the Electrical Fast Transient Burst Test, test level 3 is to be used;
- h) Conduct a failure-mode and effect analysis (FMEA);
- i) A vibration level of 2 g is to be used for the Vibration Test; and

j) If software or firmware is relied upon as part of the protective electronic control, it shall be evaluated as software class 1 in accordance with UL 1998.

Table 35.4
Humidity Class

Humidity class	Intended space
H1	Controls used in equipment intended for occupational spaces such as offices and residence.
H2	Controls used in equipment intended for laundry rooms, basements, etc.
H3	Controls intended for household heating appliances.
H4	Controls intended for appliances used in bathrooms and areas exposed to high humidity.
H5	Controls intended for outdoor use.

35.4.7 Unless otherwise specified in this standard, protective controls shall be evaluated for 100,000 cycles for Type 2 devices and 6,000 cycles for Type 1 devices with rated current.

35.5 Electromechanical and electronic controls

35.5.1 An electromechanical or electronic control used for a safety function (for example: entrapment hazard, UV radiation, burn hazard, etc.), other than as specified in [35.6](#) – [35.11](#), shall comply with UL 873 or UL 60730-1, or shall be evaluated in accordance with Section [36A](#), Evaluation of Electromechanical and Electronic Controls.

35.6 Liquid level controls

35.6.1 A liquid level control shall comply with:

- a) UL 873;
- b) UL 508, UL 60947-4-1, UL 60947-5-2, and UL 61131-2; or
- c) UL 60730-1 and UL 60730-2-15.

35.6.2 A switch employed as part of a water level detection mechanism is to comply with one of the switch standards, see Section [3](#), Components.

35.7 Motor controls

35.7.1 A control used to start, stop, regulate or control the speed of a motor shall comply with:

- a) UL 873;
- b) UL 508, UL 60947-4-1, UL 60947-5-2, and UL 61131-2;
- c) UL 61800-5-1;
- d) UL 60730-1; or
- e) UL 60335-1.

35.7.2 A component that only supplies power to a motor is not considered a controller, but a power supply.

35.7.3 The failure of a motor controller shall not introduce a risk of electrical shock, fire or injury to persons as follows:

- a) When a controller is designed to load switch (manage current to multiple loads) the reliability of the switching or load sharing shall be investigated so that under a fault condition a risk of electrical shock, fire or injury to persons is not created.
- b) When multiple motors apply a force to a portion of the furnishing the load on each motor shall be determined. Load management (switching) if provided by a controller shall be determined to be suitable for the loads or if it is determined the load management is not reliable then consideration shall be given to each motor applying its force to the furnishing portion singly or in combination whichever is determined to be worst case.

Exception: The above conditions do not apply where electronic drive circuits are determined to be reliable by single component faults as determined by evaluation with Section [35](#), Controls.

35.8 Pressure controls

35.8.1 A pressure control shall comply with one of the following:

- a) UL 508, UL 60947-4-1, UL 60947-5-2, and UL 61131-2; or
- b) UL 60730-1 and UL 60730-2-6.

35.9 Remote controls

35.9.1 Remote controls or applications on smart devices shall not be provided on any furnishing whose operation could cause personal injury (refer to [113](#), Mechanical Enclosures and Guards — Mechanical Considerations) while in motion when using the remote or application unless they can only be used in line of sight.

35.9.2 Remote controls or applications on smart devices shall comply with the control requirements in this standard based on their application.

35.10 Temperature controls

35.10.1 A temperature control shall comply with:

- a) UL 873;
- b) UL 508, UL 60947-4-1, UL 60947-5-2, and UL 61131-2; or
- c) UL 60730-1 and UL 60730-2-9.

35.10.2 A temperature sensing positive temperature coefficient (PTC) or a negative temperature coefficient (NTC) thermistor that performs the same function as an operating or protective control shall comply with UL 60730-1 and UL 60730-2-9 with Annex J, or UL 1434:

35.10.3 A temperature sensing positive temperature coefficient (PTC) or a negative temperature coefficient (NTC) thermistor, that performs the same function as an operating or protective control shall be tested using the following number of cycles when testing a sensing device in accordance with the endurance test:

- a) For a device employed as an operating device – 6,000 cycles;
- b) For a device employed as a protective device – 100,000 cycles; and

c) For a device employed as a combination operating and protective device – 100,000 cycles.

Exception: The minimum number of cycles is reduced to 6,000 under the following conditions:

a) The trip state of the thermistor is apparent in the end-use application; and

b) Manual intervention is required in order to restart the thermistor.

35.10.4 A thermal cutoff shall comply with UL 60691.

35.11 Timer controls

35.11.1 A timer control shall comply with UL 60730-1 and UL 60730-2-7.

36 Abnormal Conditions

36.1 When the conditions of intended operation are not representative of all conditions possible in service, a product shall not present a risk of fire, electric shock, or injury to persons when operated under such abnormal conditions and foreseeable misuse (likely using the furnishing in a manner not intended by the manufacturer).

36.2 Continuous operation, malfunction of components, shorting of output circuits, failure of cooling fans, and likely misuses of the product are conditions to be simulated.

36.3 Abnormal conditions (refer to Section [76](#), Abnormal – Controls and Safety Circuit Tests) shall be considered when evaluating control and safety circuits.

36.4 The failure of a component in a circuit shall not result in a risk of fire, electric shock, or injury to persons.

36.5 A product that requires operations in a specific sequence shall operate so that upon any single component failure the product does not result in a risk of fire, electric shock, or injury to persons.

36.6 A product that requires limited operation time shall operate so that upon any single component failure the product does not result in a risk of fire, electric shock, or injury to persons.

36.7 When the investigation in accordance with Section [76](#), Abnormal – Controls and Safety Circuit Tests, determines that a component or circuit fault results in a risk of fire, electric shock, or injury to persons or the controller or a circuit has a safety function, then the component(s) or circuit(s) in question shall be investigated to determine that they possess the necessary reliability for the anticipated product service life. The circuit(s) shall comply with the requirements in Section [35](#), Controls, and [35.4](#), Protective Controls.

36A Evaluation of Electromechanical and Electronic Controls

36A.1 Except as allowed in [36A.2](#), electromechanical and electronic controls used for a safety function may be evaluated as used in the furniture, in accordance with Section 19.11 of UL 60335-1. When a control includes protective software, it may be evaluated in accordance with Section 22.46 and Annex R (referencing Table R.1) of UL 60335-1.

NOTE: If off/standby provided by electronic disconnection does not raise risk of injury when operated, the EMP testing of UL 60335-1 19.11.4 does not need to be performed.

36A.2 If an electromechanical or electronic control can be bypassed or removed from the furnishing, and the furnishing still complies with all test requirements of this Standard (due to other protective devices being in place, for example), the control in question does not need to be further evaluated.

37 Furniture Flammability

37.1 Mattress flammability

37.1.1 All mattresses, mattress sets and mattress foundations shall comply with CFR 16 – Part 1633. The mattress shall be marked as required in CFR 16 – Part 1633 and any other markings required by this standard.

37.1.2 All mattresses, mattress sets and mattress foundations shall comply with CFR 16 – Part 1632. The mattress shall be marked as required in CFR 16 – Part 1632 and any other markings required by this standard.

37.1.3 Mattresses, mattress sets and mattress foundations intended for use in public occupancies shall comply with [37.1.1](#), [37.1.2](#), and Technical Bulletin 129. The mattress shall be marked in accordance with Technical Bulletin 129 and [86.20](#).

37.2 Upholstered seating flammability

37.2.1 Upholstered seating furnishings intended for household use shall comply with Technical Bulletin 117. The furnishing shall be marked in accordance with [86.21](#).

37.2.2 Upholstered seating furnishings intended for use in public occupancies shall comply with Technical Bulletin 117. The furnishing shall be marked as indicated in [86.21](#).

Exception: An upholstered furnishing marked in accordance with [86.22](#) is not required to be evaluated for flammability.

37.3 Commercial furnishing flammability

37.3.1 A commercial furnishing with a combustible surface area (*) greater than 10 square feet (0.93 m²) shall comply with one of the following test methods:

(*) Surface area calculation shall be determined as follows:

- a) Surface areas are calculated based on only one side of the surface;
- b) All surfaces between vertical and 45° including 45° from vertical are considered vertical surfaces. All surfaces between horizontal and up to 45° from horizontal are considered horizontal surfaces.
- c) Edges (Examples – Front edge of a shelf, vertical stile or horizontal rail of a unit) of surfaces 2 inches or less in dimension are not added into the area calculation unless they can be positioned directly adjacent to each other;
- d) Removable and optional portions of the furnishing are to be included in the area determination.
- e) Merchandise or electrical equipment on the furniture or separately investigated portions of the furnishing such as a conductor, cable, luminaire, power supply, amplifier, speaker, TV, monitor etc. are not to be included in the surface calculation or test.

f) The areas of the vertical and horizontal surfaces shall be added together. If the area exceeds 10 feet² (0.93 m²) in total area the store fixture shall comply with one of the test methods specified below.

37.3.2 Each commercial furnishing shall be tested in accordance with the tests specified in [37.3.3](#) – [37.3.5](#), as applicable.

37.3.3 Each planar surface with overall surface area greater than 10 ft² (0.93 m²) shall be investigated to UL 723 or ASTM E162. Each test for UL 723 requires a sample length of 24 feet (7.3 m) and a sample width of 24 inches (0.6 m). The length can usually be comprised of separate lengths butted together. Each test for ASTM E162 requires four test specimens with a sample length of 18 inches (457 mm) and sample width of 6 inches (152 mm).

37.3.4 The test methods in either UL 1975 or NFPA 289, shall be used for furnishings that do not have a flat planar surface and the overall size of one side is greater than 10 ft² (0.93 m²).

37.3.5 An individual fabric material used without a backing material with an overall size of one side greater than 10 ft² (0.93 m²) shall comply with NFPA 701.

37.3.6 Products tested to UL 723 or ASTM E162, shall have a maximum flame-spread rating of 200. If a product tested to UL 723 has a Smoke Developed index (SDI) over 450 the product shall be marked as specified in [86.29](#).

37.3.7 Products tested to UL 1975 or NFPA 289 shall have a maximum heat release rate not greater than 100 kW (105 Btu/h) and shall be marked as specified in [86.29](#) if it has a total smoke release (TSR) more than 60.

37.4 All furnishings

37.4.1 Polymeric or similar material used in the construction of a furnishing that is used as an enclosure or support for live parts shall comply with [11.5](#).

38 Heating Pads – For Use in Upholstered Furnishings

38.1 A heating pad employed in a furnishing shall comply with the applicable requirements in UL 130.

Exception: A heating pad that is not accessible and that complies with the requirements in the Resistance to moisture test, [80.1](#); Flexing and twisting test, [80.3](#); and Thermostat test, [80.2](#), is acceptable.

38.2 Fabric, batting, padding, foam, and synthetic or natural leather shall not be relied upon to serve as electrical insulation.

38.3 Current-carrying metal parts within a heating pad shall be electrically insulated with a material that complies with UL 746C. The thickness (not including the envelope or padding material) of insulation applied directly to the current-carrying metal parts shall not be less than 0.028 inch (0.71 mm) unless the parts are secured in position (to prevent their motion relative to one another, the envelope, or both). If the parts are secured, 0.013 inch (0.33 mm) shall be the minimum insulation thickness.

Exception: Appliance wiring material with insulation thickness as specified above.

38.4 A furnishing heating pad shall be provided with a supplemental envelope (enclosure) that complies with the following:

a) The envelope shall be of materials acceptable for the application and shall enclose all electrical parts of the pad without any ventilation or other openings; and

b) An envelope of unsupported vinyl sheeting on a heating pad shall not be thinner than an average thickness of 0.012 inch (0.3 mm). An envelope of unsupported vinyl sheeting on a commercial furnishing pad shall not be thinner than an average thickness of 0.020 inch (0.5 mm).

1) The average thickness of a rectangular specimen measuring approximately 1 by 4 inches (25 by 102 mm) is to be determined from measurements made by means of a dead-weight dial micrometer having a flat anvil and a flat-faced cylindrical presser foot that is 0.25 ± 0.01 inch (6.35 ± 0.25 mm) in diameter and exerts 85 ± 3 gf (0.83 ± 0.03 N) on the specimen. The calibration of the dial on the micrometer is to facilitate estimation of each measurement to 0.0001 inch (0.0025 mm); and

2) The thickness of a specimen is to be measured midway across the width of the specimen at the center of its length and at points 1/2 inch (13 mm) from each end. Each measurement is to be estimated at the nearest 0.0001 inch (0.0025 mm) and recorded. The smallest of the three recorded thicknesses is to be rounded off to the nearest 0.001 inch (0.025 mm).

39.5 Foam padding in direct contact with or provided as a component of a heating pad shall comply with the requirements for HBF or better material as specified in UL 94.

39 Electrical Insulation in Direct and Indirect Contact of Live Parts

39.1 Electrical insulation in direct or indirect contact with uninsulated live parts other than magnet wire coating shall be a material investigated and found acceptable in accordance with the requirements covering mechanical/electrical property considerations of UL 746C. The material shall withstand the most severe conditions likely to be met in service.

Exception: Small parts and adhesives are not required to be investigated if they are:

a) *Not relied upon to maintain the proper functioning of the device with regard to the likelihood of electric shock, fire, and injury to persons; and/or*

b) *Not relied upon to maintain separation between uninsulated live parts of opposite polarity, live parts, and accessible metal parts and/or uninsulated live parts and earth ground.*

39.2 After the conditioning specified in [44.1](#), conditioning of polymeric components and upon cooling to room ambient, there shall be no evidence of softening, shrinking, warpage, or other distortion of parts that results in any of the following:

a) Reduction of spacings between uninsulated live parts of opposite polarity, uninsulated live parts and accessible dead or grounded metal, and uninsulated live parts and the enclosure below the minimum acceptable values;

b) Uninsulated live parts or internal wiring accessible to contact, or defeating the integrity of the enclosure so that acceptable mechanical protection is not afforded to internal parts of the equipment; or

c) Interference with the intended operation or servicing of the equipment if the equipment is operable.

40 Immersion Heaters

40.1 Immersion heaters shall comply with UL 499.

40.2 Immersion heaters shall employ a leakage current collector that shall be located within 1 inch (2.54 cm) from the heater and shall be bonded to the furnishing ground. The collector shall be electrically isolated from the heater. The bonding wire shall not be accessible to the user once the furnishing has been installed as intended. The leakage collector shall:

- a) Have a minimum length of five times its own inside diameter or the equivalent ratio of length to cross-section for non-circular configurations.
- b) Be made of an unplated metal such as brass, stainless steel, or other equally corrosion-resistant metal that is intended to resist galvanic action in accordance with (c). Galvanized metal pipe is not considered to be sufficiently corrosion-resistant for use as a current collector. When copper alloy is used, it shall be comprised of not more than 15 % zinc.
- c) In accordance with (b), sheet and plate aluminum in contact with water shall be of an alloy of the 5000 series as specified in ASTM B209; and cast aluminum shall be one of the alloys shown in [Table 40.1](#).
- d) Replaceable heater elements shall be replaceable without disturbing the grounding or bonding of the appliance or current collectors.

Table 40.1
Aluminum Alloys

Sand-cast	Permanent-mold cast	Die cast	Machine bar and rod stock
G4A	GM70B	G8A	5052
G10A	GS42A	S5C	5056
GM70B	S5A	S12A	5456
GS42A	S5B	S12B	6061
S5A	SG70A	SG100A	6063Z
S5B	SG70B	SG100B	—
SG70A	—	—	—
ZG61B	—	—	—

40.3 The heater shall be provided with a control that prevents the water from obtaining a maximum water temperature at the suction fitting of 43 °C (109 °F) and that the water temperature at any inlet does not exceed 50 °C (122 °F). These devices shall comply with either (a), (b), (c), or (d) below:

- a) UL 353;
- b) The water heater control requirements in UL 873. In addition, the control shall comply with the calibration verification and 100,000-cycle endurance requirements in UL 873. If part or all of the control is electronic, it shall comply with Section [35](#), Controls;
- c) UL 60730-1 and UL 60730-2-6, with the parameters as specified in [Table 40.2](#); or
- d) UL 60730-1 and UL 60730-2-9, with the parameters as specified in [Table 40.2](#).

Table 40.2
Water-Flow Control Parameters
(Dry-Fire Protection)

UL 60730-1, Table 7.2DV item number	Information	Control requirement
6	Purpose of control	Protective control (temperature)
7	Type of load controlled	AC heater load
27	Number of Automatic cycles (A)	100,000
29	Type of disconnection or interruption	Micro-Disconnection
36	Limits of Activating Quantity	Factory pressure, vacuum or temperature setting
39	Type 1 or Type 2 action	Type 2
40	Additional features	Automatic reset
41	Manufacturing Deviation, maximum	The operating pressure of a pressure control shall be within $\pm 5\%$ of its set point pressure $\pm 3^\circ\text{C}$ ($\pm 5^\circ\text{F}$) for temperature sensitive controls.
42	Drift	The operating pressure shall not vary from the operating pressure initially determined by more than 5 % of the maximum set point pressure. It shall not vary from the as-received temperature by more than 5 % of the Fahrenheit setpoint temperature, or by more than 10°F (6°C), whichever is the greater.
49	Pollution degree	Pollution degree 3
52	The minimum parameters of any heat dissipater (heat sink) not provided with an electronic control but essential to its correct operation	Must be specified
53	Output waveform if other than sinusoidal	Must be specified
58A	Required protection/immunity from mains borne perturbations, magnetic and electromagnetic disturbances	Required ^a
69	Software Class	B
74	External load and emission control measures to be used for test purposes	Intended heater
90	Surge immunity	IEC 61000-4-5 installation Class 3. Overvoltage category II.
92	Class of Control Function	B
^a For the purpose of the tests specified in Section 26, Annex H, of UL 60730-1, the products covered by this Standard shall be considered as: 1) Installation Class 3 (See Annex R, UL 60730-1); 2) Overvoltage Category III; 3) Test Level 3.		

41 Fluid Connections

41.1 An opening threaded for connection of pipe shall be in accordance with ASME B1.20.1 or ASME B1.20.3. See also [119.9](#).

Exception: Valves intended for use in installations where pipe fittings incorporate other than NPT type threads shall be permitted to be provided with pipe threads complying with a national pipe thread standard compatible with those fittings. The pipe thread type shall be identified in accordance with [119.10](#).

41.2 Flanged pipe connections shall be in accordance with ASME B16.1, or ANSI/ASME B16.5.

41.3 A valve intended for connection to pipe larger than 3-inch nominal size shall be provided with flanged pipe connections in accordance with [41.2](#).

41.4 Tube fitting connections shall be in accordance with SAE J512, ASME B16.26, SAE J513, and ISO 16030.

41.5 Solder joint connections shall be in accordance with ASME B16.18 or ASME B16.22.

41.6 Weld joint connections shall be in accordance with ASME B16.9 or ASME B16.11.

41.7 When the furnishing has a direct connection to the water supply line, a means shall be provided to prevent backflow.

41.8 When the furnishing has a direct connection to the waste line, a means shall be provided to prevent backflow.

42 Rooms or Booths Intended to be Occupied (Booths and Prefabrication Rooms)

42.1 Bunk capsule cabin

42.1.1 General

42.1.1.1 A suitable fastening means shall be provided to prevent the disengagement of the top bed from the bottom bed. There shall be no separation of any of the attachments of the foundation support system to the end structures of the capsule when tested in accordance with Section [50](#), Separation Test.

42.1.1.2 The bottom cabin shall not be capable of being dislodged without the release of positive fastening devices or the use of hand tools.

42.1.1.3 The foundation support system shall not fail when tested in accordance with Section [48](#), Upper Bunk Capsule Cabin Loading Test.

42.1.1.4 Top capsule cabin shall be provided with integrated elevated means of preventing a sleeping occupant from rolling or sliding out of the capsule bed.

42.1.1.5 The upper edge of the elevated means shall be at least 5 in (130 mm) above the sleeping surface when a mattress of a thickness that is the maximum specified by the manufacturer's instructions is used on the bed.

42.1.1.6 There shall be no openings in the capsule cabin bottom structure.

42.1.2 Ladders

42.1.2.1 A lean-on (slanted) or hang-on (vertical) ladder shall be supplied with each bunk capsule cabin assembly or the ladder may be incorporated as part of the cabin structure. The ladder shall be attached in a manner that prevents inadvertent disengagement, repositioning, or tilting while in use.

42.1.2.2 The width of the ladder shall be no less than 10 in (250 mm) measured from the inside of the stiles. Vertical spacing of ladder steps shall be no greater than 12 in (300 mm) when measured from the floor to the first step or between steps.

42.1.2.3 Ladders shall comply with the appropriate ALI A14 ladder standards for a 300 lb person.

42.2 Booths and room-in-room

42.2.1 A room-in-room or booth that is intended to be occupied in an enclosed space and that are provided with a door shall not have any locking mechanism on the outside unless it can be defeated from inside the furnishing. The door shall swing outward or slide. If a lock is provided on the inside of the door, means shall be provided to defeat the lock in case of an emergency.

42.2.2 Booths shall comply with all of the applicable requirements in this standard, except for [42.3](#), Rooms or Booths With Ceilings.

42.2.3 A room-in-room shall comply with all of the applicable requirements in this standard.

42.3 Rooms or booths with ceilings

42.3.1 The ceiling surface shall comply with all of the other requirements in the standard.

42.3.2 Rooms or booths with a ceiling shall employ either an "Open-Grid Ceiling" system as specified in [42.3.3](#) – [42.3.6](#), a "Drop-Out Ceiling" as specified in [42.3.7](#) – [42.3.13](#), have its own fire extinguishing system suitable for the intended use or be designed to accept a sprinkler head drop from the building.

42.3.3 The openings in an open-grid ceiling system shall be 1/4 inch (6.4 mm) or larger in the smallest dimension. The thickness of the material of the grid shall not exceed the least dimension of an opening of the grid. The total area of the openings of the grid shall be 70 % or greater of the total ceiling area. For adjustable ceilings, these measurements shall be taken with the ceiling fully open.

42.3.4 Rooms or booths with an open-grid ceiling system shall only be used in either Light or Ordinary Hazard Occupancies.

42.3.5 Adjustable open-grid ceiling systems shall comply with the following:

- a) The system shall be monitored by a supervisory alarm with a reserve power supply provided, or the system shall be designed such that any interruption of power to the circuit results in the ceiling opening;
- b) Electrically operated heat detectors shall comply with UL 521;
- c) Electrically operated releasing devices shall comply with UL 864;
- d) Power supplies used in this system shall comply with UL 1481;
- e) The circuit shall be wired such that activation of any temperature sensing device shall open all panels;

f) As an alternate to (b) or (c), temperature indicating and regulating devices, such as thermal switches, or electromagnetic latches, shall comply with applicable requirements for safety controls in UL 873, or the applicable requirements for protective controls in UL 60730-1, and for temperature sensing devices, the applicable requirements in UL 60730-2-9, or for the electromechanical latch, the applicable requirements in UL 60730-2-12; and

g) During an emergency situation, the louvers shall fully open.

42.3.6 Adjustable ceilings shall not be used beneath quick response or extended coverage sprinklers.

42.3.7 Drop-out ceilings employed as a part of furnishing, and intended to be used beneath standard response automatic sprinklers, shall be designed such that during fire conditions, the dropout ceiling panels drop from their supports to expose the sprinklers to the fire. The dropping out of the panels shall be accomplished by physical, mechanical or electrical means.

42.3.8 Drop-out ceilings shall not be used beneath quick response or extended coverage sprinklers.

42.3.9 Drop-out ceilings shall comply with UL 723S.

42.3.10 When the dropping out of ceiling panels is accomplished by physical means, the panels shall be designed such that they are heat sensitive and fall from their setting when exposed to heat.

42.3.11 When the dropping out of ceiling panels is accomplished by mechanical means the system shall comply with mechanical heat responsive devices, such as fusible links. When mechanical heat responsive devices are used, they shall comply with UL 33, and shall be used within the terms of their ratings.

42.3.12 When the dropping out of ceiling panels is accomplished by electrical means the system shall comply with the following:

a) Where the electrical power is required to accomplish the dropping out of the ceiling panels, either the system shall be monitored by a supervisory alarm with a reserve power supply provided, or the system shall be designed such that any interruption of power to the circuit results in drop out of the panels;

b) Electrically operated heat detectors, when used, shall comply with UL 521;

c) Electrically operated releasing devices, when used, shall comply with UL 864;

d) Power supplies, when used, shall comply with UL 1481;

e) The circuit shall be wired such that activation of any temperature sensing device shall release all panels; and

f) As an alternate to (b) or (c), temperature indicating and regulating devices, such as thermal switches, or electromagnetic latches, shall comply with applicable requirements for safety controls in UL 873, or the applicable requirements for protective controls in UL 60730-1, and for temperature sensing devices, the applicable requirements in UL 60730-2-9, or for the electromechanical latch, the applicable requirements in UL 60730-2-12.

42.3.13 Drop-out ceiling panels complying with the above requirements shall be marked in accordance with [86.42](#) – [86.46](#) and installation instructions, [92.23](#) and [92.24](#).

42.3.14 In the event of a power failure, there shall be sufficient lighting for the occupant to find the exit. The lighting may be provided by an external source, for example, a window or open ceiling or by emergency lighting.

PERFORMANCE

MECHANICAL TESTS

43 General Conditions

43.1 Where an angle is referenced, the tolerance shall be $\pm 0.2^\circ$.

43.2 For furnishings that may support an audio or video load, the furnishing shall also comply with the tests from UL 1678, where applicable. See [Table 43.1](#).

Exception: A video display attached to or supported by a desk/table product may comply with the Monitor Arm Strength Test, Monitor Arm Cyclic Test, and Monitor Arm Dislodgement Test from BIFMA X5.5 in lieu of the Section [17](#) test specified in [Table 43.1](#).

Table 43.1
Tests

Referenced Test in UL 1678	Test Name
15	Temperature Stability Test
16.2	Carts or stands intended to support or store audio and/or video equipment other than a television or having other general storage
16.3	Carts, stands and entertainment centers having a support surface or mounting surface for a television
16.4	Dynamic tip stability test for tall institutional carts and stands
16.5	Force stability
16.6	Appurtenance stability (Considered the same as 53.5)
16.7	Multiple audio and video support surface test
17	Loading – except UL 962 test loads will be used.
18	Handle Strength
19	Appurtenance Strength (Considered the same as Section 47)
21	Wheel, Roller, or Caster Securement (Considered the same as Section 57)
22	Braking

43.3 Commercial tables, lab benches, or similar furnishings that are not provided with a work surface and/or secondary surfaces (shelves) shall be tested with a work surface and/or secondary surfaces (shelves) placed on the table that reflects the same sizes and shapes recommended by the table manufacturer. The work surface and/or secondary surfaces (shelves) shall have sufficient strength to support the test loads. The manufacturer may provide an actual work surface and/or secondary surfaces (shelves). The work surface and/or secondary surfaces (shelves) shall be secured by the mechanical means required by the work surface and/or secondary surfaces (shelves) manufacturer.

43.4 When a commercial table, lab bench, or similar furnishing that is not provided with a work surface and/or secondary surfaces (shelves) is evaluated with a work surface and/or secondary surfaces (shelves), whether from a different manufacturer or from the same manufacturer, the table manufacturer's instructions shall be reviewed to determine if the work surface and/or secondary surfaces (shelves) meet the table manufacturer's design specification. If not, all of the tests in Sections [44](#) – [64](#) shall be reviewed to determine if the combination of the table and work surface and/or secondary surfaces (shelves) comply with the requirements.

44 Conditioning of Products

44.1 Conditioning of polymeric components

44.1.1 A polymeric material used to support or carry a weight load shall be conditioned in accordance with [44.1.2](#) prior to conducting loading or mounting tests.

44.1.2 An unloaded representative furnishing support system employing polymeric parts and its accessories are to be placed in a full-draft circulating-air oven. The air temperature within the oven is to be maintained at 70 °C (158 °F) or 10 °C higher than the temperature obtained on the polymeric parts during the temperature test, whichever is higher, for 7 hours. The support system and its accessories are to be allowed to cool to room temperature before conducting the Stability Test, Loading Test, Cycling Test or Mounting Securement Test.

44.2 Conditioning of components secured by adhesives

44.2.1 An adhesively secured component used to support or carry a weight load shall be conditioned as specified in [44.2.2](#) prior to conducting the stability, loading tests or adhesive securement test.

44.2.2 Two representative furniture support systems employing adhesives as the sole support shall be conditioned as follows:

- a) One furniture support system shall be placed in an air-circulating oven for: Seven days at 100 ± 1.0 °C (212 ± 1.8 °F); and
- b) One furniture support system shall be conditioned for seven days in an environment of 85 ± 5 % relative humidity at 32.0 ± 2.0 °C (89.6 ± 3.6 °F).

The support system and its accessories are to be allowed to cool to room temperature before conducting the required test.

45 Adhesive Securement Test

45.1 A component of a furnishing secured by an adhesive that would create a risk of fire, electrical shock or injury to persons upon adhesive failure shall comply with the test specified in [45.2](#). The adhesive is considered satisfactory when the adhered surfaces do not separate.

45.2 The joined components shall be subjected to the conditioning specified in [44.2](#), Conditioning of components secured by adhesives.

45.3 The furnishing shall be installed in accordance with the Installation Instructions. A weight equal to 4 times the weight of the adhered component is to be attached to any point on the adhered component that subjects the adhesive to the weight load. The component shall remain affixed to the furnishing for 1 minute.

46 Structural Test Requirements for Furnishings

46.1 General loading

46.1.1 A furnishing shall be subjected to the structural loading tests and shall not collapse or deform to a degree that presents a risk of fire, electric shock, or injury to persons.

a) A risk of injury to persons is determined to exist when the furnishing or part of a furnishing collapses, partially collapses or is damaged to the extent that there are sharp edges or corners exposed which do not comply with UL 1439; and

b) Electrical components within the furnishing shall comply with the requirements of Section 13, Accessibility of Uninsulated Live Parts and Film-Coated Wire, and Section 71, Dielectric Voltage-Withstand Test.

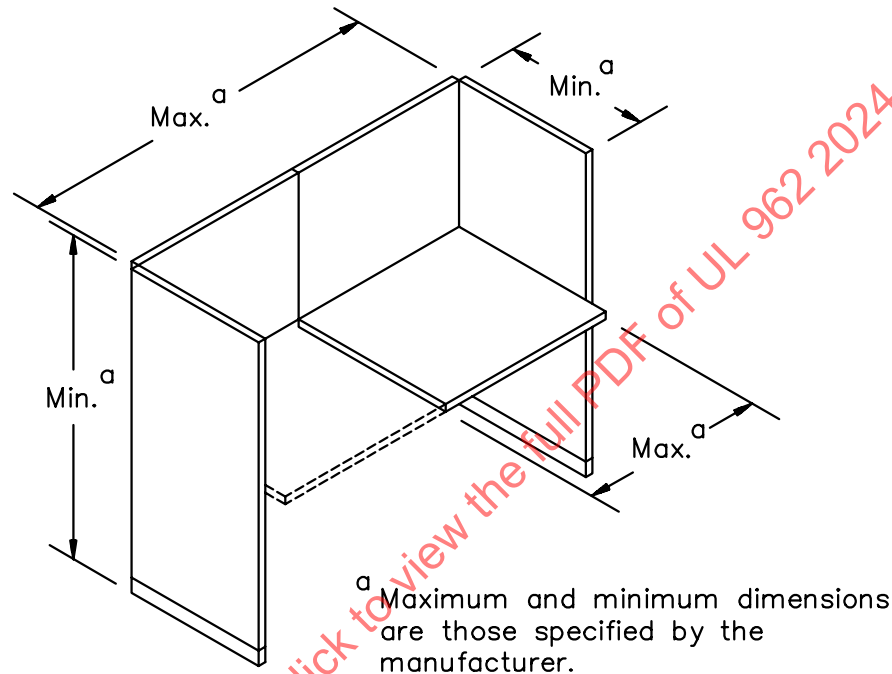
46.1.2 All supporting surfaces shall be simultaneously loaded with the functional loads specified in Table 46.1. Refer to 46.2, Specific structural test methods, for additional details on loading chairs and beds. When there is only one supporting surface the proof load can be applied as representative of conducting the functional load tests.

Table 46.1
Horizontal Surface Loading Requirements

Surface type	Surface size	Functional load	Proof load
Secondary Surface ^a	Unit depth < 8 in (20.32 cm)	1.5 lb/in (267.7 g/cm) of width or equal to the manufacturer's maximum rated capacity ^d .	3.0 lb/in (535.4 g/cm) of width or equal to the manufacturer's maximum rated capacity ^d .
Secondary Surface ^a	Unit depth ≥ 8 in (20.32 cm) ≤ 16 in (40.64 cm)	2.5 lb/in (446.1 g/cm) of width or equal to the manufacturer's maximum rated capacity ^d .	5.0 lb/in (892.3 g/cm) of width or equal to the manufacturer's maximum rated capacity ^d .
Secondary Surface ^a	Unit depth > 16 in (40.64 cm)	3.5 lb/in (624.6 g/cm) of width or equal to the manufacturer's maximum rated capacity ^d .	7.0 lb/in (1249.3 g/cm) of width or equal to the manufacturer's maximum rated capacity ^d .
Work Surface ^a	Unit width	4.7 lb/in (838.3 g/m) of width or 200 lbs (90.72 kg), whichever is greater; or equal to the manufacturer's maximum rated capacity ^d .	7.0 lb/in (1249.3 g/cm) of width or 300 lbs (136.08 kg), whichever is greater; or equal to the manufacturer's maximum rated capacity ^d .
Height Adjustable Desk or Table Work Surface ^a	All sizes	Equal to the manufacturer's maximum rated capacity	1.5 times the Functional Load
Clothes and Towel Rods	All lengths	Not applicable	1.5 lb/in (267 g/cm) times the rod length
Clothes and Towel Hooks	All sizes	Not applicable	2.5 lb/in (446.1 g/cm) per each hook length, measured from one end of the hook to the other
Television/Monitor Support Surfaces or Mounting Arms Rated ≤ 100 lbs (45.36 kg)	All sizes	Load as specified in the user instructions	4 times the load
Television/Monitor Support Surfaces or Mounting Arms Rated > 100 lbs (45.36 kg)	All sizes	Load as specified in the user instructions	2 times the load plus 200 lbs
Bed ^b	Number of intended persons	300 lbs (136.08 kg) per person	500 lbs (226.8 kg) per person
Furnishings with Seating Surfaces ^c	Number of intended persons	300 lbs (136.08 kg) per person	450 lbs (204.12 kg) per person
^a A furnishing that has a circular or irregular shaped surface if determined to be less stable in a partially loaded condition shall be loaded along 1/3 the perimeter edge. ^b Refer to 46.2.1. ^c Refer to 46.2.3. ^d When the Functional Test Load is based on the manufacturer's specification, the Proof Test Load is 4 times the Functional Test Load.			

46.1.3 All secondary support surfaces shall be loaded with the functional loads specified in accordance with [Table 46.1](#). The configuration tested is to be that in which the surface is least supported (Example [Figure 46.1](#)). The load is to be maintained for 15 minutes after the complete loading is attained. Each load is to be uniformly applied along the entire width centered on the line at 1/3 the depth or 4 inches (101.6 mm), whichever is less from the outside edge of the surface.

Figure 46.1
Configuration for Mechanical Strength Test – Load-Bearing Surface



S2768A

46.1.4 All work surfaces shall be loaded with the functional loads specified in accordance with [Table 46.1](#). The configuration tested is to be that in which the surface is least supported (Example [Figure 46.1](#)). The load is to be maintained for 15 minutes after the complete loading is attained. Each load is to be uniformly applied centered on the line of 8 inches along the entire perimeter edge of the surface.

46.1.5 For filing cabinet drawers the load is to be uniformly applied by volume using a material that has a density of 42 ± 8 pounds/feet³ (673 ± 128 kg/m³). (Bound copier paper and particle board have been found to meet this requirement).

46.1.6 For clothes and towel rods, the load is to be uniformly applied along the width of the rod.

46.1.7 For clothes and towel hooks, the load is to be applied to each hook.

46.1.8 Vegetation containers or vegetation container supports intended to support vegetation containers shall be loaded with soil or equivalent. Products not supplied with the vegetation containers shall be tested with the maximum size and weight of container specified in the use instructions and shall be loaded such that dry soil shall be considered to weigh 100 pounds (45.36 kg) per 1 foot³ (0.028 m³) ± 10 pounds (4.53 kg) per 1 foot³ (0.028 m³). Soil shall be additionally saturated with water.

46.1.9 Furnishings provided with a container that will hold water shall be filled to its capacity with water.

46.1.10 Following the functional loading test the weight loads shall be removed and each supporting surface one surface at a time independently loaded with the proof load. Refer to [46.2](#), Specific structural test methods, for additional details on loading chairs and beds.

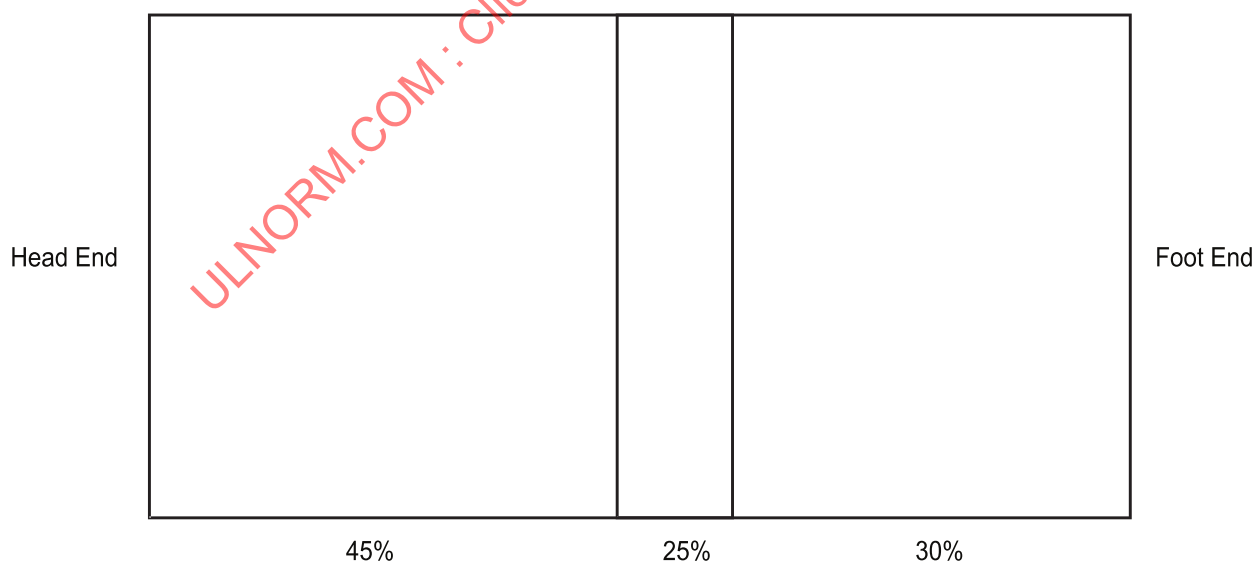
46.2 Specific structural test methods

46.2.1 For a bed, the test weight is to be 500 pounds (227 kg) per intended person. For example, a twin bed is intended for 1 person and a queen bed is intended for 2 people. The test load also includes the weight of a foundation, if applicable, and mattress. See [Table 46.2](#). The weight is to be evenly distributed over the surface. For an articulating bed the weight shall be distributed as shown in [Figure 46.2](#). The weight shall be applied for 15 minutes.

Table 46.2
Foundation and Mattress Load Weight Requirements

Bed type	Foundation (lbs)	Mattress (lbs)	Total (lbs)
Twin	50	80	130
Double (Full)	60	90	150
Queen	75	125	200
King	100	150	250

Figure 46.2
Articulating Bed Weight Distribution
Top View

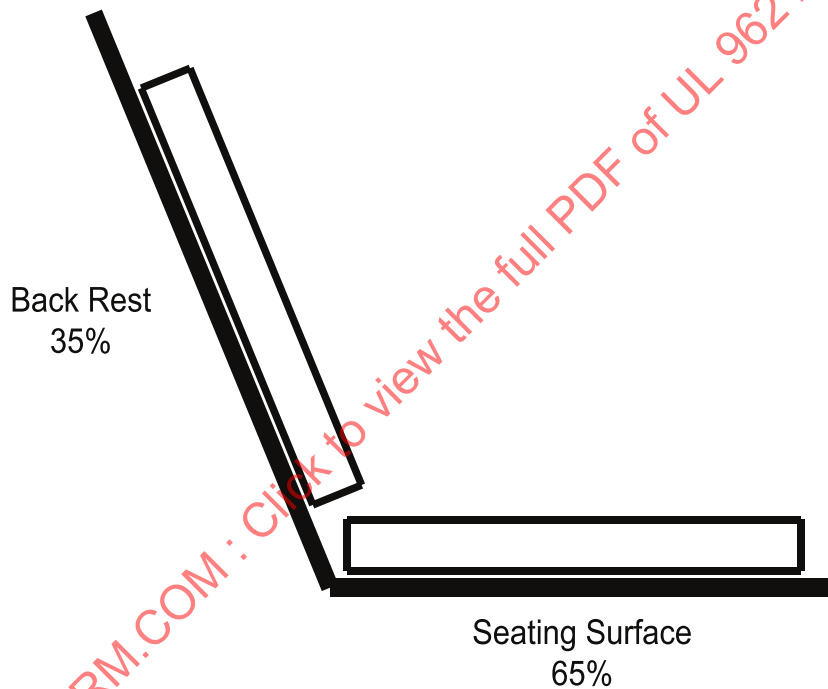


46.2.2 Following the test specified in [46.2.1](#) the weight drop test [46.3.1](#) shall be conducted on the bed. The bed shall comply with [46.1.1](#).

46.2.3 For a chair, the test weight is to be 450 pounds (204 kg) per intended person. For example, a chair is intended for 1 person and a couch is intended for 2 or 3 people. The weight shall be evenly distributed as shown in [Figure 46.3](#) or [Figure 46.4](#). The weight shall be applied for 15 minutes.

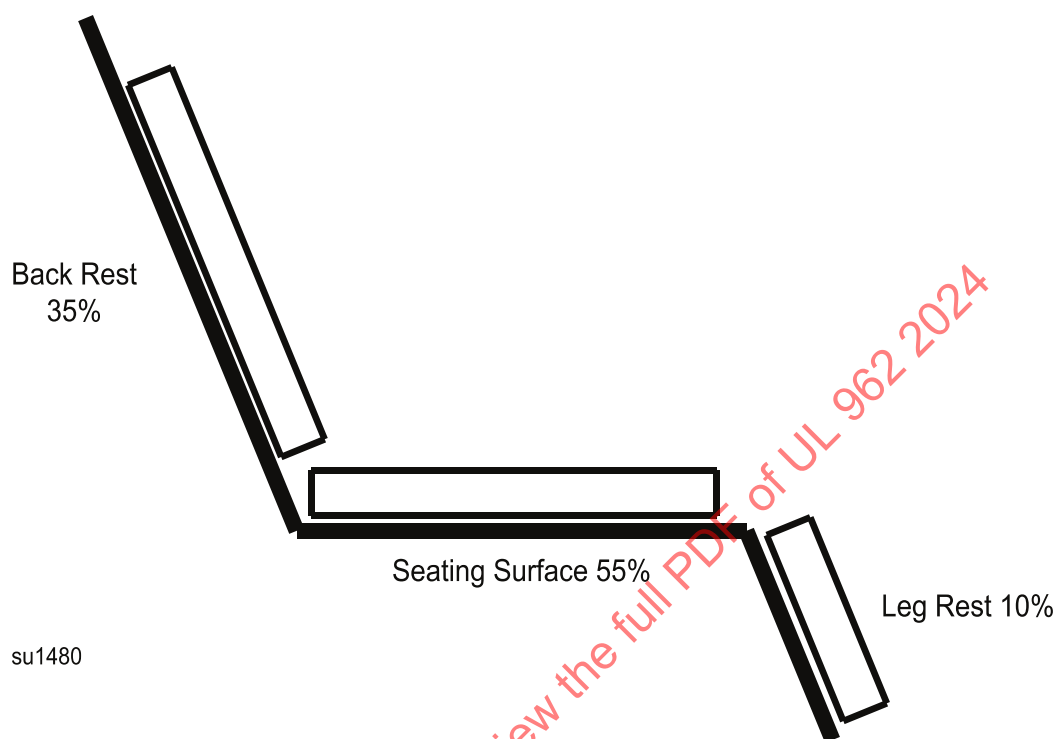
46.2.4 Following the test specified in [46.2.3](#) the weight drop test [46.3.1](#) shall be conducted on the seating surface of the chair. The chair shall comply with [46.1.1](#).

Figure 46.3
Articulating Chair Weight Distribution
Side View



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Figure 46.4
Articulating Chair Weight Distribution
Side View



46.3 Weight drop test

46.3.1 The test weight shall be 300 pounds (136 kg) in a canvass bag 16 inches (41 cm) in diameter filled with sand, ball bearings, lead shot, or steel shot. The weight shall be dropped 6 inches (21.24 cm) above the uncompressed surface. Any seating or lying position not under test shall have a weight of 300 lbs (102 kg) evenly applied over the surface. The system shall comply with [46.1.1](#).

47 Appurtenance Strength Test

47.1 A furnishing shall be constructed such that deformation or damage does not result in a risk of injury to persons, fire, or electrical shock when each appurtenance located within 30 inches (76.2 cm) of the floor (such as a shelf, drawer, door, slide out, flaps, drop fronts, etc) is subjected to the test. The furnishing if intended to support a load shall be loaded with the functional load in accordance with Section [46](#), Structural Test Requirements for Furnishings.

47.2 Each appurtenance is to be separately subjected to a 50 lbf (222 N) force applied in the downward direction for one minute. The force shall be applied:

- a) With the appurtenances in the position that results in the maximum stress to the appurtenance; and
- b) At a point on the appurtenance which will produce the most severe results.
- c) Door surfaces shall be manipulated and loaded by applying a 50-pound (22.68-kg) weight to the top edge of the door at a point 3 inches (7.62 cm) in from the top edge. See [Figure 53.1](#). A door surface located above 30 inches (762 mm) from the floor but accessible to a child by climbing up extendable appurtenances shall be subjected to the test.

d) For multiple appurtenances each appurtenance is to be loaded with 50 pounds one at a time.

48 Upper Bunk Capsule Cabin Loading Test

48.1 Upper bunk capsule cabin shall be assembled in accordance with the provided instructions.

48.2 Center a sheet of 3/4-inch (19-mm) thick plywood with dimensions 19 inch (480 mm) by 37 inch (940 mm) on the upper cabin intended foundation and place weights with a total mass of 400 lbs (181.4 kg) on the plywood sheet. The weights shall be applied gradually and shall remain in place for a minimum of 5 minutes.

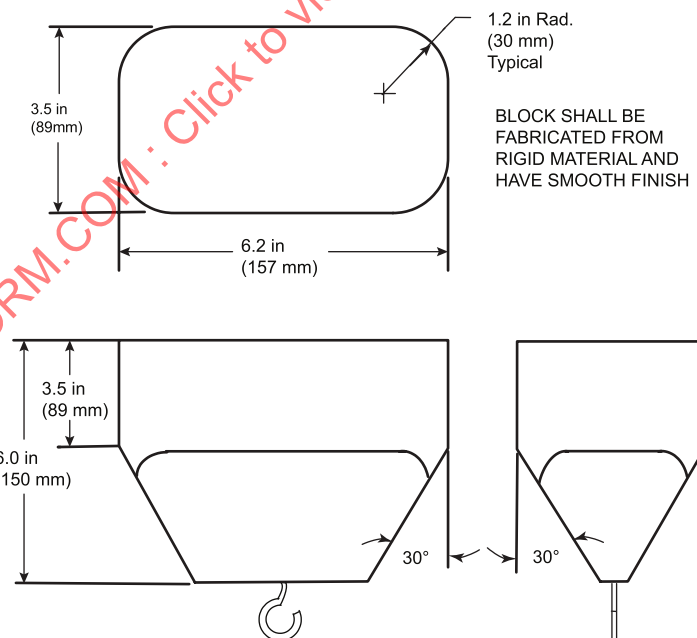
48.3 A furnishing shall not collapse or deform to a degree that presents a risk of fire, electric shock, or injury to persons.

49 Upper Bunk Capsule Cabin Elevated Protective Means Torsional Strength Test

49.1 Place the wedge block shown in [Figure 49.1](#) into any opening in the rigid bed structure below the level of any opening of the elevated protective means tapered side first, and in the most adverse orientation, and gradually apply a 33-lbf (148-N) force in a direction perpendicular to the plane of the opening for a period of 1 minute.

49.2 The block shall not pass through any of the openings.

Figure 49.1
Test Block

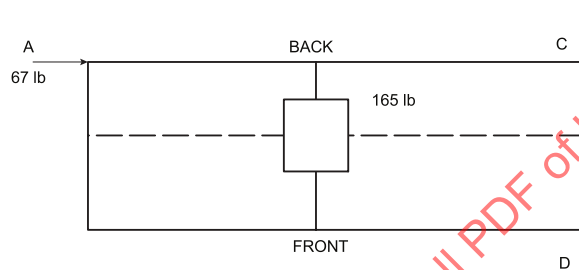


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50 Separation Test

50.1 The unit shall be prevented from sliding in a manner that does not prevent changes of angle that may take place in the bed structure. Position a test load of 165 lb (75.0 kg) at the center of the upper foundation support system on an area not to exceed 12 inch (300 mm) square (if foundation support systems does not permit the test load to be so positioned, it is permissible to add a platform to support the test load in such a way as to not increase the structural integrity of the bed). Apply an alternate force of 67 lbf (300 N) for 10 000 cycles at each point in the order ABCD or AB followed by CD at a rate not more than 24 loads per minute (see [Figure 50.1](#)). The points for applying the test forces shall be located as near the center of the vertical bunk bed support as practicable at the height of the upper foundation support system.

Figure 50.1
Test Points



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50.2 After testing in accordance with [50.1](#), remove the 165-lb (75.0-kg) load and apply a 67-lbf (300-N) force in directions most likely to cause separation between the end structure and foundation support system. The force shall be applied at each point of attachment of the foundation support system to the end structure (point of applications shall be as close as practical to the point of attachment). The force shall be applied to either the end structure or foundation support system, whichever appears most likely to cause separation.

50.3 At no time shall there be any separation.

51 Handrail and Guardrail Test

51.1 A handrail and guardrail shall withstand a lateral load of 20 pounds per linear foot (2.77 kg/linear m).

51.2 The handrail and guardrail shall not exhibit any signs of disconnection.

52 Ceiling Support Test

52.1 A room-in-room or booth with a ceiling shall show no signs of damage, such as cracking or deformation, after being subjected to the test in [52.2](#).

52.2 The weight of the ceiling shall be determined. Twice the weight of the ceiling and the rated load, if any, shall be evenly distributed along the top of the walls. If the walls have any shelves or tables attached, these items shall be loaded to their functional load. The load shall be maintained for 15 minutes.

Exception: When the ceiling is marked at the perimeter of each side of the ceiling in accordance with [86.42](#), the test is not required.

53 Stability Tests

53.1 General stability test criteria

53.1.1 A furnishing when subjected to the stability requirements shall not present a risk of fire, electric shock, or injury to persons.

a) A risk of injury to persons is determined to exist when the furnishing or part of a furnishing overturns, is displaced or dislodged from its support surface or when the furnishing or support surface is damaged to the extent that there are sharp edges or corners exposed which do not comply with UL 1439.

b) Electrical components within the furnishing shall comply with the requirements of Section [13](#), Accessibility of Uninsulated Live Parts and Film-Coated Wire, and Section [71](#), Dielectric Voltage-Withstand Test after the stability test.

Exception: Based on visual observation that no damage has occurred to the electrical components these tests are not required to be performed.

53.1.2 A furnishing is to be tested on a smooth hard surface such as concrete or smooth wood. The furnishing shall be assembled or set up in accordance with the instruction manual provided with the furnishing.

53.2 Furnishing stability configuration test requirements

53.2.1 A furnishing shall be assembled in accordance with the installation or assembly instructions.

53.2.2 A furnishing that requires an addition of a component or material in order to perform its intended function shall be tested for stability with the component or material in place. (Examples: A container that requires dirt to be in place to plant a plant, a decorative water feature where the user is required to add water for the unit to function, a patio shade umbrella that requires a ballast material in its base to remain upright in accordance with the instructions).

53.2.3 If a furnishing can perform its intended function with or without the component or material, including the intended load, in place as referenced in the functional loading requirements, Section [46](#), Structural Test Requirements for Furnishings, the furnishing shall be subjected to the stability test in any or all of the following conditions considered being most severe:

- a) Unloaded;
- b) Partial functional load as specified in [53.2.4](#); or
- c) Fully loaded with the functional load.

53.2.4 When testing for partial functional load, the full functional load shall be placed on the furnishing as defined under loading tests specified in Section [46](#), Structural Test Requirements for Furnishings. Then portions of the load are to be removed so that the furnishing is tested in the least stable position. Examples:

a) Rectangular Table with Wheels: With the table on a 10° angle, the portions of the functional load that are on the opposite side of the 10° angle are removed.

b) Bookcase: With the bookcase on a 2° angle, portions of the functional load on the bottom shall be removed first, and then the lowest shelf load shall be removed. Each shelf shall be unloaded until only the highest load is in place.

c) Desk with Hutch: With the desk on a 2° angle, and the side with the hutch closest to the 2° angle, the portions of the functional load on the desk work surface that are on the opposite side of the 2° angle are removed first. Then the rest of the load on the desk surface shall be removed. Once the desk surface is unloaded, the lowest shelf of the hutch shall be removed. Each shelf shall be unloaded until only the highest load is in place.

d) Patio Lighted Umbrella with Stand (where consumer has to add water to stand): The umbrella stand shall not be filled with water. The stand with the umbrella shall be placed on a 10° angle.

53.2.5 Articulated parts shall be positioned and loaded to represent worst case. This may require multiple tests to determine. (Example: A furnishing which is intended to be used with or without a video display or converts from an entertainment center to an armoire, wardrobe or shelving unit.)

53.2.6 The load may be secured to the furnishing for test purposes. Loads shall comply with Section 46, Structural Test Requirements for Furnishings, functional loads.

53.2.7 A furnishing that is comprised of an assembly that allows for portions of the assembly to be used without being completely assembled shall comply with the stability test both assembled and with the usable portion of the assembly alone without the other attachments. (Example: A patio umbrella and table assembly where the umbrella or table can be used without the other component).

53.2.8 A furnishing provided with a means to level the furnishing shall be adjusted to level or as closely to level as the adjustment allows in accordance with the use instructions.

53.2.9 A furnishing provided with a coordinating device that only allows the opening or extending of drawers, doors or appendages in a specific combination or sequence shall be used for the conduct of the stability test if found to function as intended when attempts are made to manually defeat the device by opening and closing the operable elements of the furnishing in any combination.

53.2.10 Doors shall be manipulated to a point that provides the least stability for the furnishing (typically perpendicular, 90°, to the front plane of the furnishing). Other positions shall be investigated if 90° to the front plane of the furnishing is determined not to be the worst case position for stability. All doors shall be manipulated singly or in combination. Positioning of doors or other appurtenances shall not be used to prevent tip over.

53.3 Stability test for portable furnishings

53.3.1 A portable furnishing shall be constructed so that there is no risk of fire, electric shock or injury to persons when subjected to the test specified in 53.3.2 and 53.3.3. The furnishing shall not overturn.

53.3.2 The load used for storage or work areas shall be fully loaded with the functional load as specified in Section 46, Structural Test Requirements for Furnishings, partially loaded, or unloaded. Loads shall be applied in accordance with 46.1, General loading, and may be secured to the furnishing for test purposes.

53.3.3 The portable furnishing is to be placed in any orientation on an incline plane at an angle of 10° to a level horizontal plane. Furnishings with articulating features are to be adjusted to the least stable position.

53.4 Stability tests for stationary and fixed furnishings

53.4.1 A furnishing shall be constructed so that there is no risk of fire, electric shock or injury to persons when subjected to the tests specified in [53.4.2](#). The furnishing shall not overturn.

53.4.2 The load used for storage or work areas shall be fully loaded with the functional load specified in Section [46](#), Structural Test Requirements for Furnishings, partially loaded, or unloaded. Loads shall be applied in accordance with Section [46](#) and may be secured to the furnishing for test purposes. The furnishing is to be placed in any orientation on the incline plane. Furnishings with articulating features are to be adjusted to the least stable position.

a) A furnishing without casters, rollers or wheels is to be placed on an incline plane at an angle of 2° to a level horizontal plane. The furnishing may be loaded or adjusted before or after being placed on the incline. The glides, feet, and similar parts are to be blocked or otherwise restricted from moving along the surface. The means used to restrict movement are not to restrict tipping of the assembly.

b) A stationary furnishing with casters, rollers or wheels is to be placed on an incline plane at an angle of 10° to a level horizontal plane. The casters, rollers or wheels shall be rotated to the least stable position. The furnishing may be loaded or adjusted before or after being placed on the incline. The casters, rollers or wheels are to be blocked or otherwise restricted from moving along the surface. The means used to restrict movement shall not restrict tipping of the assembly.

53.5 Appurtenance stability test

53.5.1 A furnishing shall be constructed such that deformation or damage does not result in a risk of fire, electrical shock or injury to persons. Each appurtenance located within 30 inches (762 mm) of the floor is to be separately subjected to a 50 lbf (222 N) force applied in the downward direction for one minute.

53.5.2 For horizontal sliding and extending appendages (drawers, slide outs, flaps, drop fronts and the like):

a) The appurtenance shall be extended from the furnishing until it reaches its fully extended position.

b) Appurtenances such as a drawer shall be loaded with the functional load requirements refer to Section [46](#), Structural Test Requirements for Furnishings. The weight shall be equally distributed over the area of the drawer bottom. If determined to be less stable the appurtenances may be unloaded and may be extended in any combination.

c) Each appurtenance:

1) The appurtenance shall be subjected to a 50-pound (22.7-kg) weight applied to the top edge anywhere along the width of the appurtenance. See [Figure 53.1](#) and [Figure 53.2](#).

2) When multiple appurtenances are provided within 30 inches (762 mm) of the floor the lowest appurtenance is to be fully extended and loaded with 50 pounds (22.7 kg). The weight is then to be removed and divided in to two 25-pound (11.35-kg) loads between the lowest and next highest appurtenance within 30 inches (762 mm) of the top surface of the lowest appurtenance. The appurtenances are to be fully extended so that 25 pounds (11.35 kg) is placed on the lowest and next highest appurtenance. The weight is then to be removed from the lowest appurtenance and the next highest appurtenance is to be loaded with the two 25 pound (11.35 kg) loads while the lowest appurtenance is left in the open position but without the simulated weight of the child. This process is to be repeated from each appurtenance located within 30 inches (762 mm) of the last loaded appurtenance

tested. This test is to simulate a child ascending a furnishing utilizing the appurtenances to climb. See [Figure 53.3](#).

Figure 53.1
Appurtenance Loading

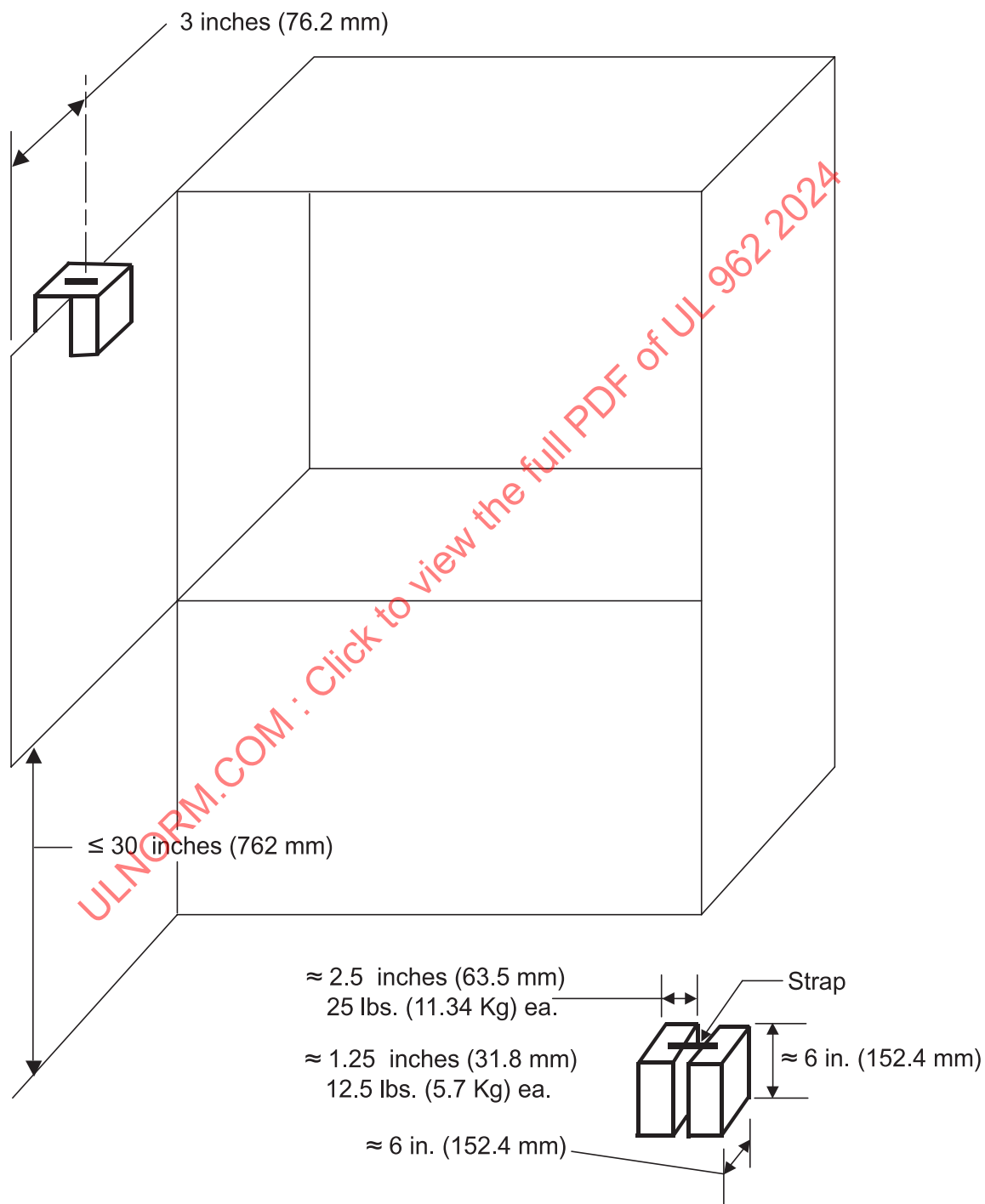
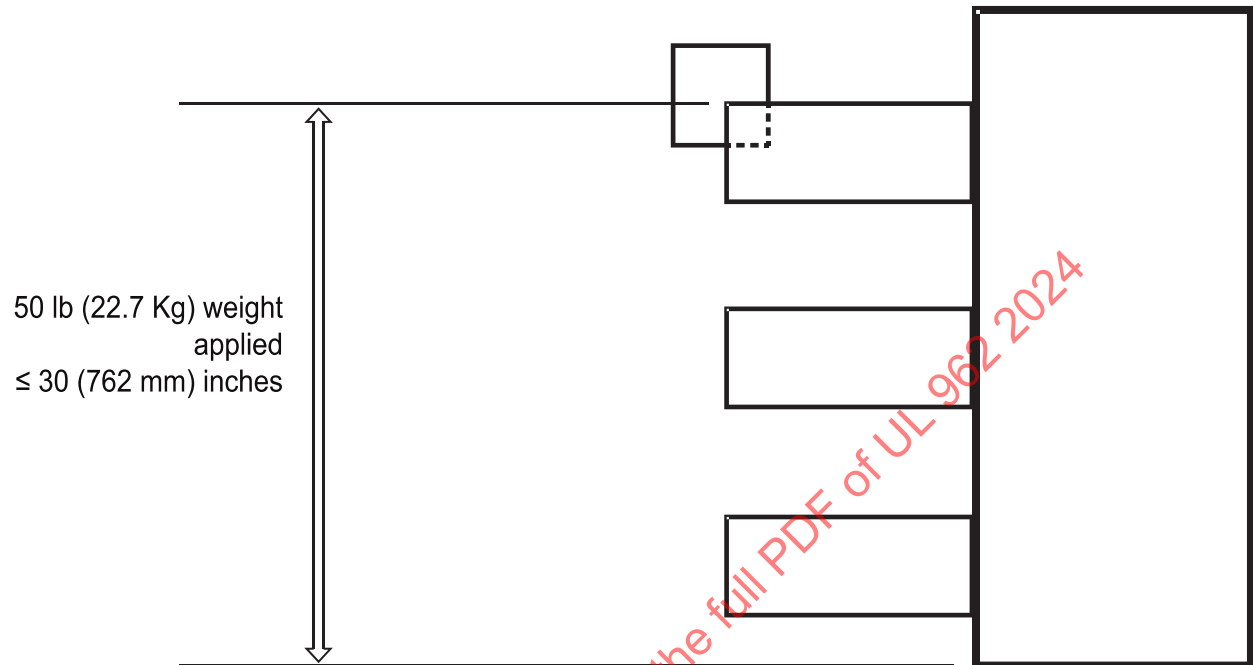


Figure 53.2

Appurtenance Loading – [53.5.2\(c\)\(1\)](#)

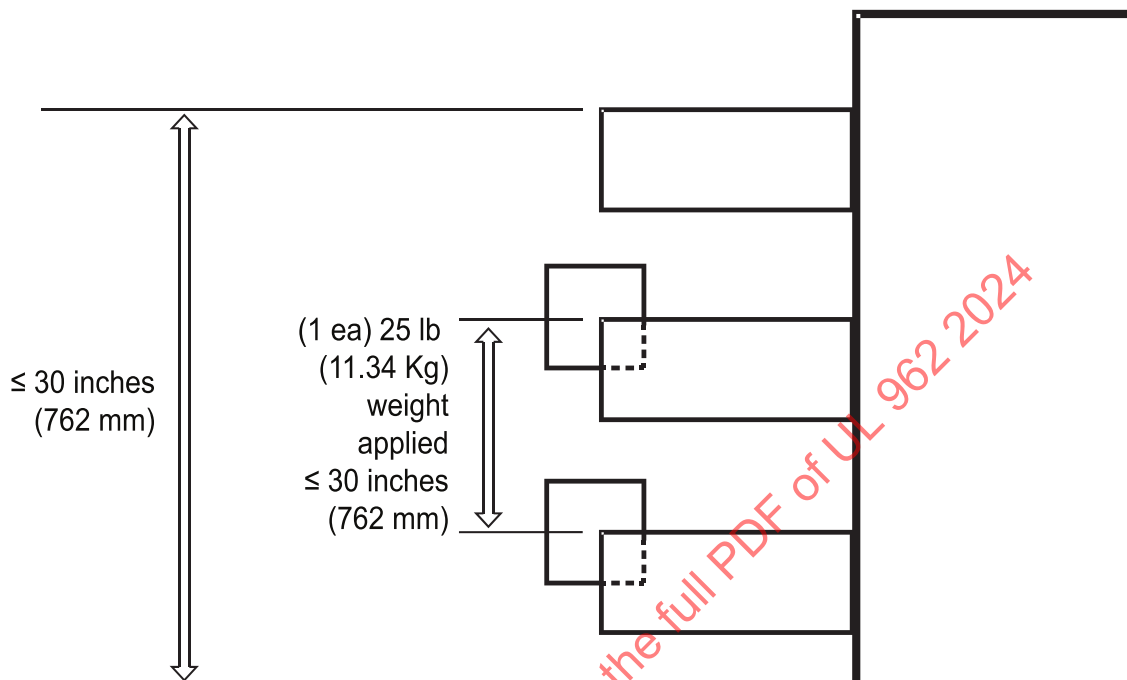
Example: Side View – Chest of Drawers



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Figure 53.3
Appurtenance Loading – 53.5.2(c)(2)
Example: Side View – Chest of Drawers



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53.6 Stability test for furnishings provided with a step

53.6.1 A furnishing with an intentional step or a surface that is likely to be used as a step shall be constructed such that there is not a risk of fire, electric shock or injury to persons when subjected to the test specified in 53.6.2. The furnishing shall not over turn or if secured to a structure shall not separate from the structure.

53.6.2 The furnishing shall be configured as specified in Section 46, Structural Test Requirements for Furnishings. A fully assembled furnishing is to be subjected to a 300-pound (435-N) load applied straight down through a flat rigid structure 4 by 4 inches (102 by 102 mm) in any position along the furnishing structure element under investigation. The load is to be applied for 1 minute.

53.7 Stability test for furnishings provided with a foot or leg rest

53.7.1 A furnishing with a foot or leg rest or a surface that is likely to be used as a foot or leg rest shall be constructed such that there is not a risk of fire, electric shock or injury to persons when subjected to the tests specified in 53.7.2. The furnishing shall not over turn or if secured to a structure shall not separate from the structure.

53.7.2 The furnishing shall be configured as specified in Section 46, Structural Test Requirements for Furnishings. A fully assembled furnishing is to be subjected to a 50 pound (222.4 N) load applied straight down through a flat rigid structure 4 by 4 inches (102 by 102 mm) in any position along the furnishing structure element under investigation. The load is to be applied for 1 minute.

53.8 Stability test for furnishings with seating surfaces

53.8.1 A furnishing intended for seating shall be constructed such that there is not a risk of fire, electric shock or injury to persons when subjected to the tests specified in [53.8.2](#). The furnishing shall not overturn.

53.8.2 The furnishing shall be configured as specified in Section [46](#), Structural Test Requirements for Furnishings. A sample of each type of fully assembled furnishing is to be subjected to a 300-pound (136-kg) load applied through a 16 inch (406 mm) diameter rigid disk. The load is to be moved or repositioned slowly over the entire surface intended for seating. The edge of the disk shall be allowed to overhang the edge of the furnishing a maximum of 4 inches (102 mm) along unobstructed edges. An obstructed edge is considered to be one which has a raised projection such as the back of a chair, the arms of a chair, a fixed railing, the foot board or head board of a bed.

53.9 Force stability test

53.9.1 A furnishing 42 inches (1067 mm) or taller shall be constructed such that there is no risk of fire, electric shock or injury to persons when subjected to the tests specified in [53.9.2](#) and [53.9.4](#). The furnishing shall not overturn.

53.9.2 A furnishing shall be unloaded and is to be subjected to a gradually increasing horizontal force applied through the center of an 8 inches (203 mm) diameter disc to at least the locations specified in [53.9.4](#) at any location centered along a horizontal line 54 inches (1371.6 mm) above the floor or 4 inches (102 mm) down from the top edge whichever is higher. The force is to be increased until either a 40 pound (180 N) force is attained or the assembly inclines to an angle of 10° without tipping over, whichever occurs first. The force is then to be gradually reduced to zero. Refer to [Figure 53.4](#).

53.9.3 With respect to [53.9.1](#), if a furnishing has installation instructions that specify a specific side or sides to be placed against a fixed structure, the force shall not be applied toward the fixed structure. The furnishing shall be marked in accordance with [86.33](#).

53.9.4 The force shall be applied as follows:

- a) To front of the product at its left side;
- b) To front of the product at its right side;
- c) To back of the product at its left side;
- d) To back of the product at its right side;
- e) To the left side of the product;
- f) To the right side of the product.

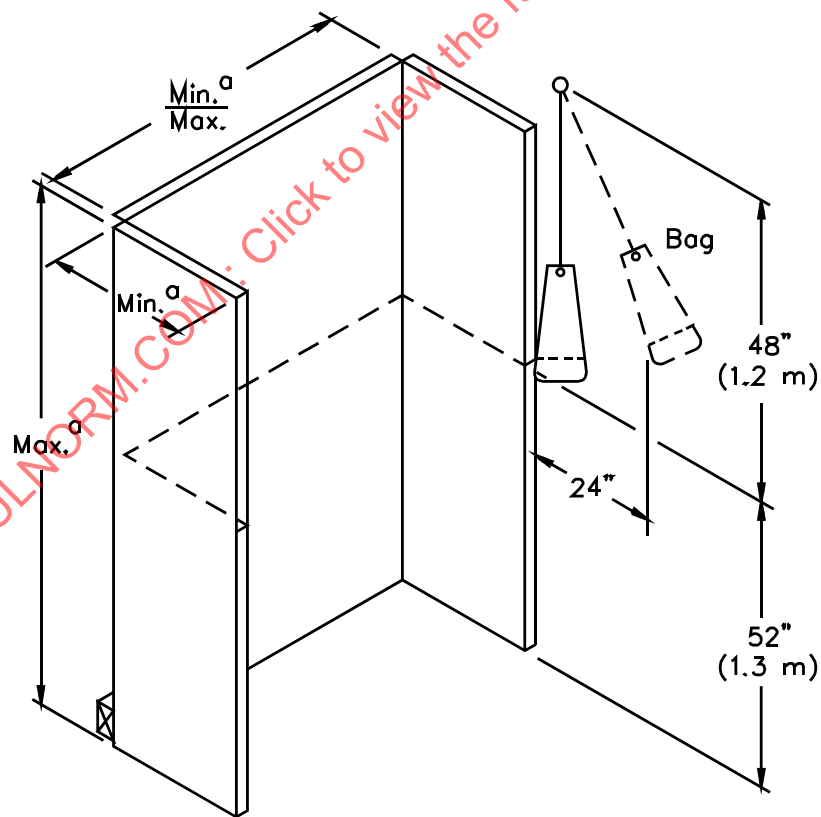
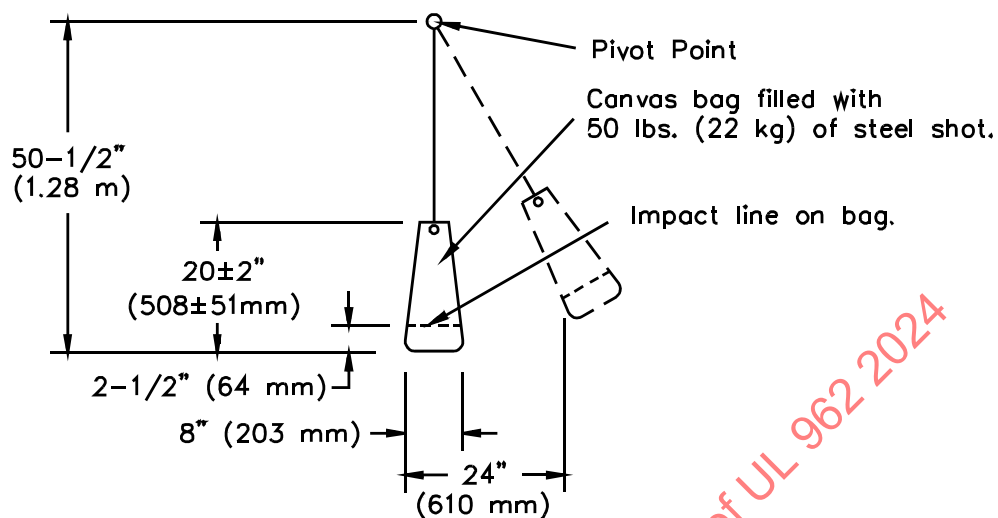
53.10 Commercial furnishing impact stability test

53.10.1 A floor supported furnishing for commercial use shall be constructed such that there is no risk of fire, electric shock or injury to persons when subjected to the tests specified in [53.10.2](#). The furnishing shall not overturn.

53.10.2 Each of the furnishing assemblies is to be subjected to a single impact of a lead- or steel-shot-filled canvass bag having a diameter of 8.0 ± 0.5 inches (203 ± 13 mm) and a weight of 50 pounds (22 kg). The bag is to fall as a pendulum from a pivot point 48 inches (1.2 m) above the point of impact so as to traverse a horizontal distance of 24 inches (610 mm) and strike the furnishing. The point of impact is to be at any location centered along a horizontal line 52 inches (1.3 m) above the floor or 4 inches (102 mm) below the top of the furnishing, whichever is lower. Refer to [Figure 53.5](#) for details regarding the impact stability test.

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Figure 53.5
Details for Impact-Stability Test



^a Maximum and minimum dimensions are those specified by the manufacturer.

53.11 SOHO small office/home office furnishing – Tests

53.11.1 A furnishing identified specifically for use in a home office as specified in the installation and use instructions, [100.3](#), and marked as required by [86.31](#), shall be tested in accordance with SOHO S6.5. The required tests are as shown in [Table 53.1](#).

53.11.2 For the functional load tests specified in SOHO S6.5, the system shall not tip over or become disengaged as a result of the tests specified in [53.11.1](#). Components shall not separate from the system, and there shall be no loss of serviceability or damage incurred that results in a risk of fire, electric shock, or injury to persons.

53.11.3 For proof load tests, there shall be no sudden and major change in the structural integrity of the product as a result of the tests of specified in [53.11.1](#). Loss of serviceability is acceptable and there shall be no damage incurred that result in a risk of fire, electric shock, or injury to persons.

Table 53.1
SOHO S6.5

Section reference	Section title
4.1 – 4.2	Stability Under Vertical Load Test
4.3	Stability Test for Units With Extendible Load Bearing Elements
4.4	Freestanding Pedestal Stability Test
4.5	Horizontal Force Stability
4.6	Vertical Force Stability For Bookcases > 42 inches (1067 mm)
4.7	Horizontal Force Stability For Bookcases > 42 inches (1067 mm)
5.1 – 5.2.4	Static Load Tests
5.3	Concentrated Functional Load Test for Primary Surfaces
5.4	Distributed Proof Load Test for Individual Surfaces
5.5	Concentrated Proof Load Test for Individual Surfaces
5.6	Unit Strength Tests
5.7	Extendible Element Proof Load Test
9	Interlock Tests – Statics
16.1 – 16.3	Hinged Door Tests

54 Structure Mounted or Secured Furnishing Tests

54.1 General

54.1.1 The Cycling Test for Furnishings with Articulating Components, Section [59](#), shall be conducted prior to conducting the furnishing securement tests.

54.2 Suspended furnishing, securement test

54.2.1 A furnishing secured to a vertical structure without additional support at the base (floor, shelf) or a furnishing suspended from a horizontal structure (ceiling, rack) shall be secured to a structure in accordance with the installation instructions using the hardware provided or specified. See [92.10](#). A furnishing system and its accessories shall be constructed so there is no cracking, or similar damage to the mounting bracket, securement means, supporting structure, furnishing or any combination thereof to the point where the mounting system releases from the structure, the product collapses, creates a risk of fire, electric shock, or injury to persons when tested in accordance with [54.2.2](#) and [54.2.3](#).

54.2.2 Section 58, Common North American Structures, is provided as guidance for typical building surfaces located in North America. The test may be conducted using any surface type. The installation instructions shall specify the surfaces that were used for the test. Sufficient detail shall be provided in the instructions to specify the structures, hardware, fasteners and mounting system that were investigated to support the furnishing.

54.2.3 The test load shall be 4 times the weight of the furnishing plus the functional load specified in Section 46.1.10. The total test weight is to be gradually applied and maintained for 5 minutes.

Example: Furnishing weighs 50 lbs (22.7 kg) and has a normal load of 20 lbs (9.1 kg). The test load to be added to the furnishing is 4 times 50 lbs (22.7 kg) plus the 20 lbs (9.1 kg) equaling 220 lbs (100 kg).

54.3 Vertically secured – Base supported, securement test

54.3.1 A furnishing system intended for attachment to a vertical structure while also resting on a horizontal structure (floor, shelf) shall be secured to the structure in accordance with the installation instructions using the hardware provided or specified. See 92.10. A furnishing system and its accessories shall be constructed so there is no cracking or similar damage to the mounting bracket, securement means, supporting structure, furnishing or any combination thereof to the point where the mounting system releases from the structure, the product collapses, creates a risk of fire, electric shock, or injury to persons when tested in accordance with these requirements.

54.3.2 The furnishing shall be placed on a 2° plane that slopes away from the vertical support structure. The test shall be configured as follows:

- a) Any adjustable leveling system shall be used to bring the furnishing parallel to the vertical structure or as close to parallel to the vertical structure as the leveling means allows.
- b) All appurtenances shall be adjusted to extend to their maximum position away from the vertical structure.
- c) The furnishing shall be loaded with the functional load in accordance with Section 46, Structural Test Requirements for Furnishings.
- d) The furnishing shall be subjected to these forces for 5 minutes.

54.4 Base secured – Base supported, securement test

54.4.1 A furnishing system intended for attachment to a horizontal structure (example: floor or shelf) while also resting on the horizontal structure shall be secured to the structure in accordance with the installation instructions using the hardware provided or specified. See 92.10. A furnishing system and its accessories shall be constructed so there is no cracking or similar damage to the mounting bracket, securement means, supporting structure, furnishing or any combination thereof to the point where the mounting system releases from the structure, the product collapses, creates a risk of fire, electric shock, or injury to persons when tested in accordance with these requirements.

54.4.2 The furnishing shall be placed on a 2° plane that slopes away from the vertical support structure. The test shall be configured as follows:

- a) Any adjustable leveling system shall be used to bring the furnishing parallel to the vertical structure or as close to parallel to the vertical structure as the leveling means allows.
- b) All appurtenances shall be adjusted to extend to their maximum position away from the vertical structure.

c) The furnishing shall be loaded with the functional load in accordance with Section 46, Structural Test Requirements for Furnishings.

d) The furnishing shall be subjected to these forces for 5 minutes.

55 Tests on Glass Sheets

55.1 Impact test

55.1.1 In accordance with 11.10.3, Glass components, a glass surface shall be subjected to the impact test specified in 55.1.2. The glass surface shall not crack or break to the extent that a piece of the glass surface is released or drops from its normal position.

55.1.2 A solid steel sphere, 2 inch (51 mm) in diameter and weighing 1.18 pounds (0.54 kg), is to fall through the distance required to result in an impact of 5 ft-lbf (6.8 J). The sample is to be supported as normally supported by the furnishing.

55.2 Glass retention test

55.2.1 In accordance with 11.10.3, Glass components, a glass surface shall be subjected to the retention test specified in 55.2.2. The glass shall not become dislodged or displaced from its mounting means.

55.2.2 The glass surface is to be mounted in the intended manner. A sand-filled bag having a 30.0 ± 0.5 in (760 ± 13 mm) circumference and a weight of 20 lb (9.1 kg) is to fall as a pendulum through the distance that produces an impact of 35 ft-lbf (47.4 J) on any point on the panel.

56 Tests On Mirrors Using Glass And Laminate Construction

56.1 Boiling test

56.1.1 Three 12 by 12 inches (30 by 30 cm) samples of the glass and laminate construction of a mirror shall be immersed in water maintained at 66 ± 2 °C (150 ± 4 °F) water for 3 minutes. The samples shall be quickly removed and placed in boiling water [minimum 100 ± 2 °C (212 ± 4 °F)] for 2 hours. After the water conditioning, the samples shall be allowed to cool by returning to room temperature. The samples are then to be dried and examined.

56.1.2 There shall be no evidence of bubbles or other defects more than 0.5 inch (12 mm) from the outer edge of the sample or from any crack in the glass that may develop. The glass itself may crack as a result of the test.

56.2 Impact test

56.2.1 Four samples of a mirror constructed with glass and laminate shall be installed in accordance with the manufacturer's installation instructions and subjected to this test. A 100 pound (45.4 kg) bag filled with shot shall be raised to a height of 48 inches (122 cm) to produce an impact of 400 ft-lbf (542 J) and allowed to fall as a pendulum to impact the mirror. For example, the bag is to fall as a pendulum with a rope 96 inches (244 cm) from a pivot point so as to traverse a horizontal distance of 83 inches (211 cm) and strike the mirror. The impact point shall be within 2 inches of the center of the mirror.

56.2.2 The glass and laminate shall not have an opening greater than 3 inches (7.6 cm) in diameter, and the total weight of ten largest pieces of the glass and laminate shall not exceed the weight of a 10 square inch (64 cm^2) section of glass and laminate.

56A Tests for Unsecured Glass Worksurfaces

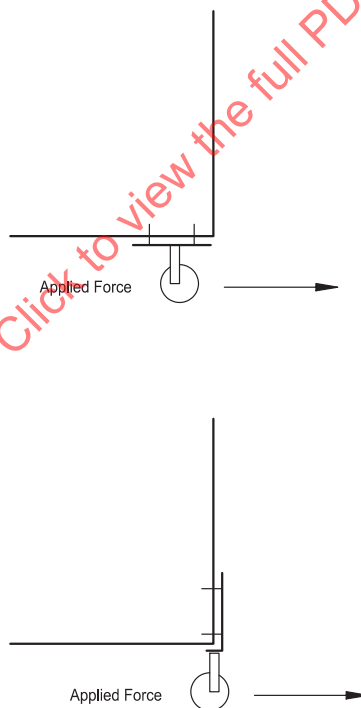
56A.1 Unsecured glass worksurfaces shall be subjected to the Unattached Desk or Tabletop Retention Test from BIFMA X5.5.

57 Wheel, Roller, or Caster Securement Test

57.1 A wheel, roller, or caster shall be capable of withstanding a pull equal to the normal functional load plus the weight of the furnishing, divided by the number of wheels, rollers, or casters supporting the loaded weight of the furnishing when applied as specified in [57.2](#).

57.2 The force is to be applied by a weight or a steady pull for a period of 1 minute as shown in [Figure 57.1](#) in any direction that represents the worst case based on how the wheel, caster or roller is attached. The force shall be applied at the axle center of the wheel, caster or roller. The force is to be applied with the specimen at room temperature and the furniture unloaded. The wheel, roller, or caster shall not pull free from its securing means and shall remain suitable for its intended use.

Figure 57.1
Caster Test



su0005

58 Common North American Structures

58.1 General

58.1.1 Section [58](#) is provided to assist the user in selecting typical representative supporting surfaces. Tests are not required to be conducted utilizing these specific surfaces. The actual surfaces that the product is intended to be mounted to and the hardware to be used to accomplish the mounting or securement shall be tested and then specified in the installation instructions. For the purpose of these requirements “standard” materials are referenced to provide a basis of comparison of test results.

58.2 Insert type masonry anchors

58.2.1 Concrete anchors are to be installed in accordance with the anchor installation instructions. For performance tests in concrete the concrete area shall be at least two times the total intend mounting surface area that the furnishing mount will cover when installed. The concrete thickness shall be at least twice the depth of the anchor.

58.2.2 Whenever a standard concrete material is necessary it shall be mixed so that the 28 day compressive strength is from 2500 to 3000 psi (17.2 to 20.7 MPa) or equivalent.

58.2.3 Whenever standard concrete block is required, it shall comply with ASTM C90.

58.2.4 Whenever standard clay brick is required, it shall be comply with ASTM C62.

58.2.5 Following the installation of the test anchors in the substrate the furnishing mounting system is to be secured to the anchors in accordance with the instructions specified in Section [46](#), Structural Test Requirements for Furnishings.

58.3 Power driven masonry anchors/fasteners

58.3.1 Concrete powder-driven fasteners are to be driven into the concrete mounting samples to the full depth of the shank. Following the installation of test samples in the concrete each assembly is to be secured and subjected to the required loading as specified in Section [46](#), Structural Test Requirements for Furnishings.

58.3.2 Whenever standard concrete material is necessary it shall be proportioned so that the 28 day compressive strength is from 2500 to 3000 psi (17.2 to 20.7 MPa) or equivalent.

58.3.3 Samples of fasteners intended for use in steel are to be driven into steel having thickness(es) in which it is intended for use and having hardness values (Brinnell) of not less than 160 nor more than 240.

58.3.4 Each sample is to penetrate to the depth specified in the installation instructions.

58.4 Welding studs

58.4.1 Welding studs are to be attached to steel plates using the tools and methods specified in the installation instructions.

58.5 Wood studs

58.5.1 The furniture mounting system shall specify the minimum acceptable wall system to which the furniture mounting system is intended to be secured to. The minimum stud size (nominal 2-inch (50.8 mm) by 4-inch (102 mm), 2-inch (50.8 mm) by 6-inch (152 mm), etc.), the minimum and maximum stud spacing, the maximum specified wall covering thickness (Gypsum drywall, lath and plaster, etc) shall be used for the test. Standard wood studs shall be graded in accordance with the American Softwood Lumber Standard No. PS 20 and shall be Grade No. 2.

58.5.2 For a typical 2-inch (50.8 mm) by 4-inch (102 mm) or 2-inch (50.8 mm) by 6-inch (152 mm) wood stud the fastening means used to secure the mounting system to the wood studs shall be secured to the thin edge of the stud, the 1-1/2 inch (38 mm) width.

58.6 Steel studs

58.6.1 The minimum acceptable wall system to which the mounting system is intended to mount shall be specified. The minimum stud size (2-inch (50.8 mm) by 4-inch (102 mm), 2-inch (50.8 mm) by 6-inch (152 mm), etc.), the minimum stud metal thickness or gauge, the minimum and maximum stud spacing, the stud type and structural shape conforming to the North American Specification for the Design of Cold-Formed Steel Structural Members, the maximum wall covering thickness (Gypsum drywall, lath and plaster, etc) shall be used for the test. Gypsum wallboard shall be standard 1/2 inch (12.7 mm) or less non fire rated secured to the studs with screws 12 inches (305 mm) on center.

58.6.2 For a typical 2-inch (50.8 mm) by 4-inch (102 mm) or 2-inch (50.8 mm) by 6-inch (152 mm) steel stud the fastening means used to secure the mounting system to the steel studs shall be secured to the thin edge of the stud, the 1-1/2 inch (38 mm) width.

59 Cycle Test for Furnishings with Articulating Components

59.1 A furnishing with an articulating feature that when loaded exceeds 50 pounds (22.68 Kg) shall be constructed so there is no collapse, permanent damage, loosening of hinges or fasteners resulting in a risk of fire, electric shock, or injury to persons during or after the cycling test. The furnishing shall be installed according to the instructions provided with the furnishing. All movement tension adjustments shall be adjusted to provide the greatest resistance to movement recommended by the instructions provided.

59.2 The cycling test shall be conducted prior to conducting the furnishing securement test.

59.3 An articulating furnishing and its accessories shall be constructed so there is no undue wear to joints or reduction of spacings or damage to electrical insulation after the cycling test. Spacings shall comply with Section 20, Spacings, after cycling and the furnishing systems electrical system shall comply with Section 71, Dielectric Voltage Withstand Test, after cycling.

Exception: Electrical systems supplied by a class 2 or LPS power source and posing no risk of injury from failure to operate are not required to comply with the dielectric voltage withstand test after cycling.

59.4 A manually or motor operated articulating furnishing shall be subjected to 500 cycles of operation. Threaded fasteners and tension adjustments shall not be adjusted during the cycling test.

59.5 During the cycling test, an articulating furnishing system shall be loaded as specified for the functional loading test in Section 46, Structural Test Requirements for Furnishings.

59.6 A cycle is considered to be one extreme position to the opposite extreme position and back to the original position.

59.7 A cycle for a furnishing system with more than one axis of movement shall be cycled such that each axis is to be cycled either individually or in combination, whichever operation is allowed by the control and results in the 500 cycles being equally divided between all axes of adjustment. (Example: A manually-adjusted two-axis movement would have 250 cycles conducted on each axis). All axes may be tested at once if the testing apparatus is able to articulate each axis through its full range of motion.

60 Hydrostatic Pressure Test

60.1 When required by Section 34, Parts Subject to Pressure, three samples of each part or the system as an assembly subject to pressure are to be filled with any nonhazardous liquid, such as water, so as to exclude air, and are to be connected to a hydraulic pump. The pressure is to be raised gradually to the required test value and is to be held at that value for 1 minute, during which time the sample shall not burst. Leakage is acceptable provided the leakage does not create a risk of fire, shock or injury to persons.

61 Entrapment Tests

61.1 Force measurement

61.1.1 A motorized or otherwise powered moving part as required by [11.2.3](#) and [11.3.4](#) – [11.3.7](#) shall be subjected to the force measurement tests specified in [61.1.2](#) – [61.1.5](#). The force shall not exceed 40 pounds (177.9 N). There shall be no collapse or permanent damage to the furnishing or mounting means (if provided) resulting in a risk of injury during or following the test.

Exception: A storage bed unit that relies on a momentary contact switch for actuation, and which uses a pushrod style actuator for lift while allowing gravity to lower the storage bed unit when the pushrod is retracted subject (Usage Area I) may comply with Verification tests – Storage bed units (Usage Area I), [61.3](#).

61.1.2 The furnishing shall be loaded in accordance with the functional load as specified in Section [46](#), Structural Test Requirements for Furnishings, as applicable to the furnishing under investigation or unloaded if determined to be more severe. Consideration shall be given to the load when the furnishing is in motion. For instance, a footrest may not have a pinch point until it is almost closed at which point, the weight may no longer be on the furnishing.

61.1.3 A furnishing that has accessories that can be removed or added shall be subjected to the force measurement in any configuration determined to be most severe. Normally the largest size accessory is used for the investigation but consideration may be given to smaller sizes when a more severe result may occur.

61.1.4 The motorized or powered moving part of the furnishing shall be operated at the maximum velocity allowed by the design of the furnishing. The force measurement shall be repeated three times and the maximum force measured shall not exceed 40 pounds (177.9 N).

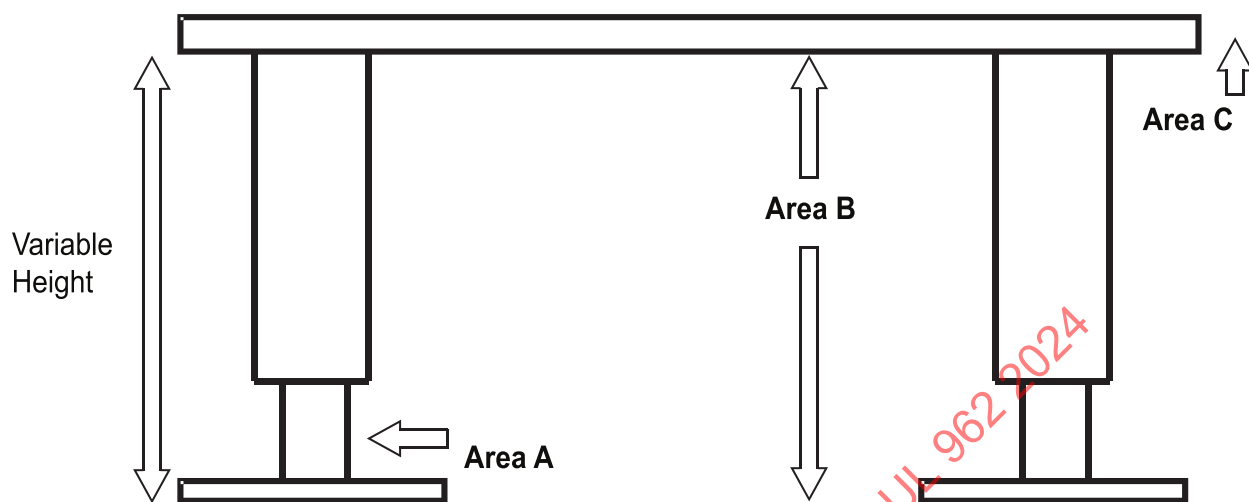
61.1.5 The force measurements shall be conducted in any location as required by [11.2.3](#) and [11.3.4](#) – [11.3.7](#). [Figure 61.1](#) – [Figure 61.4](#) are provided as typical examples of entrapment locations and shall be considered when conducting the force measurements.

61.1.6 As an alternative to the 40 lbs (178 N), the force measurements shall comply with the following values:

- a) First 0.75 seconds shall not exceed a dynamic force of 90.0 lbs (400 N);
- b) 0.75 to 5 seconds shall not exceed a static force of 34.0 lbs (150 N); and
- c) After 5 seconds shall not exceed a static force of 5.6 lbs (25 N).

The equipment used shall have a spring ratio of 2,857 lbs/in (500 N/mm) and a shall have a rising/falling time of 5 ms.

Figure 61.1
Examples of Entrapment Areas



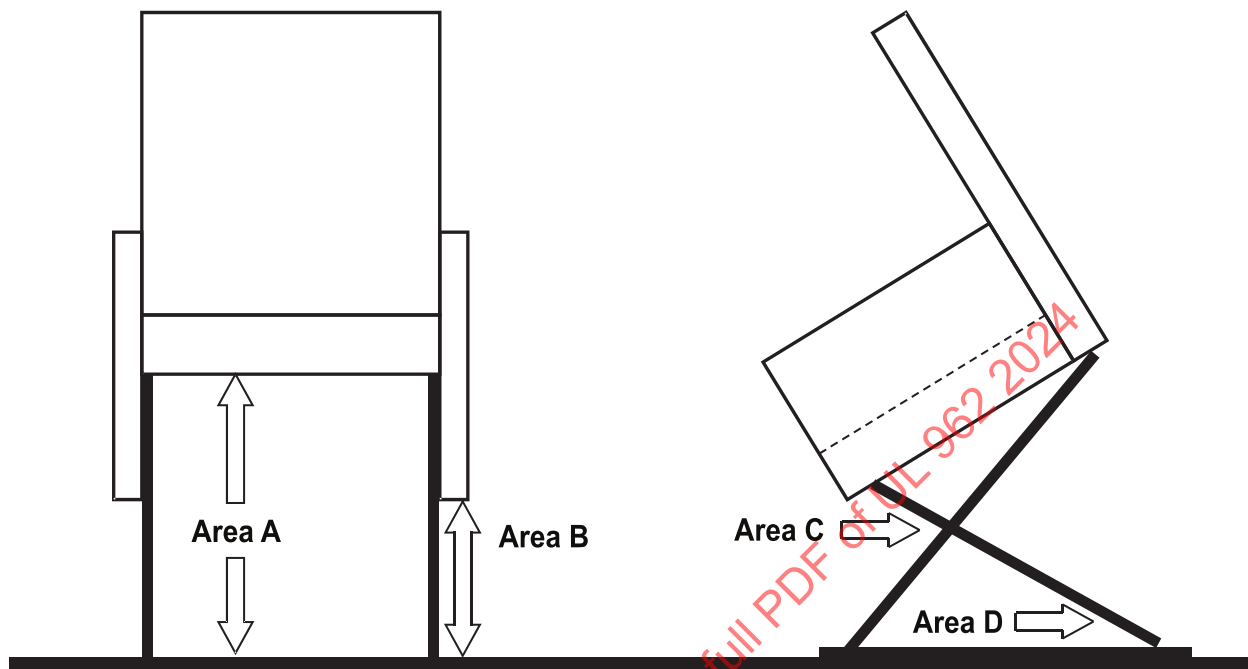
su1678

Area A – is considered to be an entrapment area because a head, hand, finger and other appendages can be pinched between the upper movable leg and lower fixed leg. Geometry and configuration can affect the entrapment concern.

Area B – is not considered to be an entrapment area because there is sufficient room between the table top and floor or between a chair seat and the table top. Instructions are also required to address entrapment.

Area C – The edge of the table could create an entrapment. Instructions address placement of the table in relation to other objects. The force limitation does not apply.

Figure 61.2
Examples of Entrapment Areas



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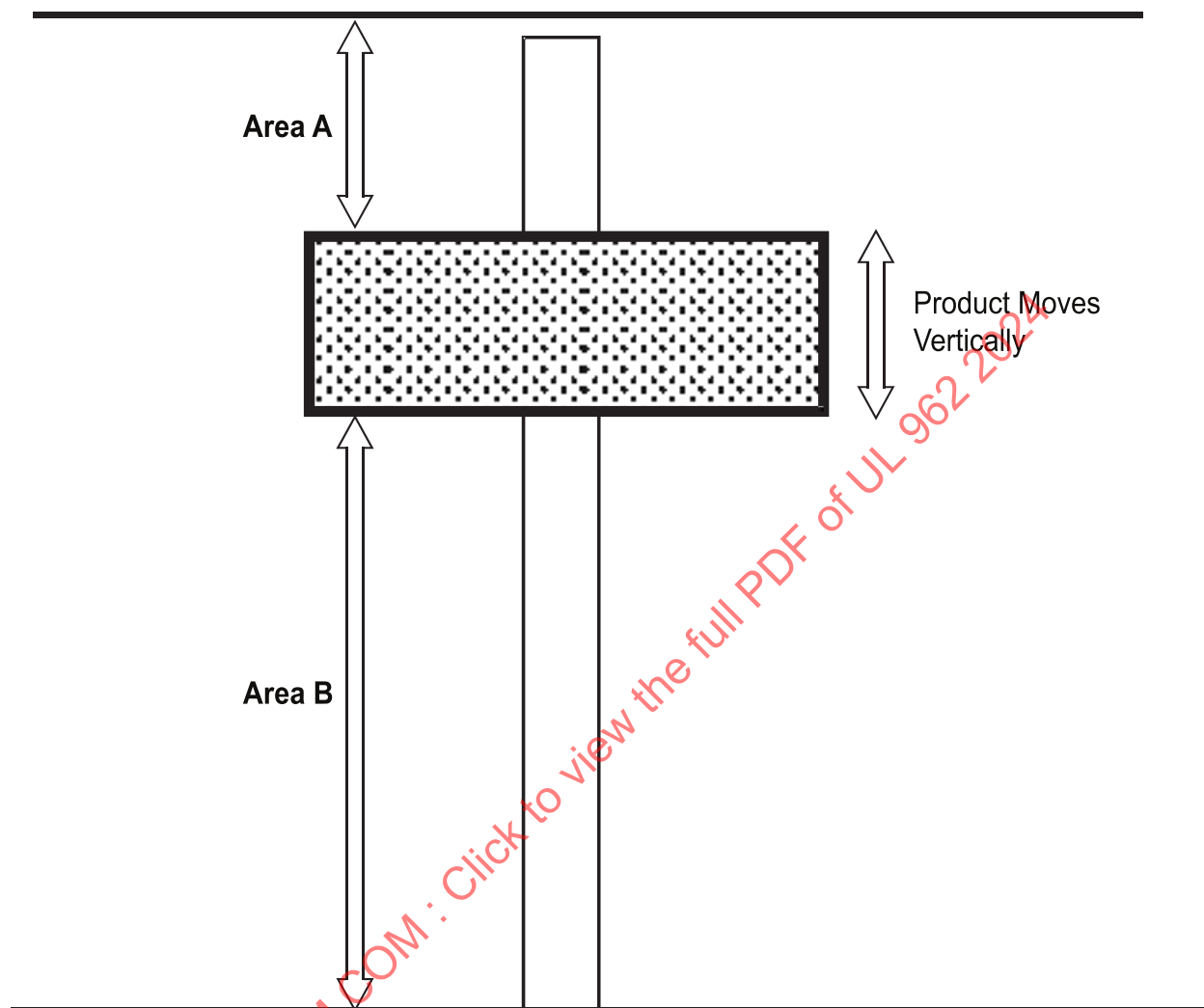
Area A – is considered to be an entrapment area because infants, children and animals could be within this area. Geometry and configuration can affect the entrapment concern.

Area B – is considered to be an entrapment area because infants, children, animals and other appendages could be within this area. Geometry and configuration can affect the entrapment concern.

Area C – is considered to be an entrapment area because of the potential for a head, hand, finger or leg to become entrapped within the scissor mechanism.

Area D – is considered to be an entrapment area because of the potential for a head, hand, finger, leg and cords to become entrapped within the scissor mechanism.

Figure 61.3
Examples of Entrapment Areas

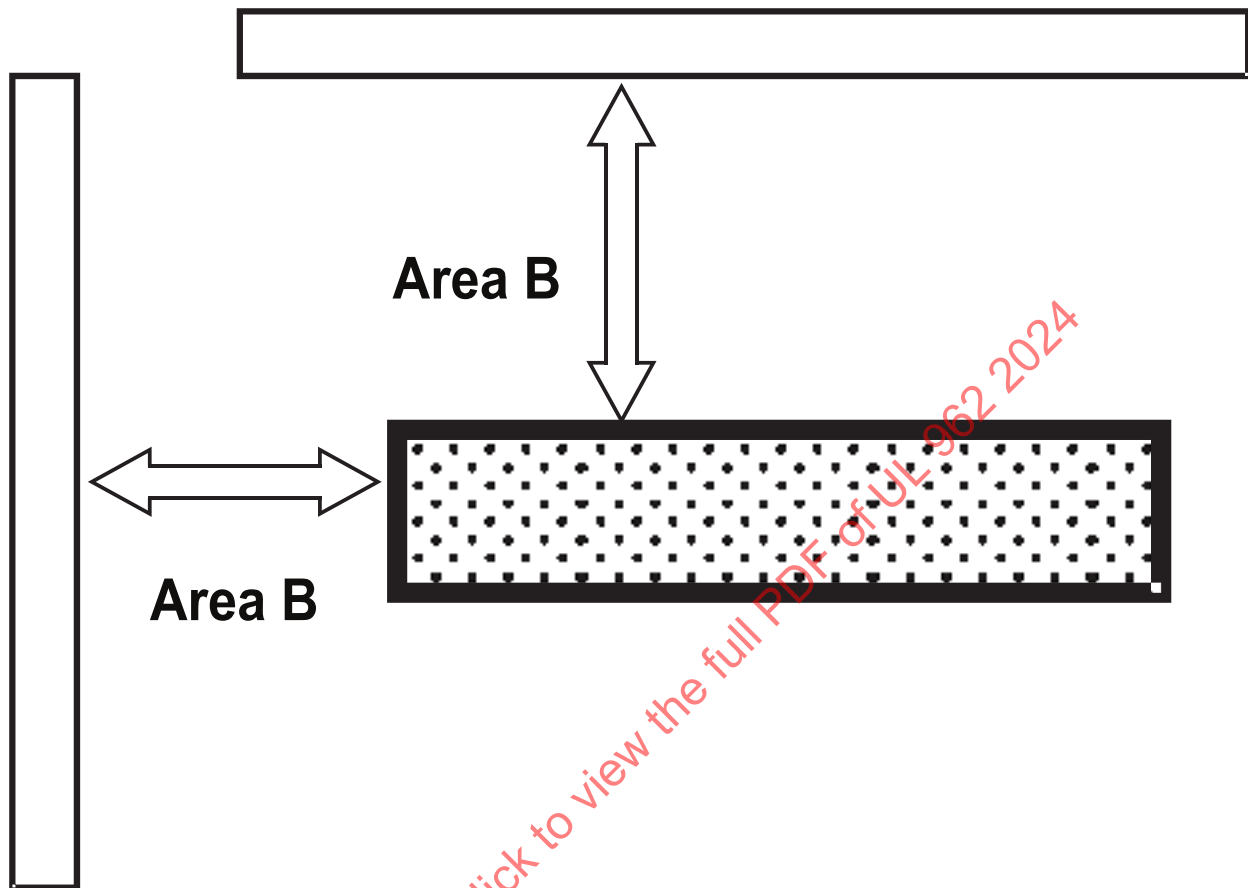


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Area A – is considered to be an entrapment area when the top of the moving furnishing is located below 84 inches (2133.6 mm) from the floor. Consideration must be given to furnishings that can be moved or placed on other furnishings that have fixed objects above them such as a shelf or top of a cabinet. Use and installation instructions can be utilized to determine recommended placement.

Area B – is considered to be an entrapment area because infants, children, animals and other appendages could be within this area. Geometry and configuration can affect the entrapment concern. A furnishing that leaves 18 inches (457.2 mm) or more between the base or floor and poses no pinch concern would not be considered a risk of entrapment.

Figure 61.4
Examples of Entrapment Areas



su1682

Area A – is considered to be an entrapment area when the furnishing rotates about an axis and can entrap between the furnishing and a fixed structure. Consideration must be given to furnishings that can be moved or placed on other furnishings that have fixed structures. Examples: a wall or back of a cabinet. Use and installation instructions can be utilized to determine recommended placement.

Area B – is considered to be an entrapment area when the furnishing moves horizontally side to side or back to front in relation to a fixed structure. Consideration must be given to furnishings that can be moved or placed on other furnishings that have fixed objects behind them or to the side of them such as a wall or side or back of a cabinet. Use and installation instructions can be utilized to determine recommended placement.

61.2 Verification tests

61.2.1 A furnishing that relies on a momentary contact switch to function in accordance with Section 31, Commercial Operator Attended Products — Usage Area II; Section 32, Commercial Operator Attended Products — Usage Area III; and Section 33, Operator Attended Products — Usage Area IA shall be subject to the following conditions with the furnishing loaded with the rated load and operating at rated voltage:

- a) When a momentary contact switch is released the corresponding moving parts shall stop within 15 mm.
- b) Upon power failure the furnishing shall remain in the existing position.
- c) Upon reinstatement of power the furnishing shall not move until the operator activates the switch controlling movement.
- d) A switch that controls the direction of travel shall be capable of being stopped and the direction of travel reversed at any point in the operation of the furnishing.

61.2.2 When speed of a moving part is being used to avoid a potential personal injury, the speed shall not exceed 1 inch/second (2.54 cm/second) when tested as specified in 61.2.3.

61.2.3 The furnishing shall be loaded, unloaded, or partially loaded, whichever method will cause the highest speed. Multiple tests may be required to determine worst case. The furnishing shall be connected to rated voltage. The furnishing shall be operated so that all possible motions may be measured. The speed shall be measured on each part that may cause personal injury. The speed shall be measured on the portion of the part that operates at the highest speed. The speed may be measured by using an instrument that measures speed or by measuring the distance the part moves its full length of movement and dividing by the time it takes for that movement.

61.2.4 In accordance with 31.1(a), the lockout feature shall be engaged 10 times. After each time the lockout is engaged, the furnishing shall try to be activated. The furnishing shall not operate.

61.2.5 In accordance with 31.1(a), the lockout feature shall be disengaged 10 times and the furnishing operated each time. Two minutes after the furnishing has been operated, the furnishing shall try to be activated. The furnishing shall not operate.

61.3 Verification tests — Storage bed units (Usage Area I)

61.3.1 A storage bed unit that does not comply with the force limits specified in Force Measurement, 61.1, and Verification Tests, 61.2, which relies on a momentary contact switch to actuate motion, and which uses a pushrod style actuator for lift while allowing gravity to lower the storage bed unit when the pushrod is retracted, shall comply with the following limits:

- a) When in operation, maximum speed of travel is 7 degrees/second, or 1 inch/second (2.54 cm/second);
- b) When a momentary contact switch is released, the corresponding moving parts shall stop within 1.5 degrees of travel, or within 10 mm if travel is in linear motion;
- c) Upon power failure the furnishing shall remain in the existing position;
- d) Upon reinstatement of power, the furnishing shall not move until the operator activates the switch controlling movement; and
- e) A switch that controls the direction of travel shall be capable of being stopped and the direction of travel reversed at any point in the operation of the furnishing.

61.3.2 When performing the testing specified in [61.3.1](#), the storage bed unit is to be loaded, unloaded, or partially loaded, whichever method will cause the highest speed. Multiple tests may be required to determine worst case. The furnishing is to be connected to rated voltage. The furnishing is to be operated so that all possible motions are able to be measured. The speed is to be measured on each part that may result in a risk of personal injury. The speed is to be measured on the portion of the part that operates at the highest speed. The speed may be measured by using an instrument that measures speed or by measuring the distance the part moves its full length of movement and dividing by the time it takes for that movement.

62 Snap-fit Cover Pull-Out Test

62.1 A snap-fit cover employed as part of a furnishing electrical enclosure shall be subjected to the tests specified in [62.2](#) or [62.3](#). The cover shall not crack or dislodge from the means of support on the electrical enclosure. Any distortion of the cover resulting from the tests shall not restrict the normal removal and replacement of the cover.

62.2 The electrical enclosure is to be clamped in place and oriented so that the covered face of the electrical enclosure is parallel to the horizontal and directed down. A 25 pound (11.3 kg) weight is to be attached to any point on the edge or outside surface of the cover and gradually released until it hangs freely. The weight is then to hang for 1 minute.

62.3 For a snap-fit cover formed of polymeric material, the test specified in [62.2](#) is to be repeated on three additional samples of the cover after the samples have been conditioned as specified in Section [44](#), Conditioning of Products.

63 Tightening Torque Test

63.1 With respect to the Exception to [10.1.9](#), the tapped threads in a plate not less than 0.30 inch (7.6 mm) thick are able to be used when the threads do not strip after being subjected to the tightening torque specified in [Table 63.1](#). A screw, either supplied or specified in the instructions, is to be tightened to the terminal at a torque, and with a wire in place, as specified in [Table 63.1](#). There shall be two or more full threads in the metal. The metal is able to be extruded, when required, to provide the threads.

Table 63.1
Tightening Torque for Wire-Binding Screws

Size of terminal screw, No.	Wire sizes to be tested, AWG ^a	Tightening torque pound-inches (N·m)
8	14 (S) and 16 – 22 (ST)	16 (1.8)
10	10 – 14 (S) and 16 – 22 (ST)	20 (2.3)

^a ST – stranded wire; S – solid wire.

64 Portable Furnishing Drop Test

64.1 Three samples of a portable furnishing provided with a factory filled and sealed liquid container shall be subjected to the drop test specified in [64.2](#) without leakage of the material within the vessel as determined by visual observation following the drop.

64.2 Three samples shall be dropped 3 feet (91.4 cm) onto a nominal 1/2 inch (12.7 mm) thick trade size knot free softwood or softwood plywood sheet directly supported by a concrete floor.

ELECTRICAL TESTS

65 Leakage Current Test

65.1 A cord-connected furnishing rated for a nominal 250-volt or less single phase supply shall be tested in accordance with [65.2](#) – [65.10](#). Leakage current shall not be more than:

- a) 0.5 MIU for a two-wire cord- and plug-connected portable furnishing; and
- b) 0.5 MIU for a three-wire (including grounding conductor) cord- and plug-connected portable furnishing; and
- c) 0.75 MIU for a three-wire (including grounding conductor) cord- and plug-connected stationary or fixed furnishing.

Exception: The leakage current of a furnishing incorporating a sheath type heating element is to be monitored during heat-up and cool-down and shall not exceed 2.5 MIU during the first 5 minutes of energizing the furnishing. At the end of this time, the leakage current shall be not more than the 0.5 MIU or 0.75 MIU limit, as applicable.

65.2 All accessible conductive parts are to be tested for leakage currents. Leakage currents from these parts are to be measured to the grounded supply conductor individually as well as collectively when simultaneously accessible, and from one part to another when simultaneously accessible. A part is determined to be accessible unless it is guarded by an enclosure that is intended for protection against the risk of electric shock as defined in Section [13](#), Accessibility of Uninsulated Live Parts and Film-Coated Wire. Conductive parts are determined to be simultaneously accessible when they can be readily contacted by one or both hands of a person at the same time. These measurements do not apply to terminals operating at voltages that do not involve a risk of electric shock. When all accessible conductive parts are bonded together and connected to the grounding conductor of the power-supply cord, the leakage current is to be measured between the grounding conductor of the product and the grounded supply conductor

65.3 For furnishings where the user may be in contact with water, the water is to be considered an accessible dead metal part. The water used shall be the same as specified in [78.1.4](#).

65.4 When a conductive part other than metal is used for an enclosure or part of an enclosure, leakage current is to be measured using a metal foil with an area of 3.9 by 7.9 inches (10 by 20 cm) in contact with the surface. When the conductive surface has an area less than 3.9 by 7.9 inches (10 by 20 cm), the metal foil is to be the same size as the surface. The metal foil is to conform to the shape of the surface but is not to remain in place long enough to affect the temperature of the product.

65.5 A furnishing employing water or other liquid is to be tested with a hard water solution of 0.5 grams of calcium sulphate (CaSO_4) per liter of distilled water (0.07 ounces CaSO_4 per gallon of distilled water).

Exception: The composition of the water solution is not specified when it is determined by engineering evaluation that the leakage current will not be affected.

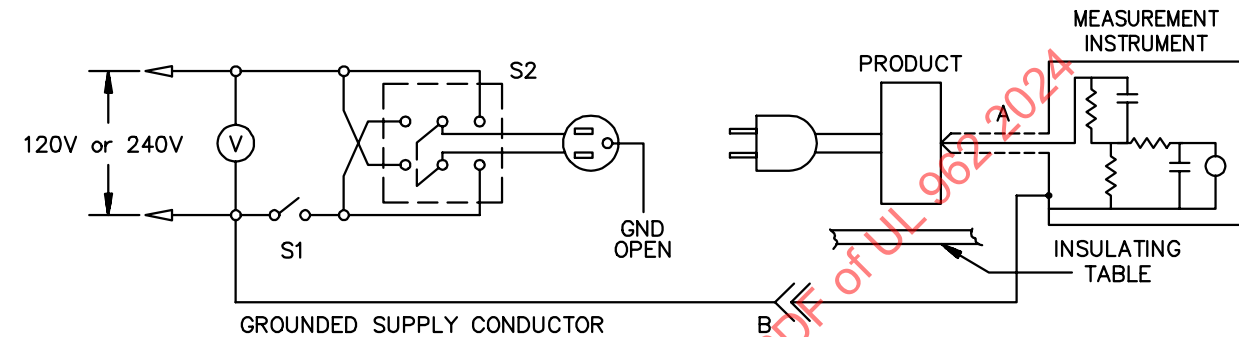
65.6 Typical measurement circuits for leakage current with the ground connection open are illustrated in [Figure 65.1](#). The measurement instrument is defined in [Figure 65.2](#). The meter that is used for a measurement is only required to indicate the same numerical value for a particular measurement as would the defined instrument; it is not required to have all the attributes of the defined instrument. Over the frequency range 20 Hz to 1 MHz with sinusoidal currents, the performance of the instrument is to be as follows:

- a) The measured ratio $V1/I1$ with sinusoidal voltages is to be as close as feasible to the ratio $V1/I1$ calculated with the resistance and capacitance values of the measurement instrument shown in [Figure 65.2](#).

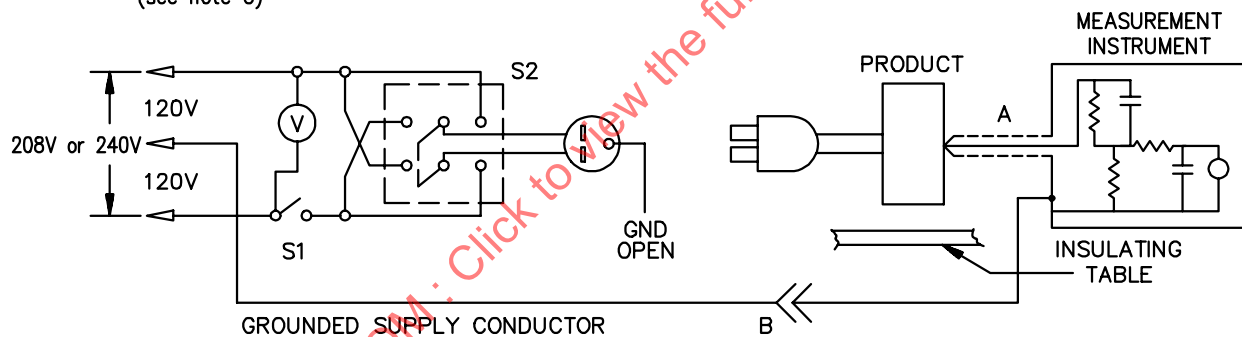
b) The measured ratio V_3/I_1 with sinusoidal voltages is to be as close as feasible to the ratio V_3/I_1 calculated with the resistance and capacitance values of the measurement instrument shown in [Figure 65.2](#). V_3 is to be measured by the meter M in the measuring instrument. The reading of meter M in RMS volts can be converted to MIU by dividing the reading by 500 ohms and then multiplying the quotient by 1,000. The mathematic equivalent is to simply multiply the RMS voltage reading by 2.

Figure 65.1

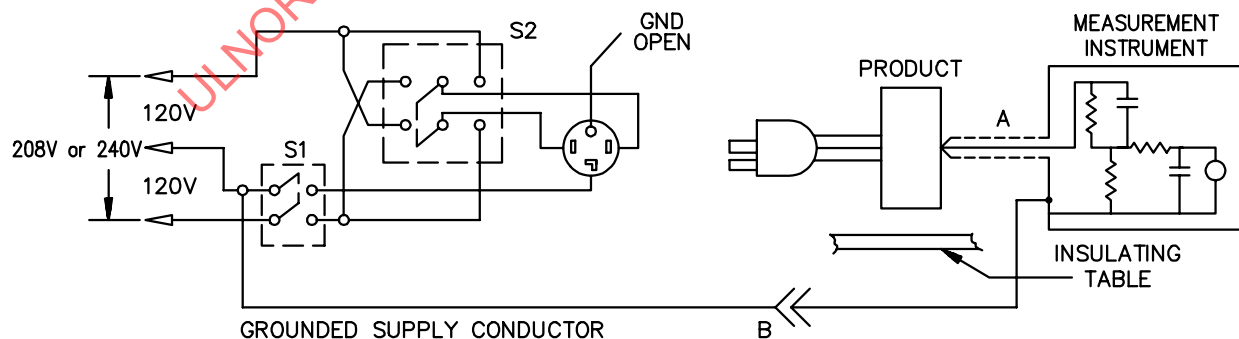
Equipment Intended for Connection to Power Supply



Equipment intended for connection to a 120-volt or an end-grounded 2-wire, 240-volt power supply (see note C)



Equipment intended for connection to a 2-wire grounded-neutral 208-volt or 240-volt power supply (see note C)



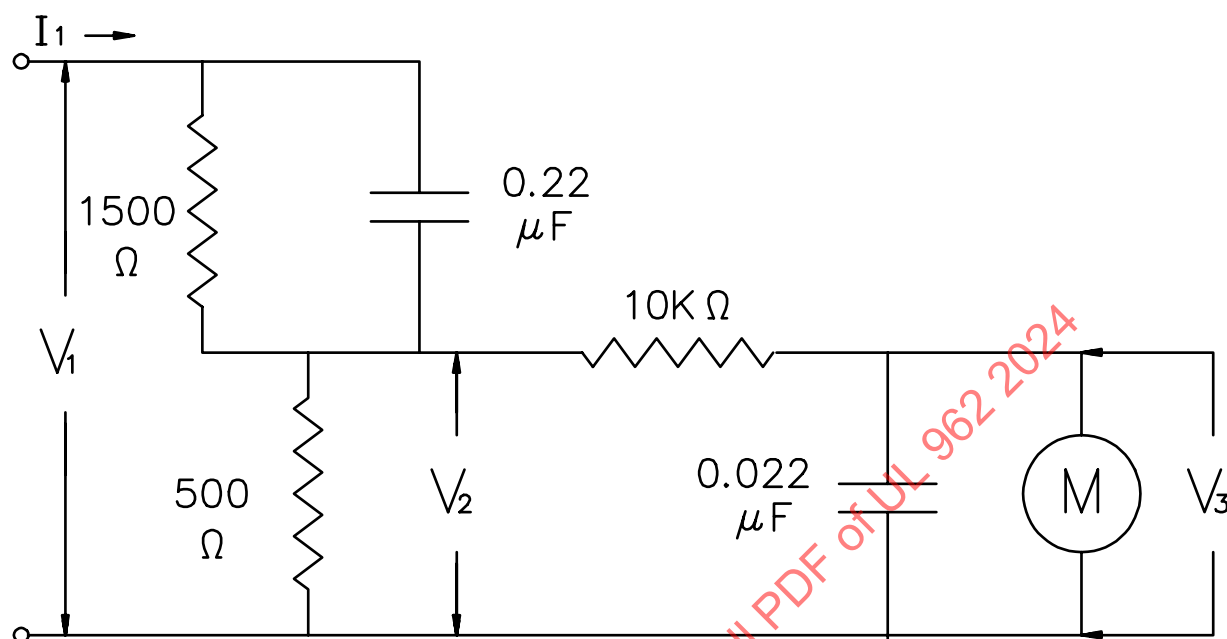
Equipment intended for connection to a 3-wire grounded-neutral 208-volt or 240-volt power supply

A – Probe with shielded lead.

B – Separated and used as clip when measuring currents from one part of equipment to another.

C – Equipment intended for connection to a 2-wire 240-volt power supply is to be tested assuming that the product will be connected to an end-grounded supply (top circuit, above), unless the product is marked in accordance with paragraph 86.11 of UL 197, in which case it is to be tested for connection to a grounded-neutral supply (middle circuit, above).

Figure 65.2
Measurement Instrument for Reaction (Leakage) Current



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65.7 Unless the measurement instrument is being used to measure leakage current from one part of a furnishing to another, it is to be connected between accessible parts and the grounding and supply conductor connected to ground (the grounded or grounding conductor) that has the least extraneous voltages introduced from other equipment operated on the same supply. For products rated 120 volts or 240 volts, with one supply conductor grounded, this is likely to be the grounded supply conductor.

65.8 Prior to the test specified in 65.9, a furnishing utilizing one or more sheathed heating elements is to be conditioned for 24 hours in a chamber having a temperature of 30 ± 5 °C (86 ± 9 °F) and a relative humidity of 50 ± 5 %, followed by conditioning for 48 hours in a chamber having a temperature of 30 ± 5 °C (86 ± 9 °F), and a relative humidity of 90 ± 5 %. The test in 65.9 is to be conducted as soon as is practical after the conditioning, but in no case more than 24 hours after the furnishing is removed from the conditioning chamber.

Exception No. 1: The entire furnishing is not required to be conditioned if the sheathed heating elements are removed from the furnishing and conditioned as stated. The elements are to be re-installed in the furnishing before the test is conducted.

Exception No. 2: The conditioning is not required if all sheathed heating elements in the furnishing comply with the requirements of UL 1030.

65.9 A sample of the furnishing, conditioned as specified in 65.8, where required, is to be tested for leakage current starting with the as-received condition – the as-received condition being without prior energization, except as may occur as part of the production-line testing. The supply voltage is to be adjusted to rated voltage. The test sequence is to be as follows, with reference to the measurement circuit shown in Figure 65.1:

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

65.10 A sample is to be subjected to the entire leakage current test, as specified in [65.9](#), without interruption for other tests.

Exception: With the concurrence of those concerned, the leakage current test is not prohibited from being interrupted to conduct other nondestructive tests.

66 Starting Current Test

66.1 A motor-operated furnishing shall start and operate normally on a circuit protected by an ordinary – not time-delay – fuse having a current rating corresponding to that of the branch-circuit power-supply to which the furnishing is to be connected. As a result of the test the fuse shall not open or an overload protector provided as part of the furnishing shall not trip.

Exception: The requirement for an ordinary fuse does not apply when:

- a) *The construction of the motor-operated furnishing or the nature of its usage is such that it is used continually on the same branch circuit after installation;*
- b) *The motor-operated furnishing starts and operates as intended on a circuit protected by a time-delay fuse;*
- c) *The motor-operated furnishing is marked in accordance with [87.3](#); or*
- d) *A household motor-operated furnishing is intended to be used on a 15- or 20-ampere branch circuit, and the furnishing starts and operates as intended on a circuit protected by a time-delay fuse having an ampere rating corresponding to that of the branch circuit on which the furnishing is intended to be used.*

66.2 The motor-operated furnishing is to be started three times at room temperature at the beginning of the test. Each start of the motor is to be made under conditions representing the beginning of intended operation and the motor is to be allowed to come to rest between successive starts.

67 Input Test

67.1 The current or wattage input to a furnishing shall not be more than 110 % of the rated value when the furnishing is operated under the condition of maximum normal load and when connected to a supply circuit of maximum rated voltage and rated frequency.

Exception: When the furnishing is not provided with an installed electrical load (such as motor or luminaire), the input is determined as specified under Markings.

67.2 For a furnishing having a single voltage rating, such as 115 volts, maximum rated voltage is determined to be that single value of voltage. When the rating is given in terms of a range of voltages, such as 110 – 120 volts, maximum rated voltage is determined to be the highest value of the range.

68 Temperature Test

68.1 General

68.1.1 An electrified furnishing shall be tested as specified in [68.1.2](#) – [68.1.6](#). Temperatures shall not exceed the applicable values specified in [Table 68.1](#).

Exception No. 1: When the furnishing is only provided with an outlet assembly that complies with UL 111, UL 962A or UL 1363, the temperature test is not required.

Exception No. 2: A furnishing provided with a Luminaire that complies with [3.5](#), when installed and operated in accordance with its installation and operation instructions, has no other electrical load and no receptacle outlets is not required to be subjected to the temperature test.

Exception No. 3: When the furnishing is not provided with an installed electrical load (such as motor or Luminaire), the temperature test is not required when the electrical system consists of receptacle assemblies installed and connected to a field wiring junction box or is cord and plug connected; and complies with the requirements as specified in ANSI/NFPA 70.

68.1.2 The temperature limits specified in [Table 68.1](#) are based on an ambient temperature of 77 °F (25 °C). The temperature test is able to be conducted at any ambient temperature 50 – 104 °F (10 – 40 °C) and corrected to an ambient of 77 °F (25 °C).

Table 68.1
Maximum Temperature Rises

Material and component parts	°C	(°F)
1. Capacitors: ^b		
Electrolytic ^a	40	(72)
Other types	65	(117)
2. Fuses		
A. Class G, J, L, T, and CC		
Tube	100	(180)
Ferrule or blade	85	(153)
B. Other ^f	65	(117)
3. Fiber employed as electrical insulation	65	(117)
4. At any point within a terminal box or wiring compartment of a permanently connected furnishing in which power-supply conductors are to be connected, including such conductors themselves, unless the furnishing is marked in accordance with 89.1 .	35	(63)
5. A surface upon which a furnishing is able to be fastened in place, and surfaces that are adjacent to the furnishing when so fastened.	65	(117)
6. Surfaces that are adjacent to the cabinet light when it is mounted	65	(117)
7. Class 105(A) ^{c,h}		
Thermocouple method	65	(117)

Table 68.1 Continued on Next Page

Table 68.1 Continued

Material and component parts	°C	(°F)
Resistance method	75	(135)
8. Class 120(E) ^{c,h}		
Thermocouple method	75	(135)
Resistance method	85	(153)
9. Class 130(B) ^{c,h}		
Thermocouple method	85	(153)
Resistance method	95	(171)
10. Class 155(F) ^{c,h}		
Thermocouple method	110	(198)
Resistance method	120	(216)
11. Class 180(H) ^{c,h}		
Thermocouple method	125	(225)
Resistance method	135	(243)
12. Phenolic composition employed as electrical insulation or as part of the deterioration of which results in a risk of fire or electric shock ^d	125	(225)
13. Phenolic lampholder body ^a	125	(225)
14. Rubber- or thermoplastic-insulated wire and cord ^{d,e}	35	(63)
15. Sealing compound	40 °C (104 °F) less than melting point	
16. Varnished-cloth insulation	60	(108)
17. Wood and other combustible material	65	(117)
18. Lampholder screw shell	175	(315)
19. Current carrying parts		
A. Copper or copper alloy	175	(315)
B. Aluminum	175	(315)
C. Stainless steel, monel, nickel plated copper	225	(405)
20. Accessible parts		
A. External surfaces (other than lamps or lenses) ⁱ	65	(117)
B. Operating knobs, handles, and levers intended for momentary contact during adjustment only or areas that are able to be incidentally contacted.		
1. Wood	65	(117)
2. Plastic or rubber ^j	60	(108)
3. Glass, porcelain, or vitreous enameled material	50	(90)
4. Metal	25	(45)
C. Handles or surfaces intended to be grasped for lifting, carrying, or holding:		
1. Metallic	20	(45)
2. Nonmetallic	35	(63)
21. The maximum acceptable temperature rise on external surfaces of a furnishing employing a heating pad in the area subject to user contact	55	(99)
^a The temperature rise on insulating material integral with the enclosure of an electrolytic capacitor that is physically integral with or attached to a motor shall not be more than 65 °C (117 °F).		
^b A capacitor that operates at a temperature rise of more than 65 °C (117 °F) is able to be judged on the basis of its marked temperature limit.		

Table 68.1 Continued on Next Page

Table 68.1 Continued

Material and component parts		°C	(°F)
° At a point on the surface of a coil where the temperature is affected by an external source of heat, the temperature rise measured by a thermocouple are not prohibited to be higher by the following amount than the maximum specified when the temperature rise of the coil, as measured by the resistance method, is not more than that specified in the table.			
Item	Additional temperature rises		
	°C	(°F)	
7	15	(27)	
8	15	(27)	
9	20	(36)	
10	15	(27)	
11	15	(27)	
d The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds that have been investigated and found usable at higher temperatures.			
e Rubber-insulated conductors within a Class A-insulated motor, rubber-insulated motor leads, or a rubber-insulated flexible cord entering a motor are able to be subjected to a temperature rise of more than 35 °C (63 °F), when a braid is employed on the conductor of other than a flexible cord. However, this does not apply to thermoplastic-insulated wires or cords.			
f A fuse that has been investigated and found usable at a higher temperature is able to be used at that temperature.			
g Does not apply when investigated and found to be usable at a higher temperature.			
h A totally enclosed motor is able to have winding temperature 5 °C (9 °F) higher than those stated.			
i Where lens is not also serving as a portion of the shade.			
j Includes plastic with a metal plating not more than 0.005 inch (0.13 mm) thick; and metal with a plastic or vinyl covering not less than 0.005 inch thick.			

68.1.3 Material provided for direct or indirect contact with live parts and any electrical insulating barrier shall be suitable for continuous operation at the maximum temperature measured on the material.

68.1.4 When temperature readings are to be obtained by means of thermocouples, the thermocouples shall consist of wires not larger than 24 AWG (0.21 mm²). When thermocouples are used in the determination of temperatures in connection with the heating of electrical devices, it is common to employ thermocouples consisting of 30 AWG (0.05 mm²) iron and constantan wire, and an instrument specifically designed for accurate determination of the attained temperature. Such equipment is to be used whenever reference temperature measurements are required.

68.1.5 A polymeric material used as a decorative trim or part shall be rated for the temperatures to which it is subjected during intended use, in that it shall not melt or deform in such a way as to interfere with the intended operation of the furnishing.

68.1.6 A cabinet light is to be operated continuously at rated luminaire wattage until constant temperatures are attained. A motor-operated furnishing is to be on and operating at maximum load during the temperature test. A temperature is determined to be constant when the test has been running for at least 3 hours, and three successive readings, taken at 30-minute intervals, are within 1.8 °F (1 °C) of one another and are not still rising. A motor operated furnishing shall be operated as specified in [68.2.1](#) – [68.2.3](#).

68.2 Motor-operated furnishing

68.2.1 A thermal- or overload-protective device shall not open the circuit during the temperature test.

68.2.2 For a furnishing that is not intended for continuous operation, the time of operation of the furnishing is to be evaluated when conducting the temperature test.

68.2.3 For the Temperature Test, a load is to be placed on the furnishing to simulate the intended use as follows:

- a) The furnishing shall be loaded in accordance with the functional loading requirements of Sections [46](#), Structure Test Requirements for Furnishings.
- b) For a furnishing that is not intended to operate continuously, the furnishing shall be cycled until maximum temperatures are obtained in accordance with one of the following:
 - 1) The minimum duty cycle sequence shall be nine complete cycles of its complete range of motion, without pause between cycles, except that a 5-minute period is to be interposed between the third and fourth cycle and between the sixth and seventh cycles. During the 5-minute interval the motor is to be running, with the furnishing not operating, when allowed by the construction. Otherwise, the motor is to be de-energized. A temperature is determined to be maximum when the test has been running for at least 4 hours, and three successive readings, taken at 1-minute intervals, are within 1.8 °F (1 °C) of one another and are not still rising. When the speed of operation of the furnishing is controllable, the test is to be performed at such speed that maximum heating results. A furnishing that is capable of more than one mode of motion is to be tested in each mode for the nine complete cycles; or
 - 2) When the operation instructions specify a different cycle and endurance sequence than "1" the operation sequence shall follow the sequence specified in the instructions. The operation instructions shall specify a duty cycle that is reasonable for the application of the product. Consideration shall be given to the intended use environment such as household retail or commercial use and also the specific function of the product.

68.3 Furnishings with heated water

68.3.1 All units shall be filled with water at a temperature of 50 °C (122 °F) at the start of the test. They shall be operated continuously until maximum temperatures are obtained under the following duty cycle simulating use and drain time: 13 minutes on – 2 minutes off. During the off cycle, the unit shall be drained and then refilled. Operation of an electric drain valve would be part of the 2 minute off period of the circulation system.

Exception: The cycling rate may be based on the manufacturer's instructions.

68.3.2 The results are in compliance when:

- a) The maximum water temperature at the suction fitting does not exceed 43 °C (109 °F);
- b) The water temperature at any inlet to the tub does not exceed 50 °C (122 °F);
- c) The temperature-limiting control does not operate; and
- d) The limits are as defined in [68.1](#), Temperature Test – General.

68.3.3 The test in [68.3.1](#) shall be repeated with no water in the unit.

69 Strain Relief Test

69.1 Cords

69.1.1 The strain-relief means provided on an attached flexible cord, when tested in accordance with [69.1.2](#) shall be capable of withstanding for 1 minute, without displacement, a pull of 35 lbf (156 N) applied to the cord, with the connection within the furnishing disconnected.

69.1.2 The cord conductors are to be severed within the furnishing. A 35 pound (156 N, 15.9 Kg) force is to be applied to the cord and supported by the furnishing so that the strain-relief means is stressed from any angle that the construction of the furnishing permits. The strain relief is not acceptable if:

- a) At the point of disconnection of the conductors, there is sufficient movement of the cord to indicate that stress on the connections have resulted; or
- b) At the point of disconnection of the conductors movement exceeded 0.063 inches (1.6 mm).

69.2 Strain relief for internal conductors and connectors test

69.2.1 A pull force of 89 N (20 lb) shall be applied for 1 minute to each conductor in a direction perpendicular to the plane of the entrance to the conductor connection. If the conductors are bundled into a single monolithic cable the test may be conducted on the cable assembly instead of the individual conductors. There shall be no breaking of the conductor or loosening of the conductor connections.

69.3 Conductor cycling endurance test

69.3.1 In accordance with [19.3](#), Conductors subject to flexing, a furnishing in which the normal use of the furnishing results in movement of conductors or other insulated electrically energized parts shall withstand an endurance test as specified in [69.3.3](#) and [69.3.4](#). There shall be no electrical or mechanical malfunction of the furnishing and, after the endurance test, the conductors subjected to the flexing and the furnishing as a complete assembly shall comply with the requirements in the Dielectric Voltage-Withstand Test, Section [71](#). In addition to the general requirements specified in Section [71](#) the Dielectric Voltage Withstand Test shall be conducted between each individual conductor and any other conductor that was subjected to the Conductor cycling test.

Exception: Conductors utilized in a Class 2 or LPS circuit are not required to be subjected to the conductor cycling endurance test unless the circuit is relied upon for the safe operation of the furnishing.

69.3.2 The furnishing is to be energized during the test. The voltage supply circuit and the temperature conditions shall be in accordance with the normal temperature test.

69.3.3 The endurance test required by [69.3.1](#) is to consist of 6000 cycles of operation. The conductors are to be flexed while energized from one extreme position to the opposite extreme position as allowed by the design of the furnishing.

69.3.4 For the endurance test specified in [69.3.3](#), any mechanical arrangement is to be employed to operate the movable member at a rate of between 12 – 30 cycles per minute or at rate allowed by the furnishing construction.

70 Grounding-Impedance Test

70.1 The exposed non energized metal parts and the ground contact of a receptacle outlet of the furnishing shall be conductively connected to the ground pin of the attachment plug as determined by the grounding test in [70.2](#) – [70.4](#).

Exception: A ground path comprised of components evaluated for use as an assembly and suitable as a fault current path are not required to be tested.

70.2 Any resistance measuring device, such as an ohmmeter, is to be employed during testing.

70.3 When tested, the resistance between any point required to be grounded and the equipment grounding terminal in the case of a furnishing intended for permanent electrical connection; or the point on

the furnishing where the grounding conductor of the cord is attached; shall not be more than 0.1 ohm. The resistance is to be determined by any convenient method as noted in [70.2](#), except that when unacceptable results are obtained, the measurement is to be taken in accordance with [70.4](#).

70.4 When a measurement is required by [70.3](#), an alternating current of at least 25 amperes from a power supply of not more than 6 volts is to be passed from the equipment grounding terminal or the point of attachment of the wiring system to the unenergized live part, and the resulting drop in potential is to be measured between these two points. The resistance in ohms is to be determined by dividing the drop in potential in volts by the current in amperes passing between the two points.

71 Dielectric Voltage-Withstand Test

71.1 The insulation and spacings of a furnishing shall withstand for 1 minute, without breakdown, the test potential specified in [71.3](#). For products employing double insulation, the test potential shall be as specified in [71.5](#).

71.2 Breakdown is usually indicated by the tripping of an overload protector in the test equipment; however, an abrupt decrease or retarded advance of the voltmeter reading also indicates insulation breakdown.

71.3 A 60-hertz sinusoidal potential is to be applied between live parts conductively connected to the supply circuit and dead metal parts. The applied potential is to be 1240 volts, or 1000 volts plus twice the supply voltage, whichever is higher. The supply source is to have capacity to maintain the potential specified, except in case of breakdown. The voltage is to be increased gradually from zero until the specified test potential is reached or until breakdown occurs.

Exception: Circuits operating at a voltage of 42.4Vac peak or 60Vdc or less the test potential shall be 500Vac or 700Vdc.

71.4 For furnishings where the user may be in contact with water, the water is to be considered an accessible dead metal part. The water used shall be the same as specified in [78.1.4](#).

71.5 For products employing double insulation, the test potential is to be 2480 volts, or 2000 volts plus four times the supply voltage, whichever is higher.

71.6 The test equipment is to include a transformer having a sinusoidal output, a means of indicating the test potential, an audible or visual indicator of electrical breakdown, and either a manually reset device to restore the equipment after electrical breakdown or an automatic feature to reject any product that does not meet the requirement.

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

71.8 When the output of the test-equipment transformer is 500 volt-amperes or more, the test potential is able to be indicated by a voltmeter in the primary circuit or in a tertiary-winding circuit, a selector switch marked to indicate the test potential, or in the case of equipment having a single test-potential output, a marking shall be visible while the equipment is in use to indicate the test potential. When a marking is used without an indicating voltmeter, the equipment shall include a positive means, such as an indicator lamp, to indicate that the manually reset switch has been reset following a dielectric breakdown.

71.9 Test equipment other than that specified in [71.6](#) – [71.8](#) is able to be used with the consent of those concerned.

71.10 For an upholstered furnishing that employs a heating pad, the test potential specified in [71.3](#) or [Table A9.1](#) for a low voltage heating pad is to be applied between interconnected current-carrying parts of each sample furnishing in the area of the heating pad and sheets of metal foil on the sides or faces of the furnishing. The furnishing, with the foil on each side or face of the heating pad surface, is to be covered with felt mats as specified in [71.11](#). A uniform pressure of 25 pound/foot² (122 kg/m²) is to be applied to the felt mats so that the metal foil is held in close contact with the heating pad covering.

71.11 The felt mats specified in [71.10](#) are to be 1 inch (25 mm) thick and have an area sufficient to completely cover the area of the heating pad and to extend for not less than 2 inches (51 mm) all the way around the pad area.

72 Printed Wiring Board (PWB) Ground Path Test

72.1 Three samples of the PWB assembly with a ground path trace shall be subjected to the Ground Path Test currents as specified in [Table 72.1](#). The furnishing shall be mounted as intended and wrapped in two layers of cheesecloth. The cheese cloth is to be bleached cheese cloth, running approximately 14 – 15 yd²/lb (28 – 30 m²/kg), and having what is known to the trade as a "count of 32 × 28" – that is, for any inch square, 32 threads in one direction and 28 threads in the other direction (for any centimeter square 13 threads in one direction and 11 threads in the other direction). During and following the test, the following conditions shall not occur:

- a) Emission of flame, molten metal, or glowing or flaming particles through any openings (preexisting or created as a result of the test) in the product;
- b) Charring, glowing, or flaming of the supporting surface;
- c) Ignition of the enclosure;
- d) Creation of any openings in the enclosure that result in accessibility of live parts, when evaluated with the probe shown in [Figure 13.1](#); and
- e) There shall not be evidence of degradation or separation of a trace from the printed-wiring board.

Table 72.1
Ground Path Test Currents

Grounding and bonding supply copper conductor size		Test current, A	
AWG or kcmil	(mm ²)	Time, s	Copper
14	(2.1)	4	300
12	(3.3)	4	470
10	(5.3)	4	750
8	(8.4)	4	1180
6	(13.3)	6	1530
4	(21.2)	6	2450

72.2 Following the test the resistance of each ground conductor trace is to be determined. This is determined by measuring the voltage drop when a current of 25 A, derived from a 60 Hz source with a no-load voltage not exceeding 6 V, is passed between the supply ground conductor or terminal and the load side of each outlet. The resistance shall not be more than 0.1 ohms.

73 Printed Circuit Board (PWB) Conductor Overcurrent Test

73.1 In accordance with Section [25](#), Printed Wiring Boards, three PWB circuit assemblies with supply conductor traces are to be subjected to the Printed Circuit Board Conductor Overcurrent Test. The assembly shall comply with the requirements in [73.4](#) and [73.5](#).

73.2 The furnishing or smallest electrical enclosure containing the circuit under test shall be mounted as intended and wrapped in two layers of cheesecloth. The cheese cloth is to be bleached cheese cloth, running approximately 14 – 15 yd²/lb (28 – 30 m²/kg), and having what is known to the trade as a "count of 32 × 28" – that is, for any inch square, 32 threads in one direction and 28 threads in the other direction (for any centimeter square 13 threads in one direction and 11 threads in the other direction).

73.3 The overload current is to be 200 % of the current rating of the maximum size branch circuit overload device to which the furnishing is intended to be connected. The overcurrent test current is to be applied for 2 minutes.

73.4 During and following this test, the following conditions shall not occur:

- a) Emission of flame, molten metal, or glowing or flaming particles through any openings (preexisting or created as a result of the test) in the product;
- b) Charring, glowing, or flaming of the supporting surface;
- c) Ignition of the enclosure;
- d) Creation of any openings in the enclosure that result in accessibility of live parts, when evaluated with the probe shown in [Figure 13.1](#); and
- e) There shall not be evidence of degradation or separation of a trace from a printed-wiring board.

73.5 After the sample has cooled to room temperature the spacing's between traces or between the traces and other grounded non-energized metal parts shall comply with the requirements of Section [20](#), Spacings.

74 Humidity Conditioning Test (Damp and Wet Location Furnishings)

74.1 The following test specified in [74.2](#) and [74.3](#) applies to a furnishing using insulating material that is able to be adversely affected by moisture under its intended operating conditions. The results comply with the intent of the requirement when the leakage current does not exceed 0.5 MIU.

74.2 The furnishing shall be conditioned for 24 hours in moist air having a relative humidity of 88 ±2 % at a temperature of 32.0 ±2 °C (89.6 ±3.6 °F). After conditioning, the leakage current shall be measured as specified in the Leakage Current Test, Section [65](#), for cord connected products or the Insulation Resistance Test (Damp and Wet Locations Furnishings), Section [75](#), for permanently connected products.

74.3 Unless otherwise specified, the test is to be conducted with the furnishing connected to a source of supply of rated frequency and of maximum rated voltage.

75 Insulation Resistance Test (Damp and Wet Locations Furnishings)

75.1 A damp or wet location permanently wired furnishing shall have an insulation resistance of not less than 50,000 ohms when tested in accordance with [75.2](#).

75.2 Insulation resistance is to be determined by the equation that follows or by another method that is equally accurate. A direct current potential of at least 250 volts is to be applied between live parts and

interconnected dead metal parts. Two voltmeters are to be used; one voltmeter is to be connected across the supply line and the other connected in series with one of the leads to the furnishing being tested. With the supply voltage adjusted so that the difference in the voltage readings of the two meters is at least 250 volts, the insulation resistance is to be calculated using the equation:

$$\text{Insulation Resistance} = \frac{(V_1 - V_2) R_2}{V_2}$$

in which:

V_1 is the measured supply line voltage, in volts.

V_2 is the voltage measured by a voltmeter in series with one of the leads of the furnishing being tested, in volts.

R_2 is the resistance of the voltmeter measuring V_2 , in ohms.

75.3 For furnishings where the user may be in contact with water, the water is to be considered an accessible dead metal part. The water used shall be the same as specified in [78.1.4](#).

76 Abnormal Tests

76.1 General

76.1.1 A product shall not present a risk of fire, electric shock, or injury to persons when operated under the abnormal conditions specified in [76.2](#) – [76.5](#). Compliance with the tests specified in this section is met when all of the following occurs:

- a) There is no ignition or charring of the cheesecloth indicator (charring is deemed to have occurred when the structural integrity of the threads has been destroyed due to temperature);
- b) The fuse from the enclosure to ground does not open;
- c) Immediately following these tests, the product complies with:
 - 1) The Dielectric Voltage-Withstand Test, Section [71](#), within 1 minute after completion of the abnormal test, or
 - 2) The Leakage Current Test, Section [65](#), when the product is provided with a power supply cord and attachment plug, or
 - 3) The Insulation Resistance Test, Section [75](#), when the product is permanently connected within 1 minute after completion of the abnormal test.
- d) Immediately following these tests the product complies with the entrapment force limitations specified in Section [61](#), Entrapment Test.; and
- e) The product complies with the enclosure and guarding requirements of [11.3](#), Mechanical enclosures and guards – Mechanical considerations.

76.1.2 During the tests, bleached cheesecloth, double-layered, running 14 – 15 square yards per pound (26 – 28 m²/kg) per layer, and having a count of 32 by 28, that is, for any square inch there are 32 threads in one direction and 28 in the other direction (for any square centimeter, there are 13 threads in one direction and 11 threads in the other direction), is to be draped loosely over the furnishing or portion of the furnishing under investigation.

76.1.3 The product is to be connected to a power supply and connected in series with a non-time-delay fuse of the maximum current rating of the branch circuit. Opening of the fuse before any condition of risk of fire or electrical shock results is considered as meeting the intent of the requirements. The enclosure, when metallic or employing dead-metal parts, shall be connected to ground either through a fuse rated to correspond to the input rating of the unit or 3 amperes, whichever is less. Only one abnormal condition is to be simulated at a time.

76.1.4 Abnormal operation tests are to be conducted until ultimate results are obtained, or for 7 continuous hours. Examples of ultimate results include the following:

- a) Ignition of any portion of the furnishing under investigation;
- b) Electrical breakdown of an insulating system;
- c) The furnishing becomes permanently inoperable by:
 - 1) Opening of one or more capacitors, diodes, resistors, semiconductor devices, printed-wiring board traces, motor, or similar part or component, when there is no indication of further change;
 - 2) Opening of the intended branch-circuit overcurrent protective device; or
 - 3) Opening of a non-user accessible, non-resettable protective device.
- d) The operating temperatures of the furnishing stabilize, and it is apparent that continued operation for the full 7 hours will not affect the test results.
- e) Reset protector functions in accordance with [76.1.5](#); and
- f) Any other condition that indicates continued operation will not affect the results of the test.

76.1.5 When an automatically reset protector functions during tests, the test is to be continued for a minimum of 7 hours or until ultimate results occur. When a M1 manual reset protector functions during a test, it is to be operated for 10 cycles using the minimum resetting time, at a rate not faster than 10 cycles of operation per minute. When an M2 manual reset protector functions during a test it is to be operated in the minimum time allowed by the construction of the furnishing as specified in the use instructions to restore the operation of the furnishing. The M2 protector shall be tripped for 10 cycles of operation or for a minimum of 7 hours or until ultimate results occur. The protector shall be operative upon completion of the test.

Exception: When the manual reset protector is a circuit breaker that complies with UL 489, it is to be operated for 3 cycles using the minimum resetting time at a rate not faster than 10 cycles of operation per minute.

76.1.6 A risk of fire or electric shock is determined to exist when any of the following occurs:

- a) Flame or molten metal is emitted from the enclosure of the equipment as evidenced by ignition, glowing, or charring of the cheesecloth;
- b) A breakdown results from the dielectric voltage-withstand test;
- c) Live parts are made accessible;
- d) The 3-amp non-time-delay ground fuse opens;
- e) A failure of the Leakage Current test; or
- f) A failure of the Insulation resistance test.

76.1.7 During these tests, all fuses which are field-renewable by the user and are of an interchangeable type shall be replaced by a fuse of the same size and voltage rating using the highest available current rating for that size. Opening of the fuse before any condition of risk of fire or electrical shock results satisfies the requirement of the test.

Exception: Fuses need not be replaced when the product employs marking identifying the need for using the indicated fuse(s) located so that it is obvious as to which fuse or fuseholder(s) the marking applies and where readily visible during replacement of the fuse(s). A single marking is acceptable for a group of fuses. The marking shall comply with [86.23](#).

76.1.8 All abnormal conditions are to be continued until ultimate results are obtained, such as burnout or stabilization of temperatures.

76.2 Operation

76.2.1 A user-operated control is to be adjusted to the position representing the most adverse operating condition.

76.2.2 A product that normally would only be operated for a limited time shall be capable of operating continuously in any condition of normal use possible without risk of fire, electric shock, or injury to persons.

76.3 Output or furnishing interconnection field-wiring

76.3.1 Each output circuit of the product to which field wiring is intended to be connected is to be individually opened or shorted.

76.3.2 The test condition in [76.3.1](#) shall be applied one at a time. The abnormal condition shall be introduced while the equipment is operating in any condition of normal use.

76.4 Electronic components

76.4.1 All circuit components located in a control or safety circuit shall be examined using the equipment circuit diagrams and component specifications to determine those faults that can occur. The failure of any component in the input and output circuits, excluding secondary ground-fault protection circuits, that results in risk of fire or electric shock, shall be subjected to short-circuits and open-circuits of transistors, rectifiers, diodes, and capacitors, faults causing continuous dissipation in resistors designed for intermittent dissipation, and internal faults in integrated circuits causing excessive dissipation. The product shall then be operated during each of the fault conditions until constant temperature or burnout occurs. Only one short-circuit or open-circuit test is to be conducted at a time.

76.4.2 The components specified in [76.4.1](#) includes an electrolytic capacitor, a diode, a solid-state device, or any other component not previously investigated and determined to be rated for the application.

Exception: A previously investigated component determined to be reliable such as a rated electromagnetic and radio-frequency-interference capacitor, a resistor, a transformer, an inductor, or an optical isolator, is not required to be subjected to this test.

76.4.3 The faults referenced in [76.4.1](#) shall be applied one at a time. Short circuits shall be applied only between two terminals of a multi-terminal device at one time. Simulated circuits are also capable of being used for high-voltage circuit abnormal tests. But when the tests performed on simulated circuits indicate likely damage to other parts of the equipment to the extent that the safety of the equipment is capable of being affected, the tests shall be repeated in the equipment. The abnormal condition shall be introduced while the equipment is operating under intended conditions. This is to be accomplished by jumper leads and remote switches with consideration given to the effect these devices have on the test.

76.4.4 Component burnout shall not be used as the sole means of preventing a risk of fire or shock.

76.5 Cooling fans and blowers

76.5.1 The product shall be operated under the condition which produces the greatest power dissipation until constant temperature or burnout occurs with all cooling fans and blowers disabled.

76.5.2 The locked-rotor test is to be conducted on the product and operated with the rotor of each cooling fan and blower motor locked.

Exception: Where a means of limiting the current is inherent in or provided as part of the device, these features are to be given consideration when conducting the locked-rotor test. These features may be external to the fan or motor and include, but are not limited to, the following:

- a) Nonresettable thermal elements that are integral with fan or motor windings;*
- b) Wire-wound, or other types of resistors that limit the load current;*
- c) Positive temperature coefficient (PTC) resistors;*
- d) Inherent limitation due to impedance of the fan or motor windings; and*
- e) Nonreplaceable fusing elements soldered into the product.*

76.6 Low water and no water test

76.6.1 While at maximum operating temperature and without the temperature-regulating control, each unit shall be operated for 7 hours; until the dry fire protection device or circuit, if provided, opens the heater circuit; or until ultimate results occur; with the water level in the water container:

- a) Below the heater enclosure; and
- b) Empty.

76.6.2 The results of the procedure in [76.6.1](#) are in compliance when:

- a) There is no damage to the heater, electrical components, wiring, water pipe, or electrical conduit;
- b) There is no fire or damage to thermal insulation or electrical insulation;
- c) The temperature of the water at the outlet of the heater enclosure does not exceed 70 °C (158 °F); and
- d) The temperature of the water entering the tub does not exceed 50 °C (122 °F) for longer than 15 minutes.

76.6.3 When a unit is provided with a temperature-sensing device to provide dry fire protection or other control circuitry to deactivate the water heater in the event of operation without water, three samples of the heater assembly shall be subjected to 50 cycles of operation without water. Each cycle shall begin at room temperature or other temperature, when agreeable to all concerned, and shall end when heater temperatures stabilize. Temperatures inside the heater enclosure shall be monitored to ensure that the resulting temperatures do not exceed the thermal index of the material being used. The calibration of the three thermostats shall be checked after this test to determine that they are still within the tolerance of ± 3 °C (± 5 °C). When one of the three thermostats is not within the specified tolerance, the test may be repeated with three new thermostat samples. The results are in compliance when all three additional thermostats are within the tolerance after the test.

76.7 Interrupted power

76.7.1 A unit using a water heater shall be operated until maximum intended operating temperatures are obtained, and the power supply is then to be interrupted. The temperature of the water in the heater shall be monitored and as this reaches a maximum value, the power shall be restored.

76.7.2 The results are in compliance when at any time the temperature of the water at the center of the water outlet to the tub does not exceed 50 °C (122 °F) and there is no damage to the heater enclosure. For this test, all temperature controls shall be in operation.

76.8 Water flow interruption

76.8.1 When either a pump motor protective device or a pump motor circuit breaker or fuse can operate without disconnecting power from the heater, the test in [76.7](#), Interrupted Power, shall be repeated with interruption of power to the pump motor alone.

76.9 Water back flow

76.9.1 Interrupting power to a blower or to a water-sanitizing device shall not result in water contacting live parts or electrical insulation. The test is to be conducted by interrupting power to the blower or to the water-sanitizing device, or both, first with the water-circulating pumps operating and then simultaneously interrupting power to all components. When water is prevented from flowing in the air lines by routing the air lines to a point above the water level, a determination shall be made that displacement of water in the container will not result in water passing the high point in the tubing. The test is to be conducted with and without the blower or water-sanitizing device, or both, operating.

76.9.2 When a blower or water-sanitizing device introduces air directly into the water-circulating pipes of an assembly, the unit is to be operated to cause maximum water flow. Water flow is to be obstructed at all outlets simultaneously for 1 minute. The results are in compliance when water does not contact live parts or electrical insulation. This test is to be conducted with and without the blower or water-sanitizing device, or both, operating.

76.10 Reverse hydrostatic pressure

76.10.1 Three samples of the check valves shall be subjected to a reverse hydrostatic pressure test twice the maximum water pressure. Paper shall be placed underneath the valve. The test shall be conducted for one hour.

76.10.2 The results are in compliance when the valves do not leak sufficient water to wet the paper.

77 Lamp Drape Test

77.1 The furnishing shall be operated continuously for 7 hours to determine that the ultimate result has been obtained. There shall be no:

- a) Emission of flame or molten metal;
- b) Combustion, glowing or flaming or disintegration of the material on which the unit is resting or of material placed on or near the unit;
- c) Exposure of parts involving a risk of electric shock; or
- d) Dielectric breakdown when subjected to Section [71](#), Dielectric Voltage-Withstand Test, while still heated following any of these tests.

77.2 An automatic temperature-regulating or -limiting control; or other protective device provided as part of the furnishing is to be shunted out of the circuit during the test, unless the control has been shown by an investigation to be reliable and unable to be defeated by the user.

77.3 The cloth used in the abnormal drape test is to be bleached cheesecloth, 36 inches (91.4 cm) wide, running 14 – 15 square yards per pound (26 – 28 m²/kg) and having what is known in the trade as a count of 32 by 28; that is, for any square inch 32 threads in one direction and 28 in the other direction (for any square centimeter, 13 threads in one direction and 11 in the other direction). The cloth is to be loosely draped over each lamp being tested in order to serve as a flame indicator (presence of ash or burnt holes) not as a blanket to trap heat.

78 Spill Test

78.1 Procedure

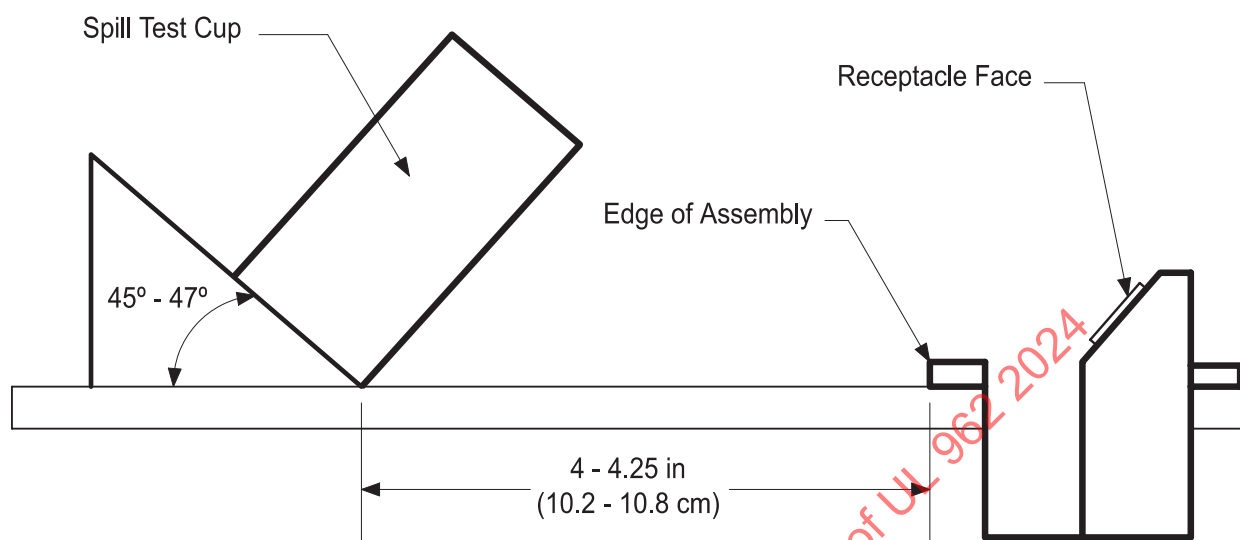
78.1.1 With reference to [26.4](#), following the testing specified in [78.1.2](#) – [78.1.4](#), the outlet assembly shall comply with Spill test dielectric voltage-withstand test, [78.2](#).

78.1.2 A outlet is to be mounted as intended in the furnishing. Suppressor elements, across-the-line or solid state connected components are to be disconnected, removed or bypassed prior to the test. All covers are to be opened. A cover that does not require a tool to remove is to be removed. Covers that tend to close themselves are to be allowed to fall to their natural resting position. When more than one convenience outlet is enclosed by a single self-closing cover, one standard 2-wire power-supply cord with a parallel blade attachment plug, NEMA 1-15P plug configuration, is to be mated with an outlet in order to hold the outlet cover open. The cord shall exit the receptacle or cord connector assembly as allowed by the cover. The receptacle or cord connector assembly shall be un-energized and shall remain undisturbed throughout the test sequence.

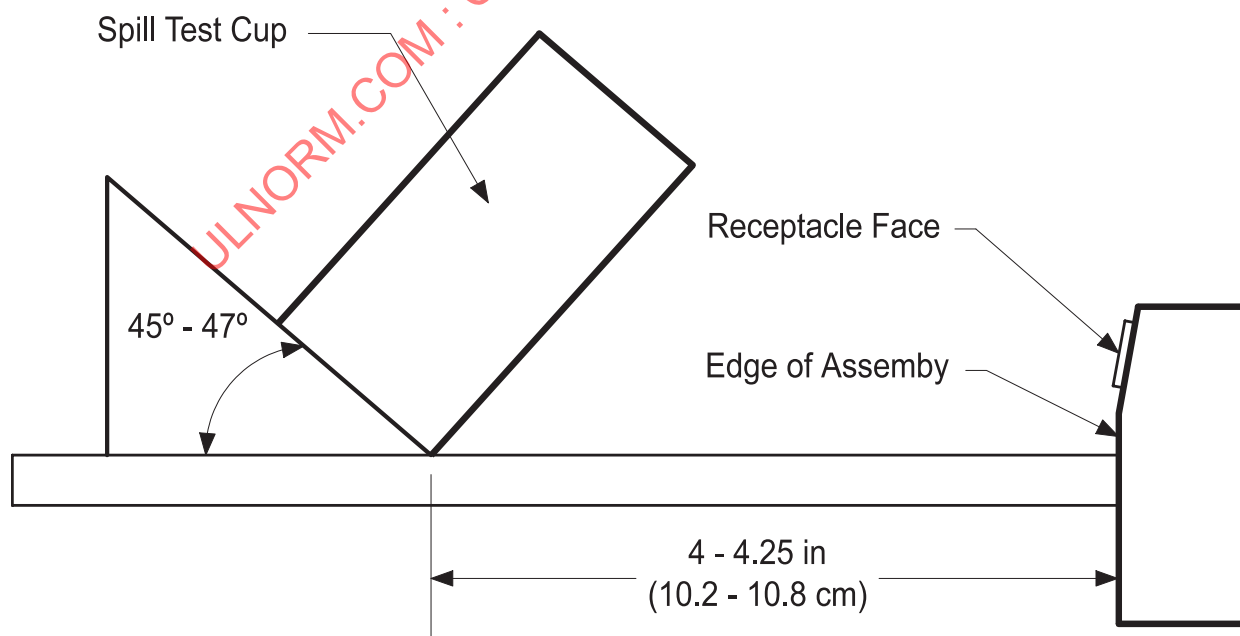
78.1.3 A cord connector shall be manually manipulated to any position allowed by the construction of the furnishing and released so that it returns to its at rest position for the Spill Test.

78.1.4 An acrylic cylinder $3 \pm 1/16$ inches (76.2 ± 1.6 mm) inside diameter by $4 \pm 1/16$ inches (101.6 ± 1.6 mm) overall height with $1/8$ inch $\pm 1/16$ inch (3.2 ± 1.6 mm) thick base and cylinder wall is to be filled with 8 ± 0.25 fluid ounces (237 ± 7.4 ml) of saline solution, consisting of 8 ± 0.1 g of plain food grade Iodized table salt per 1 ± 0.1 L of distilled water at ambient room temperature.

78.1.5 The test cup, as specified in [78.1.4](#), is to be placed on a 45 – 47° incline plane from the horizontal surface. The incline plane is to be large enough to support the entire base of the cup. The leading edge of the test cup base is to be positioned on the test surface 4 to 4.25 inches (10.2 to 10.8 cm) in from the edge of the unit. See [Figure 78.1](#) and [Figure 78.2](#). The test cup is to be placed so that the rim of the cup, when tipped over, is aligned with the receptacle, which may be a USB receptacle, or cord connector face. See [Figure 78.3](#). If a plug is inserted, the cup is to be aligned with a receptacle or cord connector without the inserted plug. The cup is then to be manually tilted toward the receptacle or cord connector under test and allowed to fall by gravity toward the receptacle or cord connector.

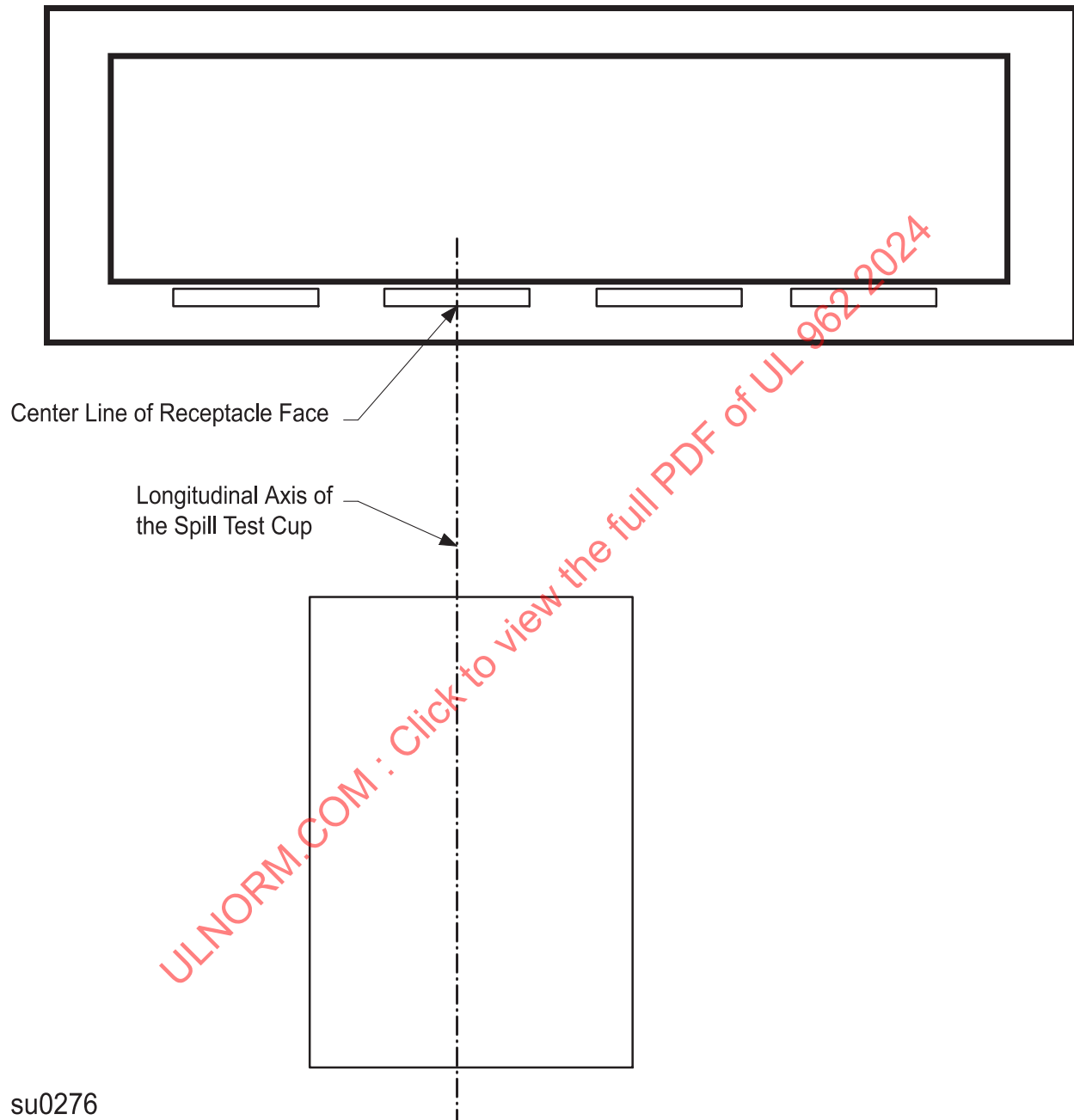
Figure 78.1**Side View of Spill Test Fixture to Test Sample (Drawing Not to Scale)**

su0274

Figure 78.2**Side View of Spill Test Fixture to Test Sample (Drawing Not to Scale)**

su0275

Figure 78.3
Top View of Spill Test Cup to Receptacle Face



78.2 Spill test dielectric voltage-withstand test

78.2.1 A receptacle or cord connector assembly shall be undisturbed following the spill test and shall withstand an applied potential of 1240 V, or 1000 V plus two times the supply voltage, whichever is higher.

78.2.2 For receptacle or cord connector assemblies provided with metallic enclosures, the potential shall be applied one minute after the spill test cup is released. The potential shall be applied between any live part conductively connected to the supply circuit and any dead metal part and the enclosure.

78.2.3 For receptacle or cord connector assemblies provided with non-metallic enclosures metal foil is to be wrapped around all of the accessible enclosure areas containing energized parts prior to spill test. Metal foil is not to be placed over a receptacle or cord connector face. The metal foil shall closely conform to the shape of the enclosure. The potential shall be applied one minute after the test cup is released between any energized part conductively connected to the supply circuit and any non energized metal part or metal foil applied to the enclosure without disturbing the product.

79 Flooding Test

79.1 A furnishing that is provided with a water reservoir or is intended to have water added (such as vegetation planter) shall be subjected to the addition of water such that the water spills out the reservoir or over the side of the furnishing. Water shall be added at a volume and rate as specified in [79.5](#) and [79.6](#). There shall be no wetting of uninsulated live parts and the furnishing shall comply with the dielectric voltage withstand test immediately following the addition of the water.

79.2 Each configuration of a furnishing is to be assembled in accordance with the instruction manual. The glides, feet, casters, and similar parts are to be adjusted to present the most likely accumulation of water. Drain holes are to be plugged or left open whichever is most likely to cause flooding or wetting of electrical component parts.

79.3 Before the flooding test is conducted, an enclosure containing an opening for supply connections is to be fitted with the intended supply connection means. All wired furnishing sections, fittings, and similar components are to be assembled as intended. The conditioning specified in Part 2 – Sections [112](#), [117](#) and [118](#), Water Shield Impact Conditioning, shall be applied when applicable to the product under test.

79.4 A gasket or bushing employed to comply with the requirements of the flooding test shall comply with the requirements of the thermal conditioning test specified in Part 2 – Sections [112](#), [117](#) and [118](#).

79.5 A water reservoir that would typically be filled from another container by hand shall be filled at a rate of 1 gallon (3.79 L) per minute and shall be subjected to twice the reservoir volume. Other fill material such as soil shall be disregarded in determining the reservoir volume.

79.6 A water reservoir that would typically be filled from a pressurized source such as a garden hose shall be filled at a rate of 5 gallons (18.95 L) per minute and shall be subjected to 5 times the reservoir volume. Other fill material such as soil shall be disregarded in determining the reservoir volume.

80 Upholstered Furnishings with Heating Pads

80.1 Resistance to moisture test

80.1.1 A furnishing that employs a heating pad with an upholstered covering in the area of the heating pad shall be tested as specified in [80.2.1](#). As a result of the test, the leakage current for a furnishing shall not exceed 0.5 MIU at 120 V, and the covering shall not lose its moisture-resistant properties.

80.1.2 To determine whether a furnishing complies with the requirements in [80.1.1](#), a furnishing of such as a chair or massage table, is to have a 1 inch (25-mm) thick felt mat placed against that portion of the furnishing containing the heating pad. The sample is then to be continuously operated at its maximum operating temperature. After operation for 300 hours, the surface of the covering is to be manipulated back and forth several times as allowed by the construction of the furnishing to flex the material throughout the entire surface. Following the manipulation, the furnishing is to be tested for leakage current in accordance with the Leakage Current Test, Section [65](#).

80.1.3 The sample or the area of the sample containing the heating pad is then to be placed in a horizontal plane, with the edges of the furnishing turned up at right angles for approximately 1 inch (25 mm) to form a shallow tray. If the edges of the furnishing cannot be turned up, supplementary sides may be attached to or formed on the furnishing to hold the solution. The side or face that was in contact with the felt mat during the 300-hour test is to be the upper or inside surface of the tray. A solution of approximately 8 g of NaCl per 1000 ml of water is to be introduced into the tray to a minimum depth of 1/4 inch (6 mm), and the leakage current between the electrolyte and the furnishing is then to be measured. The solution is to be allowed to remain on the covering for 3 hours, and if there is no measurable leakage current, the test may be discontinued, but, if any leakage current is measured, the test is to be continued until ultimate results are obtained, but not longer than 7 hours.

80.2 Thermostat test

80.2.1 General

80.2.1.1 A thermostat employed in a heating pad shall comply with [80.2.2](#) – [80.2.5](#).

80.2.2 Original calibration

80.2.2.1 The cutoff temperature of each of six thermostats that are identical to the thermostats employed in the heating pad is to be measured by any method whereby the temperature can be closely regulated and accurately measured.

80.2.3 Overload

80.2.3.1 When tested as specified in [80.2.3.2](#), there shall be no electrical or mechanical breakdown or undue pitting or burning of the contacts in any of the six calibrated thermostats.

80.2.3.2 The thermostats are to be operated automatically at rated voltage for 100 cycles at a rate of not more than 6 cycles per minute, making and breaking twice the maximum current that the thermostat normally carries in the pad. An alternating-current supply circuit is to be used if the pad is rated for use on only alternating current. A direct-current supply circuit is to be used if the pad is rated for use on only direct current or for use on both direct current and alternating current.

80.2.4 Endurance

80.2.4.1 There shall be no electrical or mechanical breakdown or undue pitting or burning of the contacts in any of the six thermostats that performed acceptably in the overload test specified in [80.2.3](#) as the result of their additional automatic operation at rated voltage for at least 100,000 cycles at a rate of not more than 30 cycles per minute making and breaking the maximum current that the thermostat normally carries in the pad.

80.2.4.2 This test is intended to represent at least 1000 hours of service under conditions that produce the fastest operation of a thermostat in the pad. The test is to be continued beyond 100,000 cycles if necessary to represent 1000 hours of service.

80.2.5 Recalibration

80.2.5.1 After the six thermostats that were subjected to the endurance test specified in [80.2.4](#) have been kept at a temperature of 0 °C (32 °F) for 1 hour and then at a temperature of 125 °C (257 °F) for an additional hour, the cutoff temperature of each of the six thermostats shall not be more than 5 °C (9 °F) higher than the original cutoff temperature determined in accordance with [80.2.2](#).

80.3 Flexing and twisting test

80.3.1 Flexing

80.3.1.1 A furnishing employing a heating pad that may be subjected to flexing or twisting, or both, shall be tested as specified in [80.3.1.3](#) – [80.3.2.4](#). Following the test:

a) The furnishing shall comply with the requirements in the:

- 1) Leakage Current Test, Section [65](#),
- 2) Strain Relief Test, Section [69](#) and Strain relief for internal conductors and connectors test, [69.2](#),
- 3) Dielectric Voltage-Withstand Test, Section [71](#), and
- 4) Resistance to moisture test, [80.1](#), and

b) There shall be no:

- 1) Loosening of the cord or conductors from the furnishing or heating pad,
- 2) Breakage of the covering material or of the seams of the covering material,
- 3) Breakage or loosening of any wiring connection,
- 4) Appreciable shifting of the position of the heating pad within the furnishing, or
- 5) Breakage of a conductor of the heating element or other interruption of the electrical circuit through the heating pad or furnishing.

80.3.1.2 Each of three complete samples of the heating pad assembly is to be flexed 8000 cycles under the conditions specified in [80.3.1.3](#) – [80.3.2.4](#).

80.3.1.3 The apparatus for conducting the flexing test is to consist of a power-driven testing machine, a pair of wide clamps for gripping the edges of each sample, and a number of weights, each large enough to exert 1 pound of force (4.45 N) when suspended from a clamp.

80.3.1.4 The machine is to draw each sample back and forth by means of a clamp over the 1/2 inch (13-mm) radius edge of a smooth horizontal metal bed at a rate of approximately 15 cycles per minute. The stroke of the machine is to be adjustable to accommodate a heating pad assembly of various dimensions, so that the greatest possible area of the heating pad is subjected to the flexing.

80.3.1.5 The clamps are to be in pairs that are long enough to accommodate edges of different dimensions, and may be of any construction that securely grips the edges of the heating pad assembly. One clamp is to be provided with hooks for the suspension of the weights. The clamps are to be applied to opposite edges of each sample, which is then to be adjusted in the machine with the weighted clamp hanging over the rounded edge of the bed. A weight exerting a force of 1 pound (4.45 N) is to be used for each 6 inches (152 mm) or fraction thereof of the edge of the furnishing in the clamp.

80.3.1.6 Each sample is to be connected by means of its flexible cord and plug to a supply circuit. After 2000 cycles of continuous operation the machine is to be stopped, the pad turned 90° so that the bending is at right angles to that previously made, and operation resumed. After the second 2000 cycles of operation the machine is to be stopped, the pad turned over, and operation resumed. After the third 2000 cycles of operation the machine is to be stopped, the pad turned again through 90°, and the operation continued for a fourth 2000-cycle period.

80.3.2 Twisting

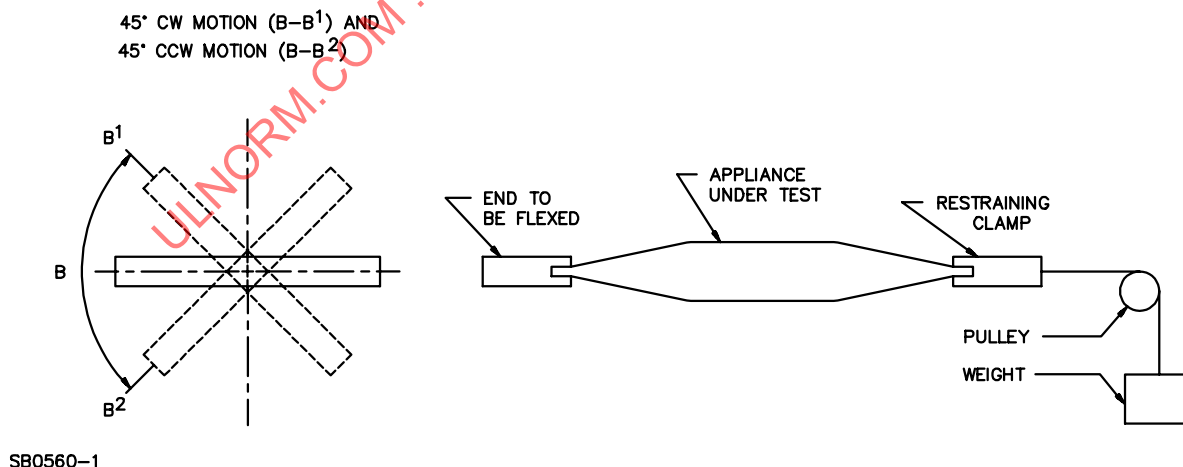
80.3.2.1 Each of three complete samples of a heating pad assembly shall be subjected to a 6000-cycle twisting test as specified in [80.3.2.2](#) – [80.3.2.4](#) while connected to a supply circuit, with the heating pad switch in the high position. At the completion of the test, the furnishing shall comply with the requirements in [80.3.1.1](#).

80.3.2.2 The apparatus for conducting the twisting test is to consist of a power-driven twisting machine and a pair of wide clamps for gripping the edges of each sample.

80.3.2.3 One end of the sample is to be rigidly clamped in a horizontal plane along its width. This end is to be prevented from twisting. The heating pad assembly is to be kept in tension by a pull of 5 pounds (22 N) that is placed on this end. The other end of the heating pad assembly is to be clamped in the twisting machine along its width.

80.3.2.4 The machine, with the sample clamped in place, is to twist back and forth through a 90° arc. The test is to be conducted at approximately 15 cycles per minute, a cycle being considered as the movement from the horizontal clockwise through 45° of arc, counterclockwise through 90° of arc to a position 45° below the horizontal, and back to the horizontal. A faster twisting rate may be used with the concurrence of those concerned. See [Figure 80.1](#).

Figure 80.1
Twisting-Test Apparatus



81 Magnetic Field Test

81.1 A furnishing that is intended to produce magnetic fields external to the furnishing shall be subjected to the applicable tests specified in this section. The furnishing shall not exceed a threshold limit (ceiling) for static magnetic fields of 0.5 mT (5 Gauss) at a distance of 1 foot (30.48 cm) from the furnishing. The furnishing may exceed 0.5 mT (5 Gauss) at a distance less than 1 foot (30.48 cm) from the furnishing if marked in accordance with [86.19](#).

81.2 The temperature test and magnetic field strength test shall be conducted with object(s) intended to be subjected to the furnishings magnetic field, without the object(s), and with other objects which could produce a visible action on the object or furnishing. Objects may be manipulated by hand only if by doing so creates a visible effect on the object or furnishing.

81.3 A furnishing shall be placed in its intended position in accordance with the installation and operation instructions. The furnishing shall be operated at rated voltage. Any doors, covers or other components which are removable or operable without the use of tools shall be removed or operated to determine the maximum magnetic field strength.

81.4 The magnetic field shall be measured at 1.0 inch intervals up to 1 foot.

MANUFACTURING AND PRODUCTION LINE TESTS

82 Grounding-Continuity Test

82.1 Each cord-connected furnishing shall be tested, as a routine production-line test, to determine that grounding continuity exists between the grounding pin of the attachment plug and the electrical enclosure or other dead metal parts. When the electrical enclosure is complete, the electrical enclosure is not required to be attached to a furnishing.

82.2 Any appropriate indicating device – an ohmmeter, battery- and buzzer-combination, or similar equipment – is able to be used to determine compliance with [82.1](#).

83 Polarity

83.1 Each furnishing provided with a cord and plug shall be checked as a routine production-line test to verify that there is electrical continuity between the grounded supply-circuit conductor of the attachment plug – wide blade of a 2-wire type – and the part of the product that is intended to be connected to the grounded supply-circuit conductor of the attachment plug (for example, screw shell of an incandescent lampholder). The continuity shall be determined either visually or through the use of an electrical test. Equivalently, continuity is able to be verified between the ungrounded supply-circuit conductor of the attachment plug and the part of the product that is intended to be connected to the ungrounded conductor (for example, the center contact of an incandescent lampholder).

Exception: The Polarity Test is not required for furnishings where the polarity of the wire will not affect the safety of the product.

84 Dielectric Voltage-Withstand Test

84.1 Each furnishing shall withstand without electrical breakdown, as a routine production-line test, the application of a 40 – 70 hertz potential as specified in [Table 84.1](#) between:

- a) The supply wiring and dead metal parts that may become energized;
- b) Supply wiring of opposite polarity when separate grounded supply conductors are employed; and
- c) The ungrounded supply conductors of opposite polarity when the same grounded supply conductor is employed for both circuits.

Table 84.1
Dielectric Voltage-Withstand Test Levels

Insulation Type	One Minute (Vac)	One Minute (Vdc)	1 Second (Vac)	1 Second (Vdc)
Single	$1000 + (2 \times \text{Rated Voltage})$	$1.414 \times (1000 + (2 \times \text{Rated Voltage}))$	$1200 + (2.4 \times \text{Rated Voltage})$	$1.414 \times (1200 + (2.4 \times \text{Rated Voltage}))$
Double	$2000 + (4 \times \text{Rated Voltage})$	$1.414 \times (2000 + (4 \times \text{Rated Voltage}))$	$2400 + (4.8 \times \text{Rated Voltage})$	$1.414 \times (2400 + (4.8 \times \text{Rated Voltage}))$

84.2 The test is to be conducted with the furnishing fully assembled. It is not intended that the product be unwired, modified, or disassembled for the test.

Exception: A furnishing employing solid-state components (such as load connected, across-the-line components or transient voltage surge suppressors) that are able to sustain damage from the dielectric potential are able to be tested before the components are electrically connected or a DC voltage may be used.

84.3 The test equipment is to include a transformer having a sinusoidal output, a means of indicating the test potential, an audible or visual indicator of electrical breakdown, and either a manually reset device to restore the equipment after electrical breakdown or an automatic feature to reject any product that does not meet the requirement.

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

84.5 When the output of the test-equipment transformer is 500 volt-amperes or more, the test potential is able to be indicated by a voltmeter in the primary circuit or in a tertiary-winding circuit, a selector switch marked to indicate the test potential, or in the case of equipment having a single test-potential output, a marking shall be visible while the equipment is in use to indicate the test potential. When marking is used without an indicating voltmeter, the equipment shall include a positive means, such as an indicator lamp, to indicate that the manually reset switch has been reset following a dielectric breakdown.

84.6 Test equipment other than that specified in [84.3](#) – [84.5](#) is able to be used when it is determined to accomplish the intended factory control.

RATINGS

85 Electrical Ratings

85.1 A furnishing shall be rated with its electrical ratings, including input voltage, frequency or "AC", "DC", and current or watts.

85.2 The maximum ampere rating shall be calculated by adding the ratings of each load and device on each circuit. The following are applicable:

a) The calculated load of each line-voltage incandescent lampholder as follows:

- 1) When the maximum lamp replacement wattage is marked on the furnishing divide the marked wattage rating by 120 volts or rated voltage; or
- 2) When the wattage is not marked on the luminaire, each candelabra-base or intermediate-base lampholder shall be counted as 0.5 ampere and each medium-base lampholder shall be counted as 2.5 amperes;

- b) The ampere rating of each ballast, transformer, power supply or driver; and
- c) The ampere rating of any other electrical load, such as a motor, or similar part.
- d) On a cord and plug connected furnishing provided with an ANSI/NEMA 5-15P plug and provided with 15 amp receptacles, the maximum rating per cord and plug connection for the furnishing shall be 15 amps, 1800VA. If the furnishing is provided with an ANSI/NEMA 5-20P cord and plug connection and 15 or 20 amp receptacles the maximum rating per cord and plug for the furnishing shall be 20 amps, 2400VA.
- e) For a permanently connected furnishing loads shall be calculated as follows:
 - 1) For any load provided with the furnishing or as an accessory for the furnishing the electrical rating of the load; and
 - 2) For unoccupied 120V 15A or 20A receptacles 180VA per outlet or 180VA for duplex or triplex outlets.

85.3 When more than one power supply cords are provided, the electrical rating for each cord shall be considered separately. When more than one cord is connected to the same branch circuit in accordance with [10.3.1\(d\)](#), the total electrical rating shall also be Marked on the product. See [96.6](#).

MARKINGS

86 General

86.1 A furnishing shall be plainly and permanently marked with:

- a) The company's name, trade name, trademark, or other descriptive marking by which the organization responsible for the product is identifiable;

Exception: The company's identification is able to be in a traceable code when the product is identified by the brand or trademark owned by a private labeler.

- b) A distinctive catalog number or the equivalent;
- c) The Electrical Ratings, see Section [85](#); and
- d) The date or other dating period of manufacture not exceeding any three consecutive months.

Exception: The date of manufacture is able to be abbreviated, or is able to be in a nationally accepted conventional code or in a code affirmed by the manufacturer, when the code does not:

- 1) Repeat in less than 10 years for a household product and less than 20 years for a commercial product; and
- 2) Require reference to the production records of the manufacturer to determine when the product was manufactured

86.2 In regard to [85.2](#), in instances where there is only one electrical load and no receptacles, the rating on the component is able to be used.

86.3 A unit intended for dry locations only shall not be provided with any information such as markings, instructions, or illustrations that implies or depicts damp or wet use.

86.4 A unit intended for damp locations only may be marked as suitable for damp locations, and shall not be provided with any information such as markings, instructions, or illustrations that implies or depicts wet use.

86.5 Furnishings with more than one cord, shall have an electrical rating for that circuit adjacent to the cord exit from the furnishing or on a tag on the cord itself. The electrical ratings are able to be provided on one marking if a means, such as different color cords, is provided to distinguish between the two circuits. The furnishing shall be marked "WARNING", "Risk of Electric Shock", "Furnishing has multiple cords. Make sure all cords are unplugged before any servicing or cleaning", or an equivalent statement.

86.6 Unless stated otherwise, all required markings shall be permanent die-stamped, ink-stamped, or paint-stenciled lettering. Adhesive-backed label systems shall comply with the requirements for indoor-use labels in UL 969. Minimum letter height shall be 3/32 inch (2.4 mm) as measured by characters such as "b", "1", or "H". A contrasting background shall be provided for legibility.

86.7 When a three part warning mark is required, the individual letters of the first word of a cautionary, warning, danger marking – "CAUTION", "WARNING", and "DANGER" – shall be larger than the letters of the statement that follows, and shall not be less than 7/64 inch (2.8 mm) high.

86.8 A furnishing that has channels intended to be used for routing flexible cord of accessories or portable furnishings shall be marked to indicate that cords are not to be routed across or through more than either one complete unit or work surface, as applicable. Each cord-routing channel shall be marked, where visible when a cord is being inserted, to indicate that the channel is not to be used for routing extension cords.

86.9 When a furnishing is produced or assembled at more than one plant, each finished furnishing shall have a permanent unique plant identifier marking.

86.10 When the design of a furnishing requires cleaning or servicing, such as the replacement of pilot lamps or fuses, by the user, and when such cleaning or servicing exposes a normally enclosed or protected live part to unintentional contact, the furnishing shall be plainly and permanently marked to indicate that such servicing or cleaning be done with the furnishing disconnected from the supply circuit.

86.11 With respect to the Exception No. 1 to [16.1.1](#), a furnishing shall not be marked with a double insulation symbol (a square within a square) the words "Double Insulation," or the equivalent unless it complies with the requirements for double-insulated furnishings.

86.12 A furnishing having a part of an enclosure as specified in the Exception to [11.3.7](#) shall be marked to indicate that such servicing is to be done with the furnishing disconnected from the supply circuit.

86.13 Unless a furnishing has been investigated and found usable for both commercial and household use, a marking shall be provided on the furnishing to inform the user that the furnishing is for either commercial or household use only.

86.14 Any user markings that are provided on a component part of a furnishing, and are not visible to the user after the component is installed in the furnishing shall be reproduced on the furnishing where visible to the user. For example, the lamp replacement wattage is to be visible once the light is installed.

86.15 When required by [10.3.1\(h\)](#) or Exception No. 1 of [10.3.1\(d\)](#), the following permanent markings shall be provided on a product that is provided with more than one power supply cord:

"CAUTION – Risk of Electric Shock. This unit has _____ power supply cords. Unplug all cords before moving or servicing this furnishing." Where the blank indicates the number of cords on the unit.

86.16 When more than two power supply cords are provided the flexible cords shall be marked with the circuit identification corresponding to the identification and labeling of the receptacles.

Exception: If appliance inlets are provided, the marking shall be on the product near the appliance inlet.

86.17 In accordance with the Exception(d) to [10.3.1](#)(f), the following marking shall be provided adjacent to each disconnect switch or control: "CAUTION – Risk of Electric Shock. This unit has more than one disconnect switch. Disconnect both electrical supplies before servicing this furnishing", or an equivalent wording.

86.18 Each shelf, magazine rack, towel bar or other support means that are part of the portable floor supported furnishing assembly and intended to support any object(s) shall be marked "WARNING – Risk of tip over"; and "Max. _____ lb. Load", or equivalent, where the blank space specifies the maximum load in pounds.

86.19 In accordance with [81.1](#), the following marking shall be provided: "WARNING: This product may adversely affect medical devices. Do not use near people using or wearing medical devices." or an equivalent wording. The marking shall be visible from the exterior of the furnishing when in use.

86.20 In accordance with [37.1.3](#), the following marking shall be provided: For use in public occupancies in accordance with The State of California Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation, Technical Bulletin 129 Flammability Test Procedure for a Mattress for use in Public Buildings (October 1992), or an equivalent statement.

86.21 A furnishing that has been investigated and found suitable for public occupancies and/or household use shall be marked on the furnishing to inform the user that the furnishing is for either public occupancies or household use only, or both as applicable. "For Household / Residential Use Only" or "For Public Occupancy Use Only" or an equivalent statement. This marking is required to be permanent. This marking shall also be on any container and be visible while displayed.

86.22 A furnishing that complies with the Exception to [37.2.2](#) shall be permanently marked "This furnishing has not been evaluated for flammability or cigarette ignition resistance" or an equivalent statement.

86.23 Products provided with user replaceable fuses shall be marked where readily visible during replacement of the fuse(s) with the fuse ratings and "CAUTION – Risk of fire" and the following or equivalent text: "For continued protection against risk of fire, replace only with same type and rating of fuse".

86.24 A furnishing that has provision for use with accessories shall be marked:

- a) With the specific model number or series number of the accessories suitable for use with the basic furnishing; or
- b) To refer to the installation and operation instructions for the accessories that are suitable for use with the furnishing.

86.25 In accordance with [10.4.3](#) a permanent marking adjacent to the appliance inlet shall be marked "WARNING – Risk of fire and shock, Use only '____' type '____' AWG cord" or an equivalent statement, where the cord type is selected based on the type and max temperature in accordance with [Table 10.5](#) and cord size selected in accordance with from [Table 10.4](#).

86.26 Furnishing rated 12 A employing 4 receptacles and 16 AWG power supply cord without supplementary overcurrent protection shall be permanently marked "Suitable for Household (Residential) use only." See [Table 26.1](#) subnote d.

86.27 Receptacles supplied from an emergency or standby system shall have a distinctive color or marking on the receptacle or on the receptacle cover plate.

86.28 A furnishing provided with a video display intended for use in a bathroom shall be permanently marked on the exterior of the remote control or on the video display screen where visible to the user "WARNING – Risk of death or serious injury. Children should never be left unattended in the bathtub, including while the television is in use."

86.29 A furnishing having a SDI of more than 450, as determined in accordance with [37.3.6](#), or a Total Smoke Release (TSR) more than 60 as determined in accordance with [37.3.7](#) (a TSR of 60 is equivalent to a SDI of 450), shall be marked "SMOKE DEVELOPED INDEX OVER 450".

86.30 When a furnishing is intended for other than household use, the maximum functional load that was used to evaluate the furnishing shall be marked where visible to the user "WARNING Risk of Injury – maximum load ___pounds" or equivalent, where the blank space specifies a value less than or equal to the maximum load in pounds. Refer to [46.1.2](#).

86.31 Furnishings investigated in accordance with [53.11](#), SOHO S6.5 shall be marked "Small Office Home Office Furnishing" or an equivalent statement.

86.32 A commercial furnishing that complies with Section [31](#), Commercial Operator Attended Products _ Usage Area II, shall be marked adjacent to the operator controls "WARNING – Risk of injury, Do not operate this equipment unless properly trained."

86.33 A surface of furnishing that is intended to be placed against a fixed vertical structure (see Exception to [53.9.1](#)) shall be marked with the following: "WARNING – Risk of Instability and Injury. This surface must be placed against a fixed vertical wall or similar structural surface", or an equivalent statement.

86.34 Mirror-type furnishings which are not evaluated for Damp or Wet Locations shall be marked "Dry Locations Only".

86.35 A television support shelf or television mounting surface shall be permanently marked where it will be readily visible prior to the placement or installation of a television (The marking may be hidden by the television when the television is set in place or installed) with the maximum allowable weight of television intended for use with the furnishing.

Exception: A supporting surface or compartment obviously intended to accommodate accessories, such as records, tapes, earphones, digital discs, and similar accessories, is not required to be indicated for use with the intended load.

86.36 The marking in [86.35](#) shall consist of the following: The safety alert symbol, , preceding the following, "Warning – Risk of tipover. For use with televisions weighing _____ lbs (Kg) or less. Use with heavier televisions may result in instability causing tip over resulting in death or serious injury", where the blank contains the manufacturer's specified maximum television weight in pounds and kilograms.

86.37 A furnishing tested with a specific TV center of gravity or range shall be permanently marked with the following where visible when installing the television, "WARNING – Risk of death or serious injury. For use with TVs 1 – 3 inches (25.4 – 76.2 mm) thick" or an equivalent statement based on the tested center of gravity.

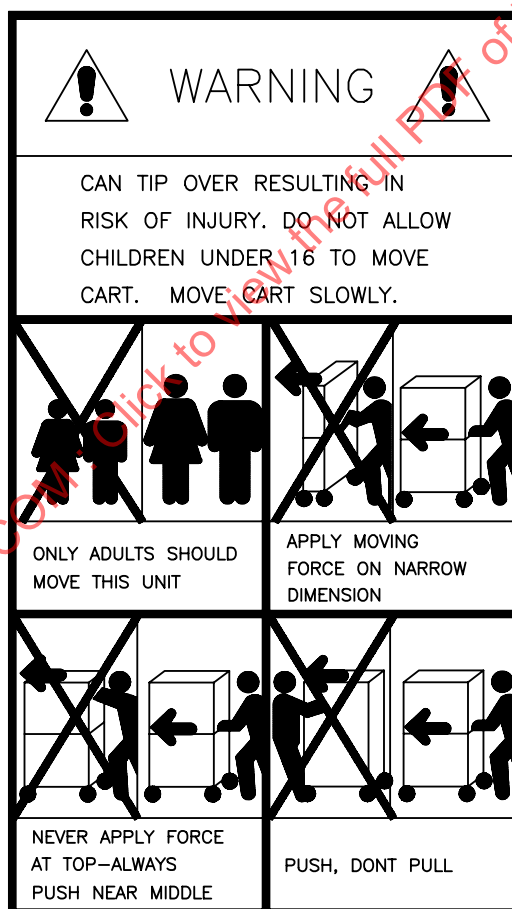
86.38 A furnishing tested with a specific model television or television series shall be permanently marked with the following where visible when installing the television "WARNING – Risk of death or serious injury. For use with model series _____ television only", or an equivalent statement, where the blank contains the manufacturer's name and model or model series of television.

86.39 Furnishings shipped unassembled shall be marked "WARNING", "Risk of Electric Shock, Fire, and Injury", "Review the assembly instructions to confirm that the appropriate critical components and accessories are being used with the furnishing." or equivalent wording.

86.40 A tall cart shall be provided with a marking as shown in either [Figure 86.1](#) or [Figure 86.2](#) (or the equivalent) that is permanently attached to the front of the cart and positioned so that it is visible after placement of the intended equipment. If a tag is used, the wording and symbols shown in [Figure 86.1](#) or [Figure 86.2](#) shall be provided on both sides of the tag. The marking shall be factory applied.

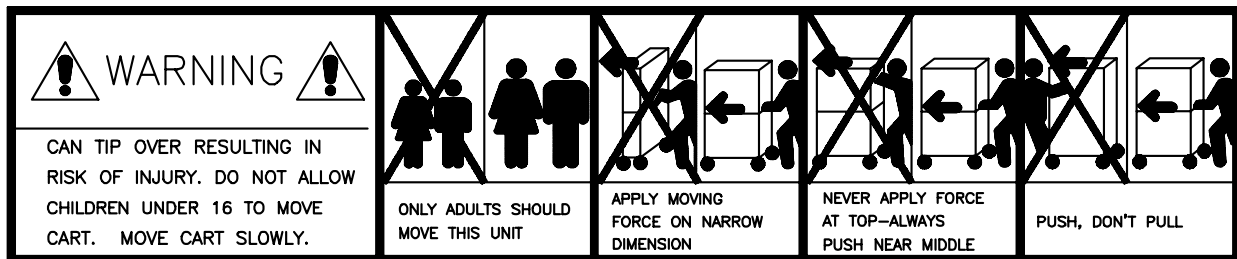
Figure 86.1

Tall Cart Warning Marking – Example 1



S 3481

Figure 86.2
Tall Cart Warning Marking – Example 2



S 3480

86.41 In accordance with [11.2.11](#) a furnishing center with more than one mounting surface that may become unstable shall be permanently marked within sight of the securement points of the audio or video equipment but not covered by the equipment with the following: “WARNING – Death or Serious injury may occur when removing mounted products. Refer to the instructions before removing mounted equipment” or an equivalent statement.

86.42 A furnishing that has a surface that is not intended to support any kind of load shall be marked “WARNING” “Risk of Injury” “This surface is not designed for any type of load” “Do not put any objects on this surface” or equivalent. This marking shall be visible from the location where the load would be applied.

86.43 Furnishings that are provided with a foundation, but not a mattress shall be marked “WARNING” “RISK of INJURY” “Use only mattresses marked for use with this foundation, Model XYZ” where XYZ would be the model of the foundation.

86.44 In accordance with the Exceptions to [11.5.1](#), attended furnishings shall be marked “Warning! Risk of Fire! Attended Use Only. Turn off power when not in use.”

86.45 Rooms or booths with an open-grid ceiling system shall be provided with the marking that states “WARNING” “Risk of Fire” “Only to be used in _____ hazard occupancies”, where the blank is either “light” or “ordinary” depending on the final location of the furnishing. “See installation instructions for additional information”, or equivalent. This marking shall be visible during installation.

86.46 Rooms or booths with an open-grid ceiling system or a drop-out ceiling shall be provided with the marking that states “WARNING” “Risk of Fire” “Do not put any objects on this surface”, or equivalent. This marking shall be visible during installation.

86.47 Rooms or booths with a “drop-out” panel ceiling system or an adjustable open-grid system shall be provided with the marking that states “WARNING” “Risk of Fire” “Only use in locations with standard-response sprinklers”. “See installation instructions for additional information”, or equivalent. This marking shall be visible during installation.

86.48 Ceiling drop-out panels or adjustable open-grid ceiling systems shall be marked with the following information:

- a) "Ceiling Panels for Use Beneath Sprinklers";
- b) The flame spread and smoke developed index shall be marked on the wall or ceiling covering system in accordance with Method I or Method II.

1) Method I – For products that fall into specific ranges of the Flame Spread and Smoke Developed indexes shown below the wall or ceiling covering system shall be marked with the maximum Flame Spread and Smoke Developed rating for one of the specific indexes as shown below:

Flame Spread 25, Smoke Developed 450;

Flame Spread 75, Smoke Developed 450;

Flame Spread 200, Smoke Developed 450;

The Flame Spread and Smoke Developed index marking may be abbreviated FHC 25/450 as appropriate to the index.

2) Method II – The specific index value determined by UL 723, shall be marked on the wall or ceiling covering system as follows:

Flame Spread 12, Smoke Developed 4;

The Flame Spread and Smoke Developed index marking may be abbreviated FHC 12/47; and

- c) The statement – "When installed in accordance with installation instructions provided with each carton, may be used beneath sprinklers subject to the Authorities Having Jurisdiction".

86.49 An upper bunk capsule cabin shall be provided with following warning label:

 WARNING

To help prevent serious or fatal injuries from entrapment or falls:

- Never allow a child under 6 years on Upper Bunk Capsule Cabin
- Only use mattress provided by manufacturer
- Ensure thickness of mattress and foundation combined is at least 5 inches below upper edge of elevated guardrail
- Prohibit horseplay on Upper Bunk Capsule Cabin
- Prohibit more than one person on Upper Bunk Capsule Cabin
- Use ladder for entering and leaving Upper Bunk Capsule Cabin

DO NOT REMOVE THIS LABEL

86.50 Commercial tables, lab benches, and similar furnishings that are not provided with a work surface and/or secondary surfaces (shelves) shall be marked "WARNING – Risk of Fire, Electric Shock, or Personal Injury – The table is not complete until mated with a work surface. Read instructions to determine the appropriate size, shape, and weight of work surface and/or secondary surfaces (shelves) is used." or equivalent.

86.51 Work surfaces and/or secondary surfaces (shelves) that are provided separately from commercial tables, lab benches and similar furnishings shall be marked "WARNING – Risk of Fire, Electric Shock, or Personal Injury – Read instructions for the work surface and/or secondary surfaces (shelves) and/or shelf and for the _____ to determine if the surface is appropriate for use with the intended _____." or equivalent. Where the blank is the type of product, such as a table or lab bench.

87 Motor-Operated Furnishings

87.1 A furnishing with only a single motor, whose rating is visible from the exterior of the furnishing, and which is the only electricity consuming component in the furnishing is not required to have a separate label for the furnishings electrical rating.

87.2 When the motor nameplate of a dual-voltage motor is employed to give the electrical rating of the furnishing as specified in [87.1](#). The furnishing shall be additionally and permanently marked to indicate the particular voltage for which it is connected when shipped from the factory. When the furnishing employs an attachment plug, instructions shall be provided to indicate the type of plug that shall be used when the furnishing is reconnected for the alternate voltage.

87.3 A motor-operated furnishing that does not start and attain normal running speed when connected to a circuit protected by an ordinary – not time-delay – fuse shall be plainly and permanently marked with the words: "If connected to a circuit protected by fuses, use time-delay fuses with this furnishing," or equivalent wording.

87.4 Usage Area II furnishings shall be marked "WARNING", "RISK OF INJURY", "Not to be used in locations where children, or people with cognitive disabilities are anticipated to be present and not supervised". The marking shall be located where visible during or after assembly.

87.5 Usage Area III furnishings shall be marked "WARNING", "RISK OF INJURY", "Not to be used in locations where children, or people with cognitive disabilities are anticipated to be present". The marking shall be located where visible during or after assembly.

87.6 Usage Area IA furnishings shall be marked "WARNING", "RISK OF INJURY", "Do not use where children or people with cognitive disabilities could be present and unsupervised". The marking shall be located where visible during or after assembly.

87.7 Usage Area I bed storage units shall be marked "WARNING – RISK OF INJURY", "Do not operate when the bed is occupied. Do not operate this furnishing when children or people with cognitive disabilities are present." The marking shall be located where visible for the user during operation.

88 Interconnected Units

88.1 An interconnected unit with a short cord in accordance with [29.1](#) shall be marked "Only connect to adjacent unit". The word "unit" is able to be replaced by the appropriate product name such as cabinet light, under cabinet light, or office furnishing light.

88.2 An interconnected unit shall be marked adjacent to the connector intended for interconnection: " _ a _ units maximum". Where "a" is the number of units.

88.3 An interconnected unit with an internal fuse shall be marked adjacent to or on the fuseholder: " _ b _ A fuse maximum". Where "b" is the fuse size.

88.4 A unit that is intended to be connected to the secondary circuit of a ballast or transformer in an adjacent unit, or to a fused unit, shall be marked "Only for use with (number of units) (catalog or parts number) manufactured by (manufacturer's name) (product name)" or the equivalent.

89 Permanently Electrically-Connected Furnishings

89.1 When any point within a terminal box or wiring compartment of a permanently-connected furnishing in which the power-supply conductors are intended to be connected, including such conductors themselves, attains a temperature rise of more than 63 °F (35 °C) during the normal temperature test, the furnishing shall be permanently marked: "For supply connection, use wires rated for at least ___°C (___°F)," or with an equivalent statement, and the temperature value shall be in accordance with [Table 89.1](#). This statement shall be located at or near the point where the power-supply connections are to be made, and shall be clearly visible both during and after installation of the furnishing.

Table 89.1
Outlet-Box Marking

Temperature rise attained during test in terminal box or compartment		Temperature marking	
°C	(°F)	°C	(°F)
36 – 50	(65 – 90)	75	(167)
51 – 65	(92 – 117)	90	(194)

89.2 A permanently-connected furnishing, having one motor and other loads or more than one motor with or without other loads, shall be permanently marked in a location that is visible after connection to the power-supply circuit and during inspection with:

- The minimum power-supply circuit conductor ampacity based on the maximum input in accordance with Section [67](#), Input Test;
- The maximum rating of the power-supply circuit overcurrent-protective device, which is not to exceed the rating of that used in the short-circuit test of the motor-overload-protective device employed in the furnishing; and
- The type of supply-circuit overcurrent-protective device (for example: non-time delay fuse or dual-element time-delay fuse).

90 Accessory Markings

90.1 An accessory for a furnishing shall be marked with the company name, trade name, or trademark; the date or other dating period of manufacture not exceeding any three consecutive months; and a distinctive catalog number or the equivalent.

Exception: The date of manufacture is in compliance when abbreviated or in a nationally recognized conventional code or in a code affirmed by the manufacturer, only when the code:

- Does not repeat in less than 20 years, and*
- Does not require reference to the production records of the manufacturer to determine when the product was manufactured.*

90.2 The accessory shall be marked with the company's identification for the part, for example – "Illuminated Shelf Model _____" in which the appropriate series, or catalog number is specified.

90.3 An accessory shall be marked as required by the applicable clauses of Sections [85](#) – [89](#).

90.4 An accessory the physical size of which is such that all the required markings are not able to be physically placed on the accessory and maintain the minimum letter heights specified in and shall be marked with the name, trade name, or trademark and the date or other dating period of manufacture. All other required markings shall be provided on the smallest shipping container.

90.5 Each furnishing accessory that is shipped separately from the basic furnishing unit to which it is to be connected shall be marked as specified in Section [86](#), General, and shall be identified with respect to its intended use and interrelationship with the furnishing; for example – "For Use with Shelving Support System Type _____" in which the appropriate series, or catalog number is designated.

90.6 Each electrical accessory that is a load on a circuit (such as a lighting attachment, a motor, or similar accessory) shall be marked with its electrical rating in volts and amperes or watts as specified in Section [85](#), Electrical Ratings.

91 Sub-Assembly Markings

91.1 The marking requirements for sub-assemblies are supplementary to the other applicable requirements in this standard and apply to furnishings marked as subassemblies.

91.2 A sub-assembly shall be marked on the product or on the packaging with the company name, trade name, or trademark; and the manufacturing date [see [86.1\(d\)](#)].

91.3 A marking shall be provided on the unit or the container that indicates that the sub-assembly is the proper component as identified in the installation instructions, complies with these requirements, and includes an identification marking for the sub-assembly.

91.4 When sub-assemblies are produced and/or assembled at more than one plant, each finished sub-assembly shall have a permanent unique factory identifier marking.

91.5 The date marking required in [86.1\(d\)](#) shall be located on the furnishing nameplate.

INSTRUCTIONS

92 General

92.1 A furnishing shall be provided with legible instructions pertaining to the risk of fire, electric shock, or injury to persons that is associated with the use of the furnishing, such as operation, user-maintenance, loading, storage, and, as applicable, grounding or double-insulation.

92.2 Unless the furnishing has been evaluated and found usable for both household and commercial use, the instructions shall indicate whether the furnishing is intended for household or commercial use.

92.3 The instructions shall include the markings, or equivalent, specified in Sections [85](#) – [90](#).

92.4 The text of all required instructions shall be in the words specified or words that are equivalent, clear, and understandable.

92.5 With reference to the requirement in Section [86](#), General, there shall be no substitute for the cautionary prefixes "DANGER", "WARNING", and "CAUTION" when a three part warning is required.

92.6 When parts of the furnishing are able to be adjusted or manipulated by the user, such as a power-adjusted chair or table, or a leveling mechanism, instructions shall be provided regarding their use. An illustration is able to be used with a required instruction to clarify the intent, but shall not replace the written instruction.

92.7 Installation instructions shall be provided with each cabinet light intended to be installed by the user. The installation instructions shall include the following:

- a) The intended use;
- b) A caution to the user to avoid contact of the cord, or contact of combustibles such as plastic, paper goods, and similar materials, with the lamp, lampholder and reflector;
- c) Positioning of the cabinet light with respect to the cabinet walls so as to allow reading of the lamp replacement markings;
- d) A cautionary marking that the luminaire is not intended for illumination of aquariums; and
- e) A cautionary marking that the luminaire is not intended for installation in plastic cabinets.

92.8 When required by other parts of the standard, operating, maintenance, and installation instructions shall be provided for each furnishing and shall be included in the shipping carton of each furnishing or accessory.

92.9 The instructions specified in [92.8](#) shall include, at least the directions and information required to cover the mechanical and electrical limitations of a furnishing and the intended installation, maintenance, operation, and use of the product.

92.10 A Installation instructions shall specify the hardware used to mount or secure the furnishing to the building structure where applicable. The installation instructions shall specify the method of mounting clearly, including the type and number of fasteners, the mounting surface material and whether the fasteners are intended to rely on studs, anchors or other features of the wall construction.

92.11 Any safety or user instructions that are provided with a component part of a furnishing shall be provided with the instructions for the furnishing. Installation instructions shall also be provided if the user will be installing the component.

92.12 A product provided with a shortened power-supply cord, or no power supply cord as specified in [10.2.12](#) – [10.2.14](#), [29.1](#), and [Table 10.6](#) shall be provided with instructions specifying the correct mounting and intended use of the product unless a nonstandard plug is used.

92.13 In order to apply [54.2.3](#), the instructions shall specify the maximum load for each load-bearing surface.

92.14 Instructions for chairs and beds shall include a maximum weight limit. This weight limit shall be 300 pounds per person unless additional testing has been performed for higher weights.

92.15 A furnishing provided with a receptacle and a fixed wiring connection to the branch circuit where the receptacle is located within 6 feet (1.8 m) of a sink shall include instructions to connect the furnishing to a branch circuit provided with Class A GFCI protection.

Exception: A furnishing provided with a Class A GFCI protecting all receptacle outlets installed on the furnishing that are located within 6 feet (1.8 m) of a sink.

92.16 Permanently wired furnishings shall be provided with a wiring system diagram and instructions shall be provided to show the proper wiring method for the furnishing.

92.17 The maximum weight of the television the furnishing is intended to support, as well as the intended load of all other supporting surfaces and dedicated storage areas, shall be specified. When a supporting shelf 15 inches (381 mm) or greater in depth is provided for the television, the maximum diagonal CRT television screen size shall be stated.

Exception: A supporting surface or compartment obviously intended to accommodate accessories, such as records, tapes, earphones, digital discs, and similar accessories, is not required to be indicated for use with the intended load.

92.18 A furnishing intended for use with a TV shall contain safety alerting information advising of the following child safety issues:

- a) "WARNING – Risk of death or serious injury may occur when children climb on audio and/or video equipment furniture. A remote control or toys placed on the furnishing may encourage a child to climb on the furnishing and as a result the furnishing may tip over on to the child".
- b) "WARNING – Risk of death or serious injury may occur. Relocating audio and/or video equipment to furniture not specifically designed to support audio and/or video equipment may result in death or serious injury due to the furnishing collapsing or over turning onto a child".

92.19 The recommended maximum width of the television intended for use with the furnishing shall be specified.

92.20 On furnishings having either an open back or no back panel, and intended for use with CRT type televisions, it is acceptable to have a CRT television extend rearward, beyond the rear edge of the cart, stand or entertainment center if marked in accordance with [86.33](#).

92.21 A product that has support surfaces for multiple audio and video devices that may become unstable when loaded surfaces are unloaded shall specify the order of removing the audio or video products to reduce the tendency of the product to become unstable. Any specific instruction regarding the need for user assistance in the disassembly and unloading of the product shall be specified in the instructions.

92.22 Rooms or booths with an open-grid ceiling system shall be provided with installation instructions that state the minimum clearances in accordance with [Table 92.1](#).

Table 92.1
Minimum Clearances

Hazard occupancy	Sprinkler type	Sprinkler spacings	Minimum distance between sprinkler deflectors and the upper surface of the open-grid ceiling
Light	Spray or old-style sprinklers	<10.0 by 10.0 feet (3.0 by 3.0 m)	18.0 inches (45.7 cm)
	Spray sprinklers	≥10.0 by 10.0 feet (3.0 by 3.0 m) and < 10.0 by 12.0 feet (3.0 × 3.7 m)	24.0 inches (61.0 cm)
	Old-style sprinklers	≥10.0 by 10.0 feet (3.0 by 3.0 m) and < 10.0 by 12.0 feet (3.0 × 3.7 m)	36.0 inches (91.4 cm)

Table 92.1 Continued on Next Page

Table 92.1 Continued

Hazard occupancy	Sprinkler type	Sprinkler spacings	Minimum distance between sprinkler deflectors and the upper surface of the open-grid ceiling
	Spray or old-style sprinklers	≥10.0 by 12.0 feet (3.0 × 3.7 m)	48.0 inches (121.9 cm)
Ordinary	Spray sprinklers only	<10.0 by 10.0 feet (3.0 by 3.0 m)	24.0 inches (61.0 cm)
	Spray sprinklers only	≥10.0 by 10.0 feet (3.0 by 3.0 m)	36.0 inches (91.4 cm)

92.23 Rooms or booths with a “drop-out” panel or adjustable open-grid ceiling system shall be provided with installation instructions that state that these room or booth shall only be used where the location is provided with standard-response sprinklers. The instructions shall also include any instructions provided with the drop-out ceiling panels.

92.24 Rooms or booths with a “drop-out” panel or adjustable open-grid ceiling system that comply with [42.3.12\(a\)](#) shall be provided with installation instructions that state that these rooms or booths shall be electrically connected to a supervisory alarm with a reserve power supply.

92.25 Rooms or booths with rigid ceiling designed to accept a sprinkler head drop from the building shall be provided with instructions stating to contact the building and fire marshal before installation for the requirements for a fire suppression system.

92.26 Bunk capsule cabin printed instructions shall accompany each unit including, as a minimum, the following information:

a) Parts List – All parts necessary to assemble the bunk bed set shall be listed, together with the tools necessary for its assembly.

b) Assembly Instructions, containing detailed diagrams showing exactly how the bunk capsule bed should be assembled, including specific instructions pertaining to the following:

- 1) Bed end structures,
- 2) Installation of the mattress/foundation support system,
- 3) Fit of upper capsule bed bunk to lower bunk,
- 4) Attachment of ladder.

c) Size of Mattress and Foundation – The size of the intended mattress shall be clearly stated. The dimensions for length and width may be stated numerically or may be stated in conventional terms, for example, twin size, twin extra-long, and the like. In addition, the maximum thickness of the mattress that will ensure conformance to the guardrail provision shall be stated.

d) Replacement Parts – Replacement parts may be obtained from any of our (insert manufacturer's name) dealers.

e) Safety Warnings – The instructions shall contain the following warning information:

- 1) Follow the information on the warnings appearing on the upper capsule bunk end structure and on the carton. Do not remove warning label from bed.
- 2) Always use the recommended size mattress or mattress support, or both, to help prevent the likelihood of entrapment or falls.
- 3) Surface of mattress must be at least 5 in (127 mm) below the upper edge of guardrails.

- 4) Do not allow children under 6 years of age to use the upper capsule bunk.
- 5) Periodically check and ensure that the guardrail, ladder, and other components are in their proper position, free from damage, and that all connectors are tight.
- 6) Do not allow horseplay in the capsule bed and prohibit jumping on the bed.
- 7) Always use the ladder for entering and leaving the upper capsule bed.
- 8) Do not use substitute parts. Contact the manufacturer or dealer for replacement parts.
- 9) Use of a night light may provide added safety precaution for a child using the upper capsule bunk.
- 10) The use of water or sleep flotation mattresses is prohibited.
- 11) Keep these instructions for future reference.

92.27 Commercial tables, lab benches, and similar furnishings that are not provided with a work surface and/or secondary surfaces (shelves) shall be provided with instructions that explain the maximum load (weight) that may be applied. The instructions shall also explain that the weight of the work surface and/or secondary surfaces (shelves) needs to be considered along with any intended accessories and their loads. For example, if the table is rated to hold 200 lbs. and the work surface weighs 50 lbs. and a 5 lb. storage cabinet for a CPU is included, then the table with these items will be able to support an additional 145 lbs.

92.28 Commercial tables, lab benches, and similar furnishings that are not provided with a work surface and/or secondary surfaces (shelves) shall be provided with instructions that explain the size and shape of the work surface and/or secondary surfaces (shelves). The instructions shall state exactly where the legs shall be located in relation to the work surface. The instructions shall also state where the supports shall be located for any secondary surfaces (shelves).

92.29 Separately-supplied work surfaces and/or secondary surfaces (shelves) for use with commercial tables, lab benches, and similar furnishings shall be provided with instructions to thoroughly review the specifications for the table or other furnishing that this work surface and/or secondary surfaces (shelves) is intended to be used with, to determine if the work surface and/or secondary surfaces (shelves) is appropriate for use with the table or desk. The instructions shall also specify that surfaces greater than 10 sq. ft. (0.93 sq. m.) shall have a flame rating of 200 or less and either a smoke-developed index of 450 or less, or be marked with the smoke rating as specified in [86.29](#).

93 Assembly Instructions

93.1 Furnishings shipped unassembled shall be provided with assembly instructions (See [6.10](#)).

93.2 Only those sub-assemblies, critical components and accessories that have been evaluated as part of the complete furnishing shall be included in the instructions.

93.3 Assembly instructions shall be provided for each furnishing and shall be included in the shipping carton of each furnishing or accessory or for commercial furnishings may be provided electronically through a web address specified on the product, packaging and/or included information sheet, which shall include a statement indicating that the appropriate instructions can be viewed, downloaded, and printed at http://www.____.com/____/. Each company shall supply the appropriate URL address where the actual instructions can be viewed, downloaded, and printed.

94 Accessory Instructions

94.1 An accessory shall be provided with use and installation instructions that comply with Sections [92](#) – [101](#) as applicable to the accessory.

94.2 The accessory instructions shall specify the furnishing or series of furnishings it is intended for use with.

94.3 The accessory instructions shall include the directions and information required to cover the mechanical and electrical limitations of the furnishing system and the intended installation, maintenance, operation, and use of the accessory with the furnishing.

95 Instructions for Sub-Assemblies

95.1 The instruction requirements for sub-assemblies are supplementary to the other applicable requirements in this standard and apply to furnishings marked as subassemblies.

95.2 All markings required on the sub-assembly shall also be included in the instructions.

95.3 Furnishings shipped as Sub-Assemblies shall have instructions that include a list of all critical components and be provided with sufficient description for the person assembling the furnishing to identify that they have the correct component. Only those sub-assemblies, critical components and accessories that have been evaluated as part of the complete furnishing shall be included in the assembly instructions. This list shall be provided in the Instructions or on a separate stuffer sheet provided with the instructions. At least one of the subassemblies shall be provided with all instructions. Other subassemblies may be provided with the some or all instructions. For commercial furnishings, instructions may be provided electronically through a web address specified on the product, packaging and/or included information sheet, which shall include a statement indicating that the appropriate instructions can be viewed, downloaded, and printed at http://www.____.com/____/. Each company shall supply the appropriate URL address where the actual instructions can be viewed, downloaded, and printed.

95.4 The instructions shall specify the sub-assemblies that make up the complete furnishing, state what marking the assembler shall identify that the sub-assembly is the proper component shipped from an authorized location, and where the marking is located, such as on the sub-assembly or on the packaging.

96 Instructions Pertaining to a Risk of Fire, Electric Shock, or Injury to Persons

96.1 Instructions pertaining to a risk of fire, electric shock, or injury to persons shall warn the user of foreseeable risks and state the precautions that are to be taken to reduce such risks.

96.2 Warnings pertaining to a risk of fire, electric shock, or injury to persons shall be in the first part of the instructions, before the operating instructions, separate in format, such as included in a border, from other instructions related to assembly, operation, maintenance, and storage.

96.3 The height of lettering in the text and illustrations of the instructions shall be as follows:

- a) Upper case letters – not less than 5/64 inch (1.9 mm);
- b) Lower case letters – not less than 1/16 inch (1.6 mm); and
- c) The words "DANGER", "WARNING", and "CAUTION" – not less than 3/16 inch (4.8 mm).

96.4 The statement "IMPORTANT SAFETY INSTRUCTIONS" or the equivalent shall precede the list of instructions required by [96.5](#) and the statement "SAVE THESE INSTRUCTIONS" or the equivalent shall either precede or follow the list.

96.5 The instructions required by Section [92](#), General, shall include the items in the following list, as applicable, and any other instructions that the company determines are required for the furnishing. The statement "Read all instructions before using" shall precede the list of items following the word "DANGER." The items are able to be numbered.

IMPORTANT SAFETY INSTRUCTIONS

When using an electrical furnishing, basic precautions should always be followed, including the following:

Read all instructions before using (this furnishing).

DANGER – To reduce the risk of electric shock:

1. Always unplug this furnishing from the electrical outlet before cleaning or servicing.

WARNING – To reduce the risk of burns, fire, electric shock, or injury to persons:

1. Unplug from outlet before putting on or taking off parts.
2. Close supervision is necessary when this furnishing is used by, or near children, invalids, or disabled persons.
3. Use this furnishing only for its intended use as described in these instructions. Do not use attachments not recommended by the manufacturer.
4. Never operate this furnishing if it has a damaged cord or plug, if it is not working properly, if it has been dropped or damaged, or dropped into water. Return the furnishing to a service center for examination and repair.
5. Keep the cord away from heated surfaces.
6. Never operate the furnishing with the air openings blocked. Keep the air openings free of lint, hair, and the like.
7. Never drop or insert any object into any opening.
8. Do not use outdoors.
9. Do not operate where aerosol (spray) products are being used or where oxygen is being administered.
10. To disconnect, turn all controls to the off position, then remove plug from outlet.
11. For chairs and similar furnishings with movable parts such as foot supports the following statement:

"WARNING: Risk of Injury – Keep children away from extended foot support (or other similar parts)."
12. For grounded products the following statement:

"WARNING: Risk of Electric Shock – Connect this furnishing to a properly grounded outlet only. See Grounding Instructions."

13. For loading always put heavier items at the bottom and not near the top in order to help prevent the possibility of the furnishing tipping over.

14. If a surface is not intended to support video monitors such as televisions or computer monitors, one of the following statements:

"Warning: Risk of Injury to Persons – do not place video equipment such as televisions or computer monitors on _____" where the blank is filled in to identify the particular surface.

"Warning: Risk of Injury to Persons – do not use this furnishing to support video equipment such as televisions or computer monitors."

15. Each surface intended to support a load shall have a corresponding statement in the use instructions specifying the maximum intended load for that surface in pounds (kilograms),

16. Mount furnishings at the correct height.

17. Mount only approved work surfaces and secondary surfaces (shelves) in accordance with instructions. Failure to do so may cause instability, collapse, or failure of electrical components. [Applicable to furnishings that are not provided with a work surface and/or secondary surfaces (shelves)].

SAVE THESE INSTRUCTIONS

96.6 When more than one power supply cord is provided, see [10.3](#), Multiple power supply cords, the unit shall be provided with installation and operating instructions that contain the following information:

a) The instructions shall clearly indicate the use of multiple cords and caution against unplugging only one during movement, testing, or repair of the product;

b) When the attachment plug caps are different indicating separate branch circuits will be employed – see Exception No. 1 of [10.3.1\(d\)](#) – the installation instructions shall clearly state that different attachment plugs are used (indicating the ratings) and that individual branch circuits are to be employed (indicating the ratings) to supply the product and indicate what actions are required for a proper installation; and

c) When the product is marked to specify the use of separate branch circuits – see Exception No. 1 of [10.3.1\(d\)](#) – the installation instructions shall clearly state that individual branch circuits are to be employed to supply the product and indicate what actions are required for a proper installation.

96.7 Furnishings that are shipped disassembled shall be provided with "WARNING", "Risk of Electric Shock, Fire, and Injury", "Review the assembly instructions to confirm that the appropriate critical components and accessories are being used with the furnishing."

97 Operating Instructions

97.1 Operating instructions shall include all information required to operate the furnishing as intended.

97.2 When a furnishing having a dual-voltage motor is provided with an attachment plug, instructions shall be provided to indicate the type of plug that shall be used when the furnishing is reconnected for the alternate voltage.

97.3 A furnishing provided with a 2-blade, polarized attachment plug shall be provided with the following instructions or the equivalent: "To reduce the risk of electric shock, this furnishing has a polarized plug

(one blade is wider than the other). This plug will fit in a polarized outlet only one way. If the plug does not fit fully in the outlet, reverse the plug. If it still does not fit, contact a qualified electrician to install the proper outlet. Do not change the plug in any way."

98 User-Maintenance Instructions

98.1 User-maintenance instructions shall include:

- a) Instructions for cleaning and user maintenance operations specified by the manufacturer, such as lubrication or non-lubrication, and a statement to the user that any other servicing is to be performed by an authorized service representative or that the furnishing has no user serviceable parts.
- b) Instructions for a furnishing employing an automatically reset thermal limiter that shuts off the entire furnishing shall inform the user what to expect when the thermal limiter operates.
- c) Specific instructions for the proper method of storage of the cord, the total furnishing, and similar components, when the furnishing is not in use, and for care of the cord while in use.

99 Grounding and Double Insulation Instructions

99.1 For a grounded furnishing, the instructions shall include those instructions in (a) – (c) applicable to the furnishing. For a double insulated furnishing the instructions shall include (d).

GROUNDING INSTRUCTIONS

- a) For a grounded, cord-connected product rated max 15 amperes and intended for use on a nominal 120-volt supply circuit :

This product is for use on a nominal 120-volt circuit and has a grounding plug that looks like the plug illustrated in sketch A (see [Figure 99.1](#)). Make sure that the product is connected to an outlet having the same configuration as the plug. No adapter should be used with this product.

- b) For all other grounded, cord-connected products:

This product is for use on a circuit having a nominal rating more than 120 volts (or "This product is rated more than 15 amperes and is for use on a circuit having a nominal rating of 120 volts") and is factory-equipped with specific electric plug to permit connection to a proper electric circuit. Make sure that the product is connected to an outlet having the same configuration as the plug. No adapter should be used with this product.

- c) For a permanently connected product:

GROUNDING INSTRUCTIONS

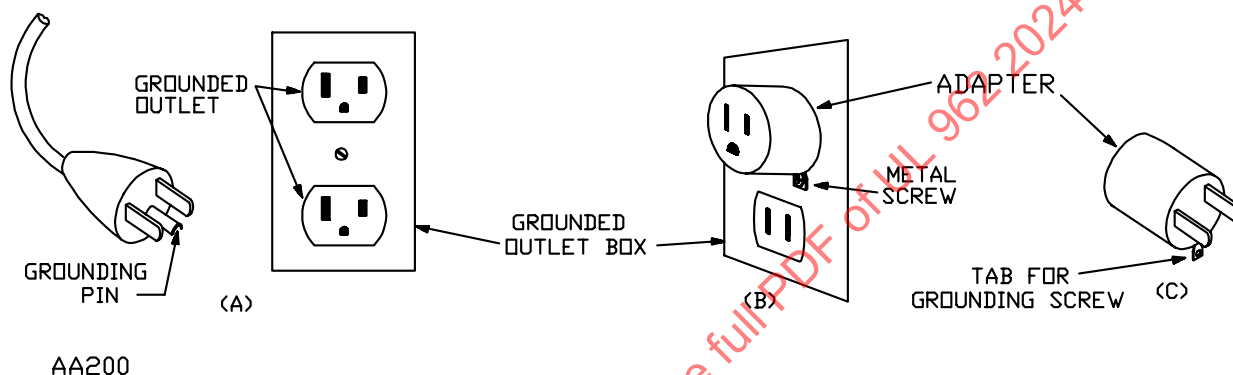
This product must be connected to a grounded metal, permanent wiring system, or an equipment-grounding conductor must be run with the circuit conductors and connected to the equipment-grounding terminal or lead on the product.

- d) For a double-insulated, cord-connected product:

SERVICING OF DOUBLE-INSULATED PRODUCTS

In a double-insulated product, two systems of insulation are provided instead of grounding. No grounding means is provided on a double-insulated product, nor is a means for grounding to be added to the product. Servicing a double-insulated product requires extreme care and knowledge of the system, and is to be done only by qualified service personnel. Replacement parts for a double-insulated product must be identical to the parts they replace. A double-insulated product is marked with the words "DOUBLE INSULATION" or "DOUBLE INSULATED." The symbol (square within a square)  is also able to be marked on the product.

Figure 99.1
Grounding Methods



100 Interconnected Units Instructions

100.1 Instructions for interconnected unit use shall include at least the following:

- a) Voltage and current rating of unit;
- b) Maximum number of units to be interconnected; and
- c) Instructions for mounting including any limitations to the installation.

100.2 An interconnected unit having a shortened cord shall include the following instructions: "CAUTION" and the following or equivalent: " – Risk of Fire or Electric Shock. If the cord is not long enough, connect to power tap with built-in overcurrent protection, or contact manufacturer to replace unit with one having a longer cord."

100.3 A furnishing that complies with [53.11](#), SOHO S6.5 may be identified for use in a Small Office or Home Office.

101 Operator Attended Products Instructions – Usage Area IA, II & III

101.1 A commercial operator attended product, Usage Area II, that complies with Section [31](#), Commercial Operator Attended Products – Usage Area II, shall provide recommendations for barriers or marking of safety zones around equipment that relies on the operator of the equipment to ensure bystanders are not in an area that presents a risk of electric shock, fire or injury to persons.

101.2 A furnishing that complies with Section 31, Commercial Operator Attended Products – Usage Area II, and Section 32, Commercial Operator Attended Products – Usage Area III, respectively, shall include instructions that inform and instruct the operator how to properly operate the equipment and of the risk of injury to persons associated with the equipment for both the operator and any other person in the vicinity of the equipment. The instructions shall impress upon the operator their role ensuring their own safety and the safety of the individuals in the vicinity of the equipment.

101.3 Specific areas of potential entrapment shall be specified and illustrated in the instructions.

101.4 For Usage Area III, instructions shall describe that children, or people with cognitive disabilities are not anticipated to be present or if present, closely supervised.

101.5 For Usage Area IA, instructions shall describe that children under the age of 8, or people with cognitive disabilities are anticipated to be present and supervised.

101A Storage Bed Unit Instructions – Usage Area I

101A.1 Instructions for a storage bed unit shall state that the mattress of a storage bed unit is to be raised only when the bed is unoccupied.

101A.2 The instructions for storage bed unit shall state that the product must be situated in a room such that risk of entrapment between the storage bed unit and other furniture or walls is avoided.

101A.3 Instructions for a storage bed unit shall include an explanation of the required warning marking “WARNING”, “RISK OF INJURY”, “The user shall not operate this furnishing when children or people with cognitive disabilities are present”.

PART 2 – OUTDOOR FURNISHINGS

INTRODUCTION

102 General

102.1 The requirements for outdoor furnishings are supplementary to the other applicable requirements in this standard and apply to furnishings marked "Suitable for outdoors." Such furnishings are suitable for installation in ordinary locations subject to rain, locations subject to spray of a noncorrosive and nonflammable liquid, and similar locations.

102.2 The requirements do not cover furnishings for use under water nor in areas that contain flammable or corrosive liquids or gases.

CONSTRUCTION

103 General

103.1 The inside and outside surfaces of cast ferrous metal, sheet steel, or ferrous tubing shall be protected against corrosion by one of the coatings specified in [Table 103.1](#).

Exception No. 1: Other finishes, including paints, special metallic finishes and combinations of the two that have, by comparative tests with galvanized-sheet steel conforming with item (A) Type G90 of [Table 103.1](#), indicated they provide equivalent protection, are not prohibited from being used.

Exception No. 2: A metal part, such as a decorative part, that is not required for conformance with this standard is not required to be protected against corrosion.

Exception No. 3: Stainless steel is not required to be additionally protected against corrosion.

Exception No. 4: Edges, fasteners, and welds complying with [103.2](#) – [103.5](#) are not required to be additionally protected against corrosion.

Exception No. 5: If the inside surfaces of the furnishing are protected from the elements such that no water enters the furnishing during the rain and sprinkler tests of Performance, Sections [112](#) – [118](#), the inside surfaces may be provided with corrosion protection equivalent to that specified in Section [12](#), Protection Against Corrosion.

Table 103.1
Sheet Steel Coatings

Type of coating	Inches	(mm)	Type or thickness ^a description
(A) Hot-dipped mill galvanized steel		G90 ^b	–
		G60 ^b	with 1 coat of outdoor paint ^c
		A60 ^b	with 1 coat of outdoor paint ^c
(B) Zinc coating other than Type (A)	0.00061	(0.0155) ^d	–
	0.00041	(0.0104) ^d	with 1 coat of outdoor paint ^c
(C) Cadmium coating	0.0010	(0.0254)	–
	0.00075	(0.01905)	with 1 coat of outdoor paint ^c
	0.0005	(0.0127)	with 1 coat of outdoor paint ^c
(D) Vitreous enamel ^e	–	–	–

^a As determined by the dropping test in ASTM B555.

^b Conforming with the coating designation G90, G60, or A60 in Table 1 of ASTM A653/A653M with no less than 40 % of the zinc on any side based on the minimum single spot test requirement in this ASTM standard.

^c Identified as outdoor paint by paint manufacturer.

^d Average thickness with a spot minus tolerance of 0.00007 inch (0.00178 mm).

^e Acceptable on sheet steel at least 0.026 inch (0.66 mm) thick.

103.2 Hinges, bolts, and fasteners made of ferrous materials shall be protected against corrosion as specified in Section [12](#), Protection Against Corrosion.

Exception: Hinge pins are not required to be provided with the corrosion protection required in [103.1](#).

103.3 The adequacy of a coating on hinges, bolts, and fasteners is not prohibited from being determined by visual inspection.

103.4 Punched holes and cut edges in ferrous material are not required to be corrosion protected.

103.5 Welds in iron or steel (other than stainless steel) shall be painted with one coat of any outdoor paint.

Exception: One coat of any indoor paint is acceptable over a spot weld on galvanized steel.

104 Enclosures

104.1 An enclosure or enclosures shall be so constructed as to prevent the wetting of live parts or electrical components or wiring not identified for use in contact with water, and to reduce the risk of electric shock due to weather exposure. Parts identified for use in contact with water include flexible cords marked "W", liquid tight flexible metal conduit, outlet boxes marked for use in outdoors, and rigid conduit.

Exception: Wetting of the outer surface of the glass envelope of a lamp is not prohibited.

104.2 To determine compliance with [104.1](#) a complete assembly is to be subjected to the rain and sprinkler tests as specified in Performance, Sections [112](#) – [118](#).

105 Gaskets and Bushings

105.1 A gasket or bushing employed to comply with the requirements for outdoors shall comply with the requirements of the thermal conditioning test specified in Sections [117](#) and [118](#).

105.2 A gasket shall be secured so that normal use and maintenance will not cause the gasket to loosen. Clips or a clamping ring are examples of means of securement. When an adhesive is used to secure a gasket, the gasket assembly shall comply with the Gasket Adhesion Test, Section [118](#). Other means of securement shall be investigated to determine compliance.

106 Openings

106.1 An opening for the connection of conduit or for an auxiliary part shall be threaded.

Exception No. 1: If the rain and sprinkler tests as specified in Performance, Sections [112](#) – [118](#), show no entrance of water into the furnishing with the opening(s) open, the opening(s) are not required to be threaded.

Exception No. 2: If a conduit fitting intended for use in outdoors is provided that complies with the requirements in UL 514B, the opening(s) are not required to be threaded.

106.2 An open drain hole shall be provided on all furnishings to prevent the accumulation of water above a level that results in the wetting of an electrical part or opening for the connection of conduit for an auxiliary part. The hole shall be as specified in [Table 106.1](#).

Exception: A furnishing that has been subjected to the rain or sprinkler test are not required to be provided with a drain hole if no water enters the furnishing.

Table 106.1
Size of Drain Holes

Opening shape	Minimum dimension		Minimum area		Maximum dimension		Maximum area	
	inch	(mm)	inch ²	(mm ²)	inch	(mm)	inch ²	(mm ²)
Slot	1/8	(3.2)	0.012	(7.74)	3/8	(9.6)	1-1/2	(9.68)
	(width)				(width)			
Square	1/8	(3.2)	–	–	1/2	(12.7)	–	–
	(side)				(side)			

Table 106.1 Continued on Next Page

Table 106.1 Continued

Opening shape	Minimum dimension		Minimum area		Maximum dimension		Maximum area	
	inch	(mm)	inch ²	(mm ²)	inch	(mm)	inch ²	(mm ²)
Round	1/8	(3.2)	–	–	1/2	(12.7)	–	–
	(diameter)				(diameter)			
Irregular	–	–	0.012	(7.74)	–	–	1-1/2	(9.68)

107 Water Shields

107.1 A material, not including wood, used as a water shield, whether provided as a lens, diffuser, or opaque part, shall:

- a) Be classified at least HB in accordance with UL 94, if of polymeric material;
- b) Comply with the exposure to ultraviolet light test in UL 746C, if of polymeric material; and
- c) Be subjected to impact conditioning as specified in Section 112, Water Shield Impact Conditioning, before the furnishing is subjected to the rain, sprinkler, or immersion tests.

107.2 A wood water shield shall be subjected to the impact conditioning specified in Section 112, Water Shield Impact Conditioning, before the furnishing is subjected to the rain, sprinkler, or immersion tests.

Exception: Wood that is at least 1/2 inch (12.7 mm) thick is not required to be subjected to the impact conditioning.

108 Receptacle Outlets

108.1 Convenience receptacles shall be of the grounding type and weather resistant type.

108.2 Convenience receptacles shall be supplied with a cover plate or hood intended to be used with a receptacle. Receptacle covers are relied upon to prevent the ingress of water and shall comply with the requirements for wet location type rain resistant or rain proof receptacle box covers in accordance with UL 514D.

108.3 Cord and plug connected furnishings supplied with receptacles or connectors for the interconnection of furnishings shall be supplied with a portable GFCI (cord GFCI) suitable for wet locations that complies with the requirements in UL 943.

Exception: Furnishings that are powered from NEC Class 2 or LPS power sources operating at 15 volts AC or less or 21.2 Volts peak or less.

108.4 Outdoor furnishings provided with receptacle outlets and intended to be electrically interconnected shall utilize electrical connectors suitable for outdoor wet location use and shall be designed so that the electrical power must be supplied through the GFCI.

Exception: Furnishings that are powered from NEC Class 2 or LPS power sources operating at 15 volts AC or less or 21.2 Volts peak or less.

108.5 Permanently connected furnishings provided with receptacles shall either incorporate a class A GFCI receptacle as the first in the series of outlets or shall specify in the installation instructions to connect the furnishing to a class A GFCI circuit. See 110.2.

109 Wet Location Power Supply Cords

109.1 A power supply cord shall be minimum 18 AWG type SJT suitable for outdoor use.

Exception: Furnishings that are powered from NEC Class 2 or LPS power sources operating at 15 volts AC or less or 21.2 Volts peak or less shall be supplied by a minimum 18 AWG type SPT-2 outdoor use cord.

109.2 A furnishing required to be supplied with a cord GFCI is required to have the cord permanently attached to the furnishing or shall be connected to the furnishing with a proprietary connector suitable for outdoor wet location use (a non standard NEMA connector).

109.3 All cord connected units where the user may contact water shall be provided with a factory installed ground-fault circuit-interrupter (GFCI). The GFCI shall comply with the requirements for a Class A ground-fault circuit-interrupter as specified in UL 943, and be either:

- a) An integral part of the attachment plug; or
- b) Located such that it is in the supply cord within 12 inches (305 mm) of the attachment plug.

Exception No. 1: This requirement does not apply to units marked in accordance with the marking specified in [119.7](#).

Exception No. 2: Units may have the GFCI installed inside a cover where the "Test" and "Reset" buttons are readily accessible after installation.

110 Instructions

110.1 Use and installation instructions shall contain the following:

- a) A statement instructing the user to route the power supply cord away from walkways, driveways and traffic areas to prevent risk of injury to persons due to tripping and damage to the power supply cord.
- b) Products which incorporate movable elements that when articulated can reduce spacings or entrap heat from components such as a luminaire shall warn the user to unplug the furnishing when not in use or when storing the furnishing.
- c) A statement shall be made in the use instructions not to place outdoor use furnishings near pools, ponds or other bodies of water.
- d) Upholstered furnishings shall include information on the care and maintenance of the fabric.
- e) "Unplug this furnishing from the electrical outlet before cleaning" or equivalent statement.
- f) For a furnishing required to be grounded "Warning – Risk of Electric shock – Connect this furnishing to a properly grounded outlet only" or an equivalent statement.

110.2 A permanently connected outdoor or wet location use furnishing provided with convenience receptacles without a Class A GFCI protecting the outlets shall include the following statement or equivalent in the installation instructions: "WARNING – Risk of Death or Serious injury, This furnishing must be connected to a Class A GFCI circuit."

111 Outdoor Furnishing Markings

111.1 Unless stated otherwise, all required markings shall be permanent die-stamped or adhesive-backed label systems and shall comply with the requirements for outdoor-use labels in UL 969. Minimum letter height shall be 3/32 inch (2.4 mm) as measured by characters such as "b", "1", or "H". A contrasting background shall be provided for legibility.

111.2 The following CAUTION markings shall be placed on the product:

- a) To be located on a cord tag or adjacent to the cord entry point on the furnishing – "Risk of injury. Route Cord to prevent tripping; Do not use extension cords with this product; Protect power supply cord from crushing or stepping";
- b) "To replace cord, contact place of purchase or manufacturer."

111.3 The following WARNING markings shall be placed on the product, "Risk of Death or Serious injury" and:

- a) Do not close furnishing [or a part of the furnishing shall be identified] on products plugged into receptacles or luminaires.
- b) Do not use near pools, ponds, or other bodies of water;
- c) Do not use when wet;
- d) Remove power when not in use.

PERFORMANCE

112 Water Shield Impact Conditioning

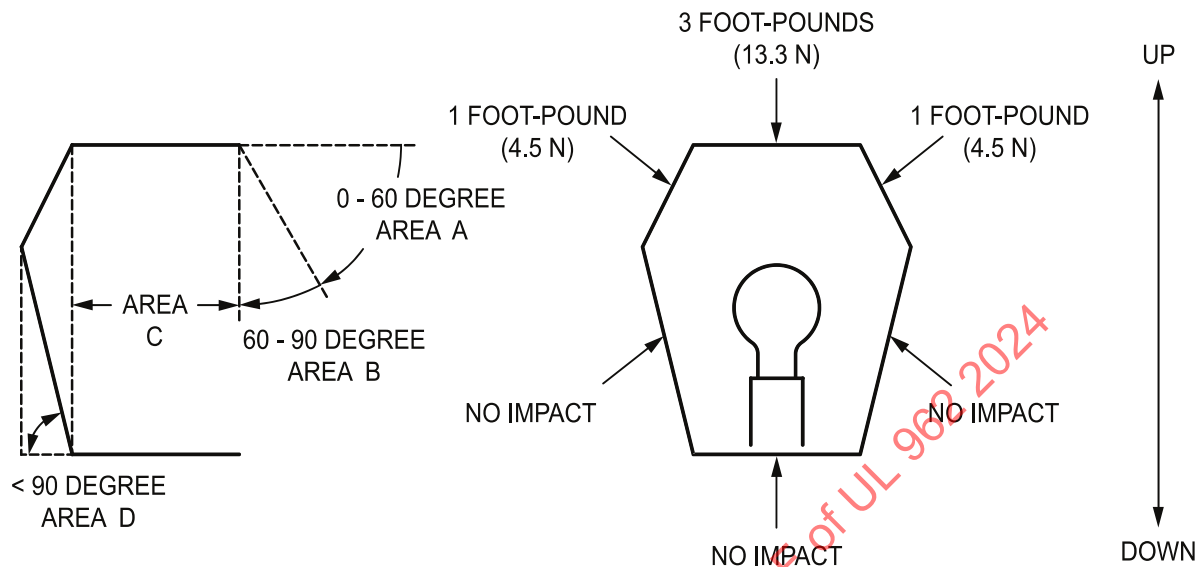
112.1 A nonmetallic water shield that is mounted as specified in (a) or (b) shall be impact conditioned as specified in [112.3](#). The impact force shall be 3 foot-pounds (4.1 N·m) on all surfaces:

- a) 4 feet (1.22 m) or less from the bottom of a ground-mounted furnishing; or
- b) On a wall- or post-mounted furnishing intended and marked for mounting less than 4 feet from the ground as specified in [119.2](#).

112.2 A nonmetallic water shield intended for installation at least 4 feet (1.22 m) above ground level shall be impact conditioned as specified in [112.3](#). The impact force shall be 3 foot-pounds (4.1 N·m) if in Area A, 1 foot-pound (1.4 N·m) if in Area B, and no impact if in Area C or D of [Figure 112.1](#).

Exception: The water shield of a furnishing marked as suitable for covered ceiling installation only, is not required to be subjected to the impact conditioning.

Figure 112.1
Impact Force on Water Shields



su1732

Example: Post-mounted unit located more than 4 feet above ground level.
Furnishing positioned as intended after installation. Rainshield installed in furnishing and furnishing mounted as intended.

112.3 The impact specified in 112.1 and 112.2 is to be produced by dropping 1 pound (0.45 kg) of lead shot, wrapped by 2 layers of cheesecloth into a 2 inch (50.8 mm) diameter sphere, from the height necessary to produce the intended impact. The height is to be 36 inches (914 mm) for a 3 foot-pound (4.1 N·m) impact and 12 inches (305 mm) for a 1 foot-pound (1.4 N·m) impact.

113 General – Test Conditions

113.1 Before a rain or sprinkler test is conducted, an enclosure containing an opening for supply connections is to be fitted with the intended supply connection means. All wired furnishing sections, fittings, and similar components are to be assembled as intended.

113.2 The rain or sprinkler test is to be conducted in the operating sequence shown in Table 113.1.

Table 113.1
Rain or Sprinkler Test Operating Sequence

Duration in hours	Lamp	Water
1	On	Off
1/2	Off	On
2	On	On
1/2	Off	On

114 General – Test Results

114.1 Test results are satisfactory if, after the impact conditioning (if applicable) and the rain or sprinkler tests, no water has entered the furnishing.

Exception: Water may if the water does not cause wetting of any lampholder, wiring, or other electrical parts that are not inherently waterproof and if the furnishing is provided with a drain hole as required in [106.2](#).

115 Sprinkler Test

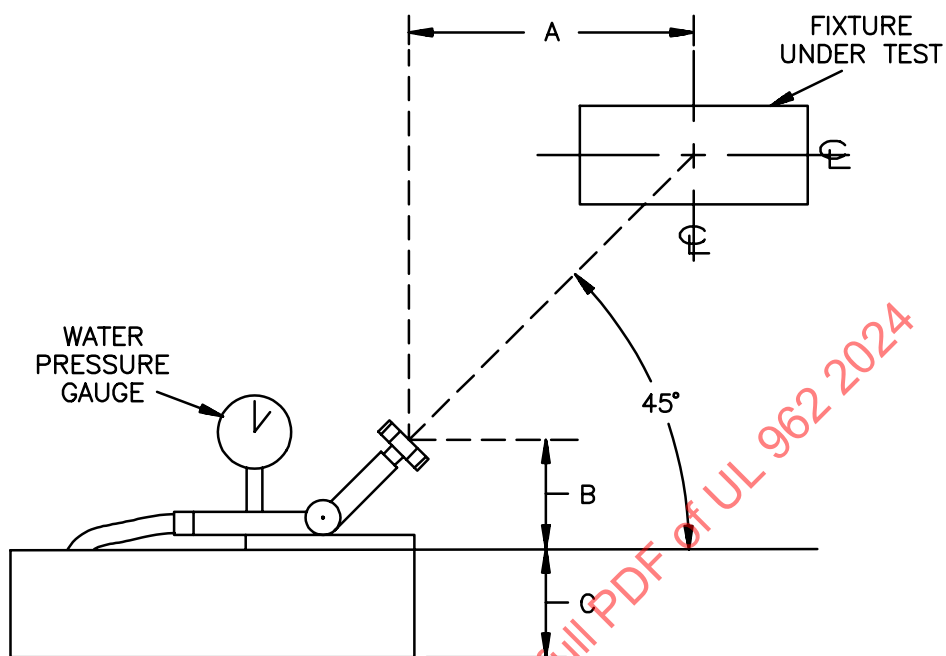
115.1 A furnishing required to be subjected to a sprinkler test shall comply with the requirements in [115.2](#) and [115.3](#).

115.2 A furnishing is to be turned about its vertical axis to each of four positions 90° from each other, each for 30 minutes during the 2-hour portion of the test specified in [113.2](#), with adjustable parts arranged for maximum vulnerability to the water spray.

115.3 The furnishing is to be positioned, as shown in [Figure 115.1](#) in front of a standard water spray head of the type shown in [Figure 115.2](#), to which the water pressure is maintained at a gage pressure of 20 pounds per square inch (137.9 kPa).

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Figure 115.1
Representative Sprinkler Test Setup



SB1840A

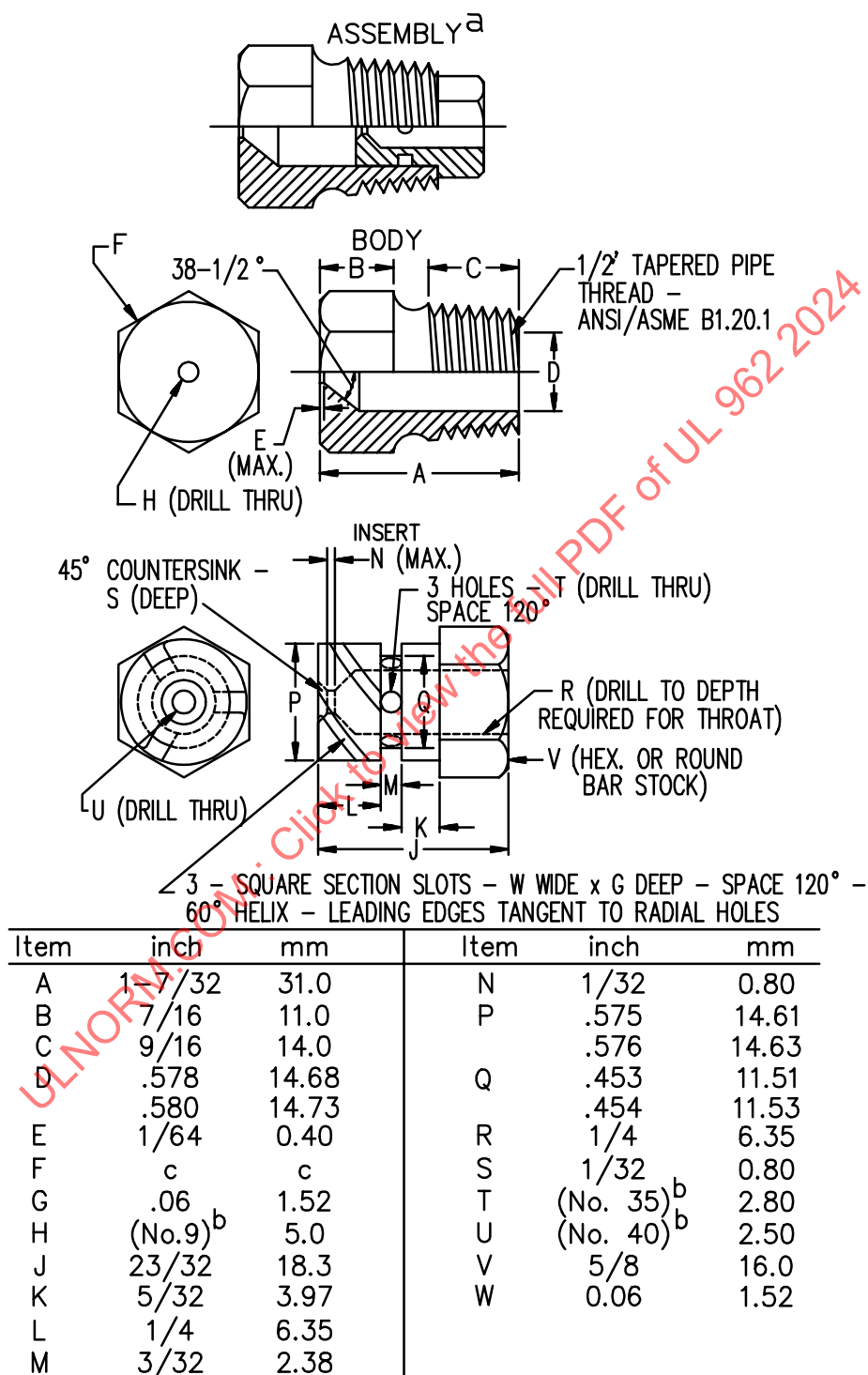
A – 36 inches (914 mm).

B – 3 – 6 inches (76.2 – 152 mm).

C – Height necessary for the furnishing to be mounted as intended with the dimensional center of the furnishing on a line projected from the center line of the nozzle head.

Figure 115.2

Spray Head



^a Nylon Rain-Test Spray Heads are available from Underwriters Laboratories

^b ANSI B94.11M Drill Size

^c Optional - To serve as a wrench grip.

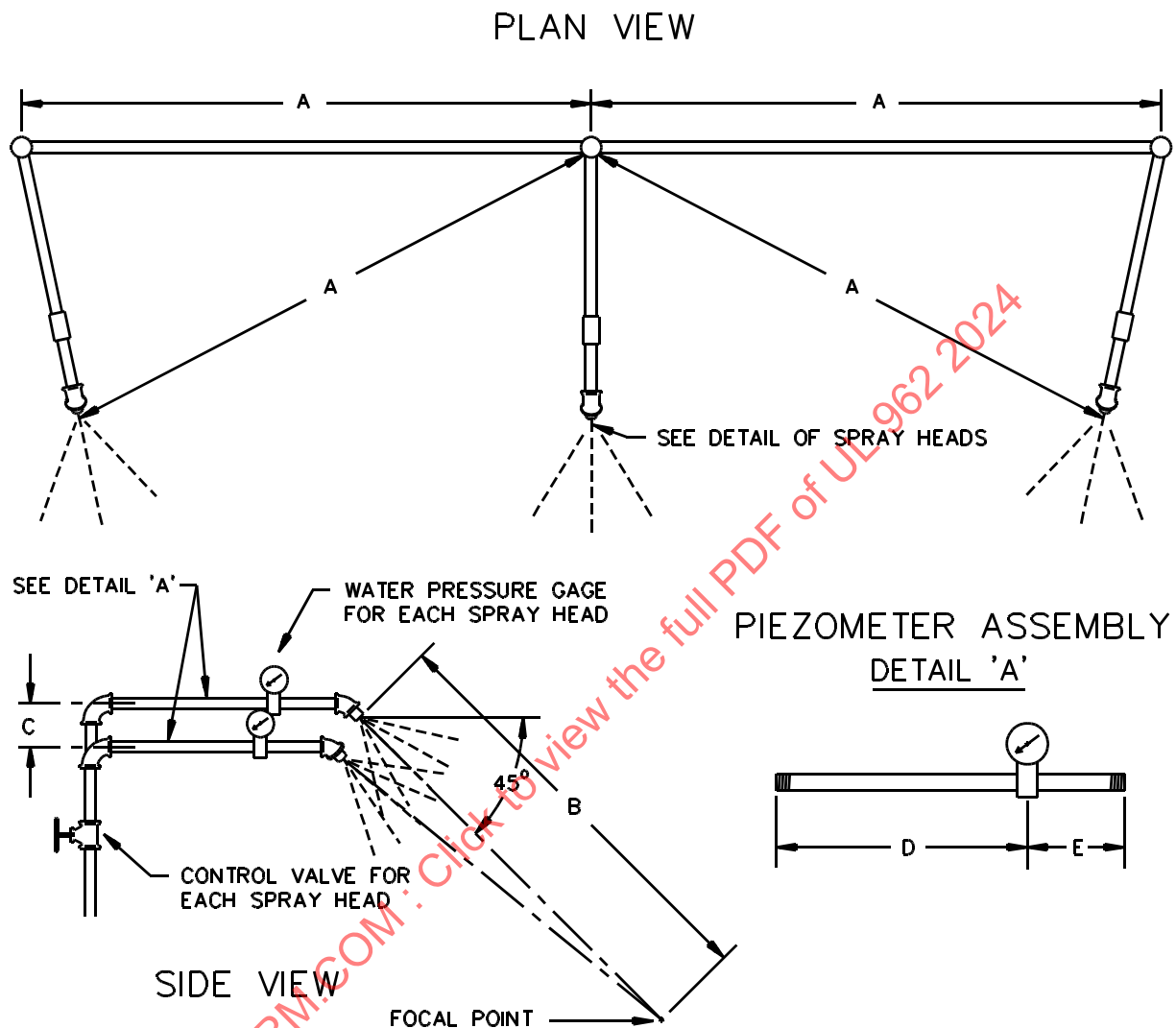
116 Rain Test

116.1 A furnishing required to be subjected to a rain test shall comply with the requirements in [116.2](#) and [116.3](#).

116.2 The rain test apparatus is to consist of three spray heads mounted in a water supply pipe rack as shown in [Figure 116.1](#). Spray heads are to be constructed in accordance with the details shown in [Figure 115.2](#). The furnishing is to be set up as in a normal installation with conduit – without pipe compound – if so intended. The enclosure is to be positioned in the focal area of the spray heads so that the greatest quantity of water potentially will enter the enclosure. The water pressure is to be maintained at 5 pounds per square inch (34.5 kPa) at each spray head.

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Figure 116.1
Rain Test Apparatus



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

RT101E

116.3 A gasketed furnishing shall be tested after the temperature test (if required elsewhere in this standard) or after operation for 1/2 hour, followed by removal and replacement of rings, frames, lamps or other replaceable part serving to compress the gasket.

117 Thermal Conditioning

117.1 A polymeric material, not including wood, used as a water shield that is subjected to an operating temperature in excess of 65 °C (149 °F) as determined by the temperature test shall retain its original dimensions and shape after exposure for 1000 hours to a temperature in accordance with [Table 117.1](#). The lamp used for the temperature test shall be as intended and marked on the furnishing, or, if the furnishing is not provided with a lamp replacement marking, the largest lamp wattage and size that will physically fit in the furnishing. Exposure time is able to be reduced by one-half for each increase in oven temperature of 10 °C (18 °F). If the sample is too large for the test oven, the sample is able to be cut to fit.

Exception No. 1: A polymeric water shield that also serves as an enclosure, as required in [11.1.2](#), and complies with the requirements in [11.5](#) is not required to be tested.

Exception No. 2: A material that possesses a mechanical temperature index, with impact, as a result of long term aging, of at least the temperature to which it is subjected, is not required to be tested.

Table 117.1
1000-Hour Exposure Temperature

Normal temperature on polymeric diffuser or lens material				Oven test temperature	
Higher than		Not higher than			
°F	(°C)	°F	(°C)	°F	(°C)
65	(149)	75	(167)	85	(185)
75	(167)	86	(185)	95	(203)
85	(185)	95	(203)	105	(221)

117.2 A gasket or bushing employed to comply with the requirements for wet locations shall, after conditioning for 168 hours in a circulating air oven at a temperature 20 °C (36 °F) above the temperature measured on the gasket or bushing during the temperature test, have a tensile strength of not less than 60 % and an elongation of not less than 75 % of the values determined before conditioning.

Exception: Neoprene rubber is acceptable for 60 °C (140 °F) and silicone rubber is acceptable for 105 °C (221 °F) without being subjected to the test.

118 Gasket Adhesion Test

118.1 A gasket assembly secured by an adhesive shall be subjected to the gasket adhesion test.

118.2 Three gasket assemblies shall be used to determine the average initial force required to remove the gasket from its mounting surface. The force shall be applied to the edge of the gasket in a plane perpendicular to the surface on which the gasket is mounted.

118.3 Six additional gasket assemblies shall be conditioned for 168 hours in a circulating air oven at 20 °C (36 °F) above the maximum gasket or bushing temperature as determined by the normal Temperature Test, Section [68](#).

118.4 The force required to remove the gaskets from the mounting surface shall be measured within 30 minutes after the conditioning for three of the samples. The force required to remove the gaskets from the mounting surface of the three remaining samples shall be measured 24 hours after the conditioning.

118.5 After conditioning, the average force necessary to remove the gaskets from the mounting surface shall be not less than 60 % of the initial average value measured before conditioning.

MARKINGS

119 General

119.1 A furnishing that complies with the requirements in Sections [103](#) – [118](#) and that is intended for use in outdoors is able to be marked "Suitable for outdoor use."

119.2 A furnishing intended for use within 4 feet (1.22 m) of the ground and that complies with the sprinkler test shall be marked as follows: "Suitable (for mounting) within 4 feet of the ground".

119.3 The markings of [119.1](#) and [119.2](#) shall be on an exterior surface that will normally be visible after the furnishing is installed, except that, in the case of residential furnishings only, the marking is not prohibited from being at a point where it will be visible when making and inspecting the connections to the branch-circuit supply wires. The marking is regarded as visible after the furnishing is installed when only the removal of the lamp, glassware, or a drop canopy is required to make the marking visible. The markings shall be on the exterior of the residential furnishing when applicable.

119.4 A furnishing with adjustable mounting or alternative mounting positions, and a furnishing provided with an open reflector, shall be marked to indicate the limits of adjustment or mounting position necessary to comply with test requirements.

119.5 A furnishing that is not intended for ground installation shall be marked to indicate the appropriate installation.

119.6 The markings in [119.4](#) and [119.5](#) shall be on the furnishing in the form of a pressure-sensitive label, decalcomania transfer, paper label, paint-ink or die-stamped lettering. A tie-on tab, stuffer sheet, or equivalent does not meet the intent of these requirements. The markings shall be where visible during or after installation.

119.7 A cord connected furnishing not provided with an integral ground-fault protection for personnel in accordance with [109.3](#) shall be plainly marked where readily visible with the word "WARNING" and the following or equivalent statement: "Risk of Electric Shock. Connect Only to a Grounding Type Receptacle Protected by a Ground-Fault Circuit-Interrupter (GFCI)."

119.8 Permanently installed units not provided with integral ground-fault protection for personnel shall be plainly marked where readily visible to the installer with the word "WARNING" and the following or equivalent statement: "Risk of Electric Shock. Connect Only to a Supply Protected by a Ground-Fault Circuit-Interrupter (GFCI)."

119.9 Any limitations for mounting, including use of dry seal pipe threads, shall be marked on the product.

119.10 Valves constructed using pipe threaded in accordance with the Exception to [41.1](#) shall be provided with a tag, label, or similar marking on the product or smallest unit package, identifying the pipe thread type for the installer.

ANNEX A (normative) – LOW VOLTAGE CIRCUITS IN FURNISHINGS

INTRODUCTION

A1 Scope

A1.1 The requirements of this Annex address potential risk of fire associated with motors, heating circuits, and control circuits powered by low voltage circuits used in furnishings, as defined in Section [A2](#), Glossary.

NOTE: If the low voltage control circuit includes functional safety or protective software, it must be evaluated to UL 60730-1, UL 873, UL 244A, or other applicable standard(s).

A1.2 Circuits powering low voltage motors and low voltage heating used in furnishings shall comply with UL 962 except as modified by the requirements contained in this Annex.

A2 Glossary

A2.1 For the purposes of this Annex, the following definitions apply.

A2.2 MOMENTARY CONTACT SWITCH – A switch that requires constant pressure to hold it in the on position, and does not include means for locking in the on position.

A2.2A PS1 – A circuit where the power source, measured according to Section [A12](#), Power Limitation Test Methods, does not exceed 15 W measured after 3 s. See [Table A2.1](#).

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A2.2B PS2 – A circuit where the power source, measured according to Section [A12](#), Power Limitation Test Methods:

- a) Exceeds PS1 limits; and
- b) Does not exceed 100 W measured after 5 s.

See [Table A2.1](#).

NOTE: USB output power source must comply with LPS or PS1 and PS2 of [Table A2.1](#).

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A2.2C PS3 – A circuit whose power source exceeds PS2 limits, or any circuit whose power source has not been classified, measured according to Section [A12](#), Power Limitation Test Methods. See [Table A2.1](#).

NOTE: PS1, PS2 and PS3 definitions are taken from UL 62368-1.

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Table A2.1
Low Voltage Circuit Definition and Comparison

Output voltage ^a U_{oc}		Output current ^{b,d} I_{sc}	Apparent power ^{c,d} S	Current rating of overcurrent protective device ^e	Terminology	
V AC	V DC	A	VA	—	UL 62368-1 ^f	NEC / UL 60950-1/ UL 1310
—	—	—	Does not exceed 15 W after 3 sec	—	PS1	—
—	—	—	Does not exceed 100 W after 5 sec	—	PS2	—
$U_{oc} \leq 30$	$U_{oc} \leq 30$	$\leq 8,0$	≤ 100	—	LPS ¹⁾	Class 2
—	$30 < U_{oc} \leq 60$	$\leq 150/U_{oc}$	≤ 100	—	LPS ²⁾	Class 2
$U_{oc} \leq 20$	$U_{oc} \leq 20$	$\leq 1\,000/U_{oc}$	≤ 250	$\leq 5,0$	LPS ²⁾	Class 2
$20 < U_{oc} \leq 30$	$20 < U_{oc} \leq 30$	$\leq 1\,000/U_{oc}$	≤ 250	$\leq 100/U_{oc}$	LPS ²⁾	Class 2
—	$30 < U_{oc} \leq 60$	$\leq 150/U_{oc}$	≤ 100	$\leq 100/U_{oc}$	LPS ²⁾	Class 2
≤ 30 rms (42.4 peak)	$20 < U_{oc} \leq 30$	—	—	—	PS3	SELV

LPS¹⁾: Limits for inherently limited power sources

^a U_{oc} : Output voltage measured with all load circuits disconnected. Voltages are for substantially sinusoidal AC and ripple free DC. For non-sinusoidal AC and DC with ripple greater than 10 % of the peak, the peak voltage shall not exceed 42,4 V.

^b I_{sc} : Maximum output current with any non-capacitive load, including a short-circuit.

^c S (VA): Maximum output VA with any non-capacitive load.

^d Measurement of I_{sc} and S are made 5 s after application of the load if protection is by an electronic circuit and 60 s in case of a PTC device or in other cases.

^f Refer to [Figure A2.1](#) for an additional depiction of PS1, PS2, and PS3 circuitry.

LPS²⁾: Limits for power sources not inherently limited (overcurrent protective device required)

^a U_{oc} : Output voltage measured with all load circuits disconnected. Voltages are for substantially sinusoidal AC and ripple free DC. For non-sinusoidal AC and DC with ripple greater than 10 % of the peak, the peak voltage shall not exceed 42,4 V.

^b I_{sc} : Maximum output current with any non-capacitive load, including a short-circuit, measured 60 s after application of the load.

^c S (VA): Maximum output VA with any non-capacitive load measured 60 s after application of the load.

^d Current limiting impedances in the equipment remain in the circuit during measurement, but overcurrent protective devices are bypassed.

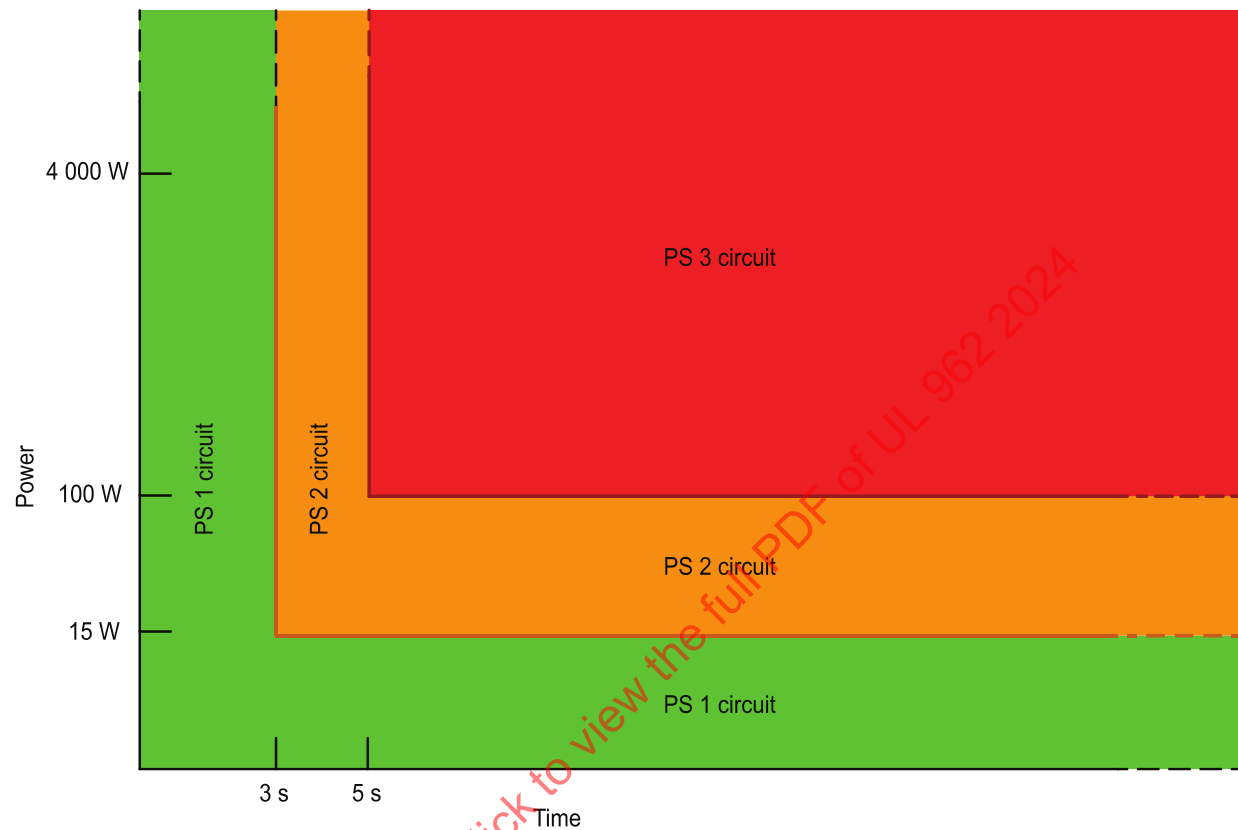
The reason for making measurements with overcurrent protective devices bypassed is to determine the amount of energy that is available to cause possible overheating during the operating time of the overcurrent protective devices.

^e The current ratings of overcurrent protective devices are based on fuses and circuit breakers that break the circuit within 120 s with a current equal to 210 % of the current rating specified in the table.

^f Refer to [Figure A2.1](#) for an additional depiction of PS1, PS2, and PS3 circuitry.

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Figure A2.1
Illustration of Power Source Classification



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A2.3 SAFETY EXTRA LOW VOLTAGE (SELV) CIRCUIT – An isolated secondary circuit that under normal operating conditions and single fault conditions provides a voltage that is 30 V rms (42.4 V peak) or 60 V DC or less. The current may exceed Class 2 limitations. These circuits are derived from a source evaluated to UL 60950-1 for the application of these requirements.

CONSTRUCTION

A3 Enclosures and Electrical Insulation

A3.1 Flammability

A3.1.1 Enclosures containing Class 2, LPS or SELV circuits shall be noncombustible, or a polymeric material that complies with [Table A3.1](#).

Exception No. 1: This requirement does not apply to small parts not exceeding 0.122 in³ (2 cm³).

Exception No. 2: This requirement does not apply to materials with an exposed edge not exceeding 0.04 inches (1 mm) thick and sandwiched between two metal parts.

Exception No. 3: Enclosures containing 15 watt or less circuits are not required as specified in footnote b of [Table A3.1](#).

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Table A3.1
Enclosure Flammability

Furnishing type	Minimum flammability ratings for enclosure material ^a		
	Energy source		
	PS1, or 15 watts or less ^b	PS2, or Class 2 or LPS	PS3, or SELV
Portable	HB	HB Motors and heating	V2
Stationary	HB	V-1	5V
Fixed	HB	V-1	5V

^a or complies with UL 746C, 12 mm flame test for HB, 20 mm flame test for V-0, V-1, V-2 materials, and 127 mm flame test for 5V materials.

^b Enclosures are not required on the load side of the power source but if provided shall be rated HB minimum.

A3.2 Relative thermal index

A3.2.1 A polymeric material used as the enclosure or in direct contact of live parts shall have a mechanical with impact RTI and electrical temperature RTI of at least the temperature of the part measured during the normal temperature test.

Exception: When the temperature measured during the normal temperature test is 50 °C (122 °F) or less the polymeric material is not required to have an RTI rating.

A3.3 Electrical properties

A3.3.1 A polymeric material used in direct contact with or within 1/32 inch (0.8 mm) of current-carrying parts that was not evaluated under the component standard shall have a HWI property that is as indicated in the table for Material Property Considerations in UL 746C. CTI and HAI ratings are not required.

A4 Motors

A4.1 A motor shall comply with one of the following forms of protection:

- The requirements in UL 1004-1 and either UL 1004-2 or UL 1004-3 as appropriate for the over temperature protection incorporated with the motor construction;
- A self-protected combination motor(s) and motor(s) controller shall comply with the requirements in Protective Controls, [35.4](#);
- The use of a device responsive to motor current;
- The use of a circuit that disconnects power or reduces power from the motor in a sufficiently short time to prevent a risk of fire as determined by Protective Controls, [35.4](#); or
- Motors that limit exposed motor surfaces (a case on an enclosed motor or a winding on an open motor) to 150 °C (302 °F) while wrapped in cheesecloth.

A5 Heating Loads

A5.1 The heating device shall comply with UL 499.

Exception: An upholstered furnishing with a heating pad shall comply with Sections [38](#) and [80](#).

A6 Interconnecting Cables

A6.1 Cables shall be rated for the intended temperature, power and voltage as indicated in [Table A6.1](#).

Table A6.1
Interconnecting Conductors and Cable Types

Furnishing type	Allowable interconnecting conductors and cable types		
	Potential energy source		
	PS1, or 15 watts or less ^D	PS2, or Class 2 or LPS	PS3, or SELV
Portable	A or B or C	B or C	C
Stationary	A or B or C	B or C	C
Fixed	A or B or C	B or C	C
A) The conductor or cable shall be rated for the intended temperature, power and voltage. B) Cords or cables not evaluated as a part of the component product requirement and not contained within a metal or polymeric enclosure in accordance with Table A3.1 shall be a jacketed type CL3, CL3R, CL3P, Power-limited Circuit Cable or other jacketed type cord with a minimum 0.013 inch (0.33 mm) jacket thickness or the combined conductor and jacket thickness not less than 0.013 inch (0.33 mm). Individual conductors may not be utilized outside a fire enclosure or without an overall jacket covering. C) The cable or cord shall comply with Power Supply Connections, Section 10, or other jacketed type cord with a minimum average jacket thickness of 0.015 inch (0.38 mm) and with a VW-1 flammability rating. Individual conductors may not be utilized outside a fire enclosure or without an overall jacket covering. SPT-2 and SPT-3 cord types are acceptable. D) 15 watts or less under any loading condition. See A12.1, Circuit Power Limit Measurement Test (Other Than PS1/PS2/PS3).			

A6.2 Each internal cable or conductor provided for wiring between components or for interconnection between parts (e.g. cord to connector contacts, internal motor, etc.) shall be subjected to the test specified in [A6.3](#).

A6.3 A pull force of 20 pounds (89 N) shall be applied for 1 minute to each conductor in a direction perpendicular to the plane of the entrance to the conductor connection. If the conductors are bundled into a single monolithic cable the test may be conducted on the cable assembly instead of the individual conductors. There shall be no breaking of the conductor or loosening of the conductor connections.

A7 Connectors

A7.1 A connector shall comply with one of the following:

- UL 498;
- UL 2459;
- UL 1977, provided the connector meets voltage and current requirements for the intended load and the material RTI is suitable for the maximum temperature on the connector developed in the Temperature Test. UL 1977 connectors shall meet minimum flammability class rating of HB, V-2, V-1, V-0, VTM-2, VTM-1, or VTM-0;
- A connector located in a SELV circuit that during the Temperature Test does not exceed 50 °C and the connector is manufactured from a polymeric material with a minimum electrical RTI of 70 °C; or
- A connector located in a class 2 or LPS circuit during the Temperature Test does not exceed 50 °C.

A7.2 A unit with multiple Class 2 / LPS supply or load connections where interconnection could cumulatively exceed Class 2 / LPS limits shall be provided with means that prohibit such interconnection.

PERFORMANCE

A8 General

A8.1 A Class 2, LPS or SELV motor operated product shall comply with the following:

a) A motor that only operates when the user is present and when activated by the user with a momentary contact switch is not required to be subjected to the Running Overload Motor Test, Section [A9](#).

b) A furnishing where the motor operation is automatic or the motor can operate without the presence of the user shall comply with the Running Overload Motor Test, Section [A9](#).

Exception: Impedance protected motors that comply with Class A limitations in accordance with UL 1004-2 are not required to be subjected to the Running Overload Motor Test.

c) All motor operated furnishings shall comply with the Locked Rotor Test, Section [A10](#), unless subjected to the locked rotor tests in UL 1004-1, UL 1004-2, or UL 1004-3 and the testing is representative of the conditions in the end use product.

Three samples of the motor under investigation shall be subjected to the test.

A9 Running Overload Motor Test

A9.1 The case of an enclosed motor or the windings of an open motor shall be thermocoupled with a minimum of three thermocouples. The case, windings or body of the motor shall then be wrapped in two layers of Cheese Cloth. The risk of fire indicator (Cheesecloth) is to be double-layered, bleached cheesecloth, running 14 – 15 square yards per pound (26 – 28 m²/kg) per layer, and having a count of 32 by 28, that is, for any square inch there are 32 threads in one direction and 28 in the other direction (for any square centimeter, there are 13 threads in one direction and 11 threads in the other direction). There shall be no ignition (charring or discoloration is acceptable) of the cheesecloth and the maximum temperature on [the case on an enclosed motor or a winding on an open motor] shall not exceed 150 °C (302 °F). The Dielectric Voltage-Withstand Test shall be conducted immediately following the running overload test while still heated. The test shall be conducted in accordance with Section [71](#), Dielectric Voltage-Withstand Test, except at the potentials shown in [Table A9.1](#) for low voltage motors.

Table A9.1
Test Potentials for Low Voltage Motors

Unit voltage rating, volts	Condition A			Condition B		
	Test potential V AC	Test potential V DC	Time, seconds	Test potential V AC	Test potential V DC	Time, seconds
42.4 ac peak or 60 dc or less	500	700	60	600	850	1

A9.2 The Running Overload test shall be carried out by operating the motor under Normal Load; and then increasing the load so that the current is increased to the point just below where the power supply or controller limits the current to the motor(s). Supply voltage shall be maintained at its original value.

A9.3 In accordance with [36.6](#) if the furnishing has a control that limits the operation time, the test duration of the overload test shall be conducted based on the controller limiting the operation of the device. Single component faults within the controller circuit shall be considered.

A10 Locked Rotor Test

A10.1 Three samples of the motor are used for this test. The motor is to be thermocoupled with a minimum of 4 thermocouple on the windings or case for a totally enclosed motor. The motor shall have

cheesecloth loosely drabbed around the motor. The motor shall be mounted on a surface with the rotor locked. If the power supply or controller provided with the product is used to provide voltage, it shall have any overload protection defeated, including software unless it was evaluated in accordance with [24.1.1](#) (d) or (e) and [36.3](#). The motor is to be operated at the voltage used in its application and with its rotor locked for 7 hours or until steady conditions are established. The Dielectric Voltage-Withstand Test shall be conducted immediately following the locked rotor test while still heated. The test shall be conducted in accordance with Section [71](#), Dielectric Voltage-Withstand Test, except at the potentials shown in [Table A9.1](#) for low voltage motors.

Exception: If a power supply is used with an evaluated foldback system, then the power supply is not required to be evaluated to [24.1](#) (d) or (e) and Protective Controls, [35.4](#).

A10.2 There shall be no ignition (charring or discoloration is acceptable) of the cheesecloth and the maximum temperature on [the case on an enclosed motor or a winding on an open motor] shall not exceed 150 °C (302 °F). It shall comply with Section [71](#), Dielectric Voltage-Withstand Test.

A10.3 As an alternate to [A10.1](#) for totally enclosed motors that have not been evaluated to [24.1.1](#) the motors shall be prepared the same as in [A10.1](#), except a power source shall be used to provide sufficient current to the motor without any protection circuit operating. The outside of the motor shall be draped with cheesecloth. If the motor is enclosed in a secondary metal enclosure, such as the leg of a table, the cheesecloth may be placed on the outside of the secondary enclosure and if the leg is open at one end, the cheesecloth shall be placed inside the leg in contact with the motor. If the test is performed with motor inside a secondary metal enclosure, such as a leg, temperatures shall be measured on the outside of the enclosure if the user may contact the surface.

A10.4 There shall be no ignition (charring or discoloration is acceptable) of the cheesecloth or any indication of a fire, such as insulation on leads discolored or melted. the maximum temperature on the exposed, either the motor or secondary, enclosure shall not exceed 90 °C (194 °F).

A11 Circuit Power Limit Measurement Test

A11.1 Deleted

A11.2 Deleted

A11.3 Deleted

A12 Power Limitation Test Methods

A12.1 Circuit power limit measurement test (other than PS1/PS2/PS3)

A12.1.1 A determination shall be made as to which points in the circuit are capable of delivering a power greater than 15 watts for more than 5 seconds into an external variable resistor connected singly between each point in the circuit and its supply return (circuit common). See [A12.1.2](#).

A12.1.2 To determine the points capable of delivering a power of more than 15 watts, the external resistor is to be set for maximum resistance before being connected to the circuit under investigation. The external resistor is to be adjusted until the maximum wattage is consumed as indicated by a peak reading of the wattmeter. A reading of greater than 15 watts indicates that the points are capable of delivering greater than 15 watts. The external resistor is to then be moved, point by point, from the point farthest from the load to other points toward the load side of the circuit until a point is reached where the maximum power consumed by the external resistor (as indicated by a peak reading of the wattmeter) is not more than 15 watts. During the test, the appliance is to be connected to a source of supply and operated as specified in the Temperature Test, Section [68](#).

Exception: When the portion of the appliance in question is tested separately from the main body of the appliance, the source of supply and loading are to be equivalent to those supplied to the circuit within the appliance when the appliance is operated as specified in the Temperature Test.

A12.1.3 With reference to [A12.1.1](#), when a thermal or overcurrent protective device operates during the test, a shorting switch is to be connected across the protective device in the closed position. The external resistor is to be adjusted for maximum resistance before being connected in the circuit. The external resistor is to then be adjusted so that the power it dissipates is 15 watts as indicated by the wattmeter reading. The switch across the protective device is to then be opened and the time required for the protective device to open is to be recorded. When the protective device opens the circuit in 5 seconds or less while the resistor is dissipating 15 watts, the first circuit point not capable of delivering more than 15 watts has been located.

A12.2 Power measurement for worst-case power source fault (PS1/PS2/PS3 circuits)

A12.2.1 With reference to [Figure A12.1](#):

- a) At points X and Y, insert a wattmeter (or a voltmeter, VA, and a current meter, IA).
- b) Within the power source circuit, simulate any SINGLE FAULT CONDITION that will result in maximum power to the circuit being classified. All relevant components in the power source circuits shall be short-circuited or disconnected one at a time at each measurement.
- c) Short-circuit of the output terminals is also considered to be an abnormal operating conditions.

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A12.2.2 Measure the maximum power as specified and classify circuits supplied by the power source according to [A2.2A](#), [A2.2B](#) or [A2.2C](#).

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A12.2.3 If an overcurrent protective device operates during the test, the measurement shall be repeated at 125 % of the current rating of the overcurrent protective device.

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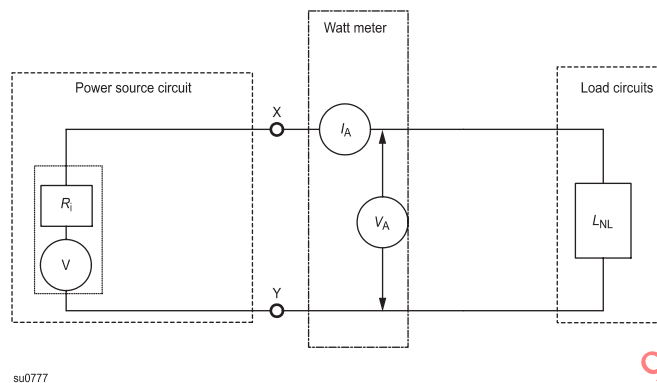
A12.2.4 If a power limiting device or circuit operates during the test, the measurement shall be repeated at a point just below the current at which the power limiting device or circuit operated.

- a) When the tests are repeated, a variable resistance may be used to simulate the component under fault.
- b) To avoid damage to the components of the normal load, a resistor (equal to the normal load) may be substituted for the normal load.

NOTE: Experimentation can be used to identify the single component fault that produces maximum power.

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Figure A12.1
Power Measurement for Worst-Case Power Source Fault



V – voltage source

R_i – internal resistance of the power source

I_A – current from the power source

V_A – voltage at the points where determination of PS power is made

L_{NL} – normal load

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ANNEX B (normative) – HEATED GLAZING UTILIZING CONDUCTIVE COATING TECHNOLOGY

INTRODUCTION

B1 Scope

B1.1 The technology used for this application consists of a conductive coating modularly bonded (heat fired) into the glazing. These requirements do not cover adhesive applied systems or separate membrane systems. Other technologies may require additional considerations.

B1.2 These requirements address glazing intended to be mounted into a building structure. A permanent wiring system (not a cord and plug connected system).

CONSTRUCTION

B2 General

B2.1 The heated glazing system power shall be supplied by a class "A" GFCI.

B2.2 Glazing shall comply with ANSI Z97.1, Class A requirements.

B2.3 Glazing surface temperatures shall not exceed 70 °C (158 °F).

B2.4 Any dead metal in contact with the glazing system shall be bonded to a ground lead.

B2.5 The glazing shall be supplied with a length of AC, MC, Flexible Conduit, or other suitable permanent wiring method as specified in ANSI/NFPA 70.

B3 Articulating Glazing Assemblies

B3.1 Heated glazing assemblies that move (slide, pivot, rotate and the like) shall be provided with a means to transmit power to the heated glazing which does not present a risk of fire, shock or casualty.

B3.2 Conductors shall not be less than 18 AWG stranded copper and shall be provided with a sleeve or jacket for mechanical protection. Other means (electrical slip rings, sliding contacts, etc) to transmit the power to the articulated heated glazing assembly may be used but shall be enclosed, comply with the requirements for that component, comply with the temperature, dielectric voltage withstand test, and the Grounding-Impedance Test, Section [70](#), after the 6000 cycles test.

B3.3 Mechanical articulating joints, pivots, glides, etc. shall show no visible signs of wear after the 6000 cycle test.

B3.4 An articulating system that is moved by any means other than manual activation by a single individual shall comply with the requirements in Mechanical enclosures and guards – Mechanical considerations, [11.3](#), and Controls, Section [35](#), if applicable.

PERFORMANCE

B4 Power Input Test

B4.1 Samples shall be supplied in the minimum and maximum wattage per square unit area. The heated glazing system shall be operated at the maximum rated voltage at 60 Hz. The measured input wattage shall not exceed 105 % of the rated input wattage.

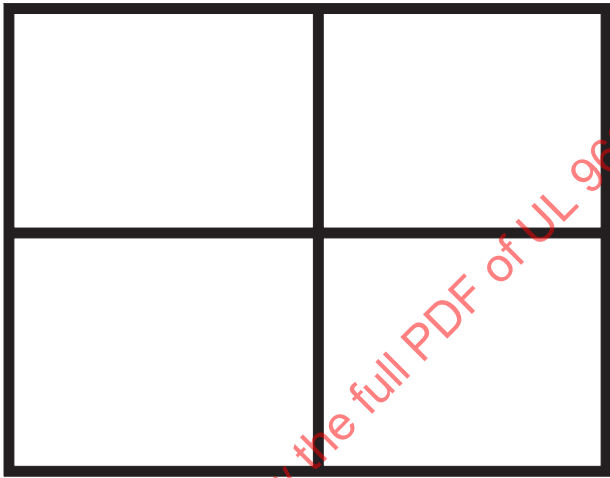
B5 Normal Temperature Test

B5.1 The heated glazing assemblies shall be mounted in a framing system as intended in the actual installation. The framing system may be arranged differently than shown in [Figure B5.1](#). The framing system shall take into consideration the recommended installation as shown in the installation instructions. The arrangement of the framing system for test purposes shall create the maximum temperature on the heated glazing system and on the building wiring system. The temperature limits shall comply with [Table 68.1](#) for the material employed and the specific limit specified in [B2.3](#) for the heated glazing surface.

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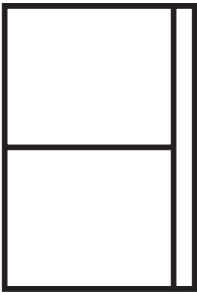
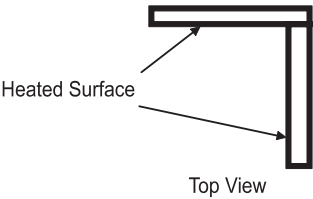
Figure B5.1
Normal Temperature Test
Method A

Top View



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Method B



Front View

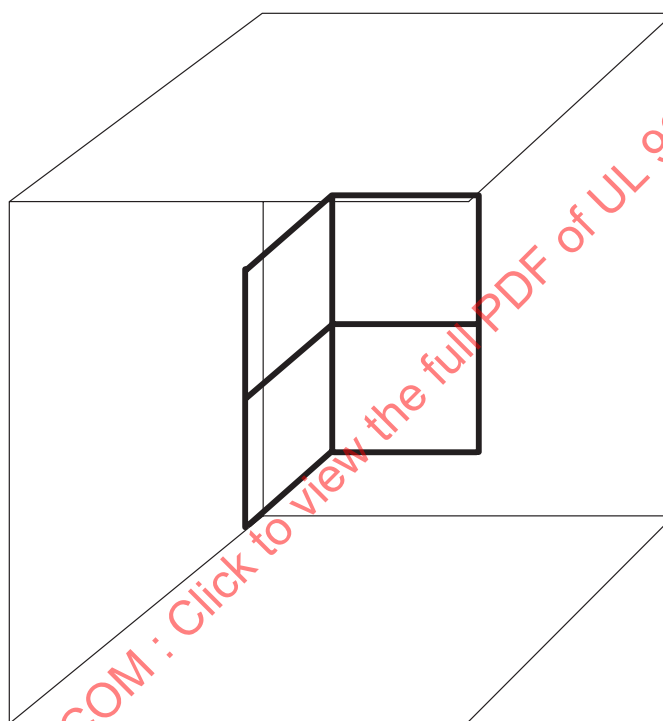
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B6 Test Installation

B6.1 Tests shall be conducted on each type of heated glazing assembly. When the glazing assembly is manufactured in more than one type, tests are to be conducted on as many types and sizes as required to determine compliance with the requirements.

B6.2 The heated glazing assembly shall be tested in a structure similar to that in [Figure B6.1](#) constructed to accommodate the product.

Figure B6.1
Heated glazing assembly testing structure



B6.3 The temperature of the room and the entire test structure within the room shall be between 50 – 104 °F (10 – 40 °C) throughout the test.

B6.4 The test structure in which the heated glazing shall be installed consisted of a back wall, one side wall, a ceiling, and a floor. The combustible floor below the heated glazing assembly consisted of two layers of 3/4 inch (19 mm) thick plywood over trade size 2- by 4-inch [nominal 1-1/2 by 3-1/2 inch (38- by 89-mm)] floor supports placed on 16 inch (405 mm) centers. The floor under the heated glazing assembly extended at least 4 feet (1.2 m) in front of the assembly. The side wall shall be placed perpendicular to the back wall. The floor and walls extended at least 4 feet beyond the heated glazing assembly. The side, back walls, and ceiling each consisted of one thickness of 3/4 inch (19 mm) thick plywood. The test structure is to include a 3/4 inch (19 mm) thick plywood ceiling located 8 feet (2.4 m) above the floor and extending not less than 4 feet (1.2 m) beyond the heated glazing assembly. The heated glazing assembly shall be installed in the test structure at the minimum ceiling and floor clearances specified by the installation instructions. The assembly shall be located a minimum 2 feet (0.6 m) from the walls. All wall, floor, and ceiling surfaces of the test structure shall be painted flat black.

B7 Temperature Measurement

B7.1 Temperatures shall be measured using Type J (iron-constantan) thermocouples of 18 AWG (0.82 mm²) to 24 AWG (0.21 mm²) wire.

B7.2 The ambient temperature shall be determined by using a thermocouple that is shielded by being located centrally within a vertically oriented 6 inch (152 mm) length of aluminum-painted 2 inch (50 mm) steel pipe complying with ANSI B36.10-1979, open at both ends.

B7.3 The shielded thermocouple shall be located 6 inches (152 mm) away from the side wall, 4 feet (1.2 m) above the floor or centered vertically between the floor and ceiling, and a distance of 2 feet (0.6 m) in front of the assembly.

B7.4 Thermocouples are to be attached to metal surfaces by screws, rivets, or by silver soldering, brazing or welding of the tip to the metal surface.

B7.5 Thermocouples shall be secured to wood surfaces by staples placed over the insulated portion of the wires. The thermocouple tip is to be depressed into the wood so as to be flush with the wood surface at the point of measurement and held in thermal contact with the surface at that point by pressure-sensitive paper tape.

B7.6 Thermocouples shall be attached to surfaces and electrical components by being cemented or taped to the surface in a manner to maintain thermal contact with the surface. Materials and parts whose temperatures were measured are included in the table below. Temperatures on electrical conductors are to be measured on the surfaces of the conductor insulation.

B7.7 Thermocouples were placed on floor and ceiling surfaces of the test structure at various locations as required to measure maximum temperatures during tests.

B7.8 When test enclosure elements are in contact with the glazing assembly or frame, thermocouples are to be placed on the heated glazing assembly mounting frame at representative points of contact.

Exception: When a point or line contact of a spacer with an enclosure is not greater than 1/8 inch (3.2 mm) diameter or width, thermocouples are to be placed on the test enclosure at points 1/2 inch (12.7 mm) from the center of the point or line contact.

B7.9 Thermocouples shall be attached to the heated glazing assembly at various locations as required to measure maximum temperatures during the tests. A minimum number of locations included the following:

- a) A 8 to 12 inch grid on the heated glazing exterior surface. (See Note 1).
- b) At points of thermal contact of the glazing mounting frame to the combustible building structure.
- c) At the point the wire leads exit the heated glazing assembly spacer.
- d) Between the heated glazing and the spacer between glazing panes.
- e) On the leads where the leads from each glazing assembly meet and are connected to the building wiring system within a junction box.
- f) On the conductors within the cable assembly supplying the junction box. Or if of a type such as MC or AC cable on the cable jacket. The conductors or jacket shall be wedged against the glazing frame assembly for at least 6 inches so that thermal contact is made. The building supply conductors were routed in the center glazing frame.

Note 1 – Thermocouples may be used provided thermal contact can be maintained. A thermesthesiometer type instrument may be used as a referee method. The National Institute of Standards and Technology developed the instrument in the 1980's; however, they are not produced commercially.

Note 2 – If the thermesthesiometer is used the limit shall be 53 °C based on comparison testing between the thermesthesiometer and thermocouples contained in UL's Research Report dated April 28, 2003.

Note 3 – The glazing temperature limit addresses contact by small children and the elderly who cannot respond to the sensation of heat as quickly as normal healthy adults. Refer to UL's Research Report dated April 28, 2003.

B7.10 The temperature test is to be conducted at any ambient temperature 50 – 104 °F (10 – 40 °C) and corrected to an ambient of 77 °F (25 °C).

B7.11 The heated glazing assembly shall be connected as specified in the normal temperature test the regulating thermostat was short-circuited.

B8 Abnormal Temperature Test

B8.1 The test configuration shall be as indicated in the Normal Temperature Test, Section [B5](#).

B8.2 The heated glazing side is to be covered with a minimum 1/4 inch (6.4 mm) thick fir plywood painted flat black facing the glazing. The plywood shall be held in thermal contact with the glazing. Thermocouples shall be attached as specified under the normal temperature test to the plywood surface.

B8.3 This test is intended to address materials such as combustible, drapes, blinds and other furnishings being in contact with the heated glazing surface. The maximum temperature shall not exceed 90 °C on the combustible surface.

B9 Dielectric Voltage Withstand Test

B9.1 The dielectric voltage withstand test shall be conducted while the heated glazing is at the maximum temperature attained in normal use. The test shall be conducted as specified in Section [71](#), Dielectric Voltage-Withstand Test, except the test shall be conducted at a potential of 3000 Vac applied between live parts and dead-metal parts.

B10 Abnormal Heat Cycling Test

B10.1 A representative sample shall be installed as specified under the normal temperature test. The voltage shall be adjusted to 110 % of rated voltage. The heated glazing shall be operated for 6000 cycles of heating to maximum temperature and cooling to room temperature.

B10.2 The glazing system resistance shall be measured prior to the start of the cycling test and again at the conclusion. The resistance shall not increase more than 10 %. The connections between the glazing and the conductive coating shall be unaffected.

B11 Insulation Resistance and Leakage Current as a Result of Moisture and Broken Seal

B11.1 General

B11.1.1 As a result of the Insulation Resistance Test the glazing shall not crack or rupture there shall be no arcing or electrical tracking that occurred on the conductive coating the power leads shall remain bonded to the conductive coating insulation resistance shall be greater than 50,000 ohms and the system shall comply with Section [B16](#), Leakage Current Test. There shall be no electrical or mechanical risks of fire, electric shock or injury to persons.

B11.2 Method I

B11.2.1 The glazing seal was breached by drilling a minimum of one 1/4 inch (6.4mm) diameter hole for every 4 inches (101.6 mm) of spacer along one edge. Immediately following conditioning, the insulation resistance between live parts and accessible dead-metal parts was measured.

B11.2.2 The of the heated glazing system with a broken seal was placed in a moist air conditioning chamber having a relative humidity of 88 ± 2 % at a temperature of 32.0 ± 2.0 °C (89.6 ± 3.6 °F) for 48 hours.

B11.2.3 The insulation resistance shall be measured by one of the following methods:

- a) By a magneto 1 meg-ohmmeter that has an open circuit output of 500 V;
- b) By a voltmeter having an internal resistance of at least 30,000 ohms and using a 250 V dc circuit, by equivalent equipment;
- c) For units without accessible dead-metal parts, the insulation resistance was measured using a piece of metal foil with an area of 10 by 20 cm in contact with the glazing system edge spacer and seal away from the area which was slit.

B11.2.4 Following the cycling test while heated the glazing system was subjected to Section [B9](#), Dielectric Voltage Withstand Test.

B11.3 Method II

B11.3.1 A sample of the heated glazing system with a broken seal shall be mounted as specified in the normal temperature test. The glazing seal shall be breached by drilling a hole large enough to pour water into the space between the inner and outer glass panes. The window was filled with the water solution described below such that the heating element or coating was submersed to a depth of 1 inch (25.4 mm). The hole was covered with adhesive paper tape such that it reduced evaporation but will allowed pressure to escape if developed.

B11.3.2 The glazing system shall be filled with a solution of 8 grams of table salt per liter of distilled water to the depth specified above simulating a failed seal. The orientation of the supply leads was as described in the installation instructions. If no orientation was described the test shall be repeated with the supply leads both submersed and with the line side lead submersed.

B11.3.3 The glazing system shall then be operated as specified in the normal temperature test until temperatures are stabilized.

B11.3.4 The insulation resistance shall be measured by one of the following methods:

- a) By a magneto 1 meg-ohmmeter that has an open circuit output of 500 V;
- b) By a voltmeter having an internal resistance of at least 30,000 ohms and using a 250 V dc circuit, by equivalent equipment;
- c) For units without accessible dead-metal parts, the insulation resistance was measured using a piece of metal foil with an area of 10 by 20 cm in contact with the glazing system edge spacer and seal away from the area which was slit.

B11.3.5 Following the cycling test while heated the glazing system was subjected to Section [B9](#), Dielectric Voltage Withstand Test.

B12 Thermal Shock Tests

B12.1 Following the overvoltage (+10 % rated voltage) temperature test and while still hot, the interior and exterior glass shall be contacted with a wet rag previously immersed in melting ice water 32 °F to 38 °F (0 °C to 3.3 °C) to simulate a cleaning or cold water spillage operation. Following this, the interior and exterior glass was permitted to reach thermal equilibrium and then shall be sprayed with a fine spray of ice water 32 °F to 38 °F (0 °C to 3.3 °C). There shall be no evidence of cracking of the glass or other visible damage.