UL 2305

STANDARD FOR SAFETY

Exhibition Display Units, Fabrication and Installation

UL Standard for Safety for Exhibition Display Units, Fabrication and Installation, UL 2305

First Edition, Dated February 9, 2001

Summary of Topics

The revisions of UL 2305 includes the removal of ANSI information and miscellaneous editorial updates.

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

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UL 2305

Standard for Exhibition Display Units, Fabrication and Installation

First Edition

February 9, 2001

This UL Standard for Safety consists of the First Edition including revisions through June 15, 2018.

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

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INTRODUCTION

1 Scope

1.1 These requirements cover exhibition display unit constructions that are intended for indoor use for the purpose of illuminating, animating, activating, or displaying with respect to temporary expositions, exhibits, show conventions, meetings, or assemblies. These units are intended for temporary construction and display at exposition events. Electrical components and systems shall be used in accordance with the National Electrical Code, NFPA 70 and with the installation requirements of this standard. These requirements also cover portable tradeshow displays, hanging components, and other exhibit assemblies.

1.2 These requirements cover exhibition display units rated 600 volts ac or less.

1.3 These requirements cover light boxes for use with exhibition display units. Electric advertising displays and electric signs are covered by Standard for Electric Signs, UL 48.

1.3.1 These requirements cover under carpet convention center cord sets and assembled on or molded on attachment plugs and cord connectors, rated 250 volts dc or less or 600 volts ac or less, that are intended to supply temporary power from an exhibit facility to an exhibition display unit or to exhibitor equipment and products that are displayed or exhibited within the exhibition display unit, in accordance with 518.3(B) of the National Electrical Code, ANSI/NFPA 70.

1.4 These requirements do not cover products that are displayed or exhibited within the exhibition display unit, such as cars, audio equipment, appliances, or exhibitor equipment.

1.5 These requirements do not cover combustible materials stored within an exhibition display unit, such as promotional pamphlets or giveaways.

1.6 These requirements do not cover the use of the following materials and their interconnecting components used in an exhibition display unit:

a) Natural gas-fired equipment,

b) Cooking equipment,

c) Open flame devices,

d) Exhibits involving processes or materials that present a risk of injury to persons,

e) Pressure vessels,

f) Fossil fuel powered equipment,

g) Hydraulically powered equipment using flammable fluids,

h) Radiation producing devices, including lasers,

i) Flammable liquids, and

j) Compressed air that is determined to be not part of an exhibition display unit.

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

2 Glossary

For the purpose of this standard the following definitions apply.

2.1 CLASS 1 CIRCUIT – The portion of the wiring system supplied from a source that has a rated output greater than 30 volts rms (42.4 volts peak) and 100 volt-amperes.

2.2 CLASS 2 CIRCUIT – An isolated secondary circuit involving a potential not greater than 30 volt rms (42.4 volts peak) supplied by:

a) An inherently-limited Class 2 transformer;

b) A combination of an isolated transformer secondary winding and a fixed impedance or regulating network, that together comply with the performance requirements for an inherently-limited Class 2 transformer;

c) A dry-cell battery having output characteristics not greater than those of an inherently-limited Class 2 transformer;

d) Any combination of (a), (b), and (c) above that together comply with the performance requirements for an inherently-limited Class 2 transformer; or

e) One or more combinations of a Class 2 transformer and an overcurrent protective device that together comply with the performance requirements for a noninherently-limited Class 2 transformer. A circuit derived from a line-connected circuit by connecting impedance in series with the supply circuit as a means of limiting the voltage and current is not considered to be a Class 2 circuit.

2.3 CLASS 2 TRANSFORMER – An isolation type transformer as specified in the Standard for Low Voltage Transformers Part 1 General Requirements, UL 5085-1 and Low Voltage Transformers Part 3; Class 2 and Class 3 Transformers, UL 5085-3.

2.4 CORD-CHANNEL – A completely enclosed channel intended specifically for the holding and routing of wiring, excluding communication and low-voltage wiring. A cord channel provides mechanical protection for internal wiring.

2.4.1 CONVENTION CENTER CORD SET – A convention center cord set shall be defined as one of the following types:

a) Parallel Type – The cord provided is of the flat, jacketed parallel conductor type for installation under carpet. See Part VII, Convention Center Cord Sets, Attachment Plugs and Cord Connectors (Parallel Type).

b) Booth Stringer Type – The cord provided is jacketed round extra-hard usage Type S intended to supply convenience outlets along the length of a cord set to provide power for lighting and displays for several booth locations. See Part VIII, Convention Center Cord Sets, Attachment Plugs and Cord Connectors (Booth Stringer Type).

2.4.2 CONVENTION CENTER ATTACHMENT PLUG, ASSEMBLED-ON – An attachment plug that is provided unattached to the cord of a convention center cord set. The attachment plug is intended to be assembled onto the cord of a cord set as a line fitting.

2.4.3 CONVENTION CENTER CORD CONNECTOR, ASSEMBLED-ON – A cord connector that is provided unattached to the cord of a convention center cord set. The cord connector is intended to be assembled onto the cord of a cord set as a load fitting.

2.5 DEFLECTION, HORIZONTAL – The measure of horizontal movement of elements of an exhibition display unit resulting from addition and movement of live loads on the unit.

2.6 DEFLECTION, VERTICAL – The measure of vertical movement of elements of an exhibition display unit due to live and dead loads.

2.7 ELEMENT – A part or portion of an exhibition display unit.

2.8 EXHIBITION DISPLAY UNIT – A complete show exhibit or any subcomponent element that is able to be used as a complete stand-alone display.

2.9 EXHIBITION DISPLAY UNIT, CUSTOM DESIGN – A unit with unique construction that is intended for display at a particular exhibition, show, meeting, or assembly. The unique construction is intended to be used for a particular product, service, or organization.

2.10 EXHIBITION DISPLAY UNIT, MOTOR-OPERATED – An exhibition unit provided with a motor.

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2.11 EXHIBITION DISPLAY UNIT, MULTIPLE-STORY – An exhibition unit with two or more stories, with or without a ceiling or covering for the top floor.

2.12 EXHIBITION DISPLAY UNIT, PORTABLE – An exhibition unit that is intended to be moved and is hand carried and set up without tools and/or ladder.

2.13 EXHIBITION DISPLAY UNIT, STATIONARY – An exhibition unit located in a dedicated space, and not normally or easily moved.

2.14 EXHIBITION DISPLAY UNIT, MODULAR-TYPE SYSTEM – A system consisting of individual components that mechanically connect together to form the supporting structure of an exhibition display unit or portion of a unit. Elements of these systems are intended to be used repeatedly in various configurations. A modular system uses a locking means of connection whereby the strength and integrity of the connection is maintained.

2.15 FRAME AND ENCLOSURE (For Moving Parts and Electrical Components) – A frame consisting of parts that provide the structural integrity of a product and provides the means of securing the enclosure to the product. The enclosure refers to that portion of a product that:

a) Renders parts that present a risk of electric shock inaccessible;

b) Reduces the risk of emission of flame or molten material; or

c) Reduces the risk of unintentional contact with internal parts that involve a risk of injury.

2.16 GUYING – To attach a rope, chain, rod, wire, or similar device to a structure to provide reinforced support for the structure.

2.17 HANGING COMPONENT – A fabric structure, graphic, or sign, electrical or nonelectric, that is suspended or supported over the portion or portions of an exhibition display unit located on the floor.

2.18 KIOSK-TYPE STRUCTURE – A free standing element of an exhibition display unit less than 8 feet (2.44 m) in height.

2.19 LEAKAGE CURRENT – Currents, including capacitive 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.

2.20 LIGHT BOX – A custom-built sign assembled using certified components, or a sign that was certified in accordance with the Standard for Electric Signs, UL 48 that has been modified after certification.

2.21 LOAD, DEAD – The weight of materials of construction incorporated into the unit, such as walls, floors, ceilings, stairways, partitions, finishes, and other similarly incorporated structural components.

2.22 LOAD, LATERAL – The lateral unit forces on elements of an exhibition display unit due to the inertia of the unit and occupants in motion.

2.23 LOAD, LIVE – The load resulting from the occupancy of the unit, not including construction load or environmental loads, such as wind loads or dead loads. Live loads occur because of the movement of people and objects on the unit.

2.24 MARKING – Information provided on or in connection with a product, such as company identification, product designation, ratings, warnings, etc.

2.25 PULL-OUT STRENGTH – The measure of the tensile force or load a vertical element and horizontal element connection maintains before the horizontal element disconnects from the vertical component.

2.26 SLIP RESISTANCE – The measure of the slip force or load a vertical element and horizontal element connection maintains before the horizontal element in the groove of an interconnecting vertical element slips out of the groove.

2.27 STAIR NOSING – The rounded edge of a stair tread that projects over the riser.

2.28 STAIRWAY, CIRCULAR OR CURVED – A stairway having an open circular or curved form in its plan view with uniform section shaped treads attached to and radiating from adjacent supporting structures.

2.29 STAIRWAY, SPIRAL – A stairway having a closed circular form in its plan view with uniform section shaped treads attached to and radiating about a minimum diameter supporting column.

2.30 STAIRWAY, WINDING – A stairway having straight sections connected with sections of radially shaped treads where a change of direction occurs.

2.31 TOWER – A free standing component of an exhibition display unit 8 feet (2.44 m) or greater in height that is separate from, or attached to, the main unit construction. A tower is not intended to be occupied.

3 Components

3.1 Other than as indicated in 3.2, a component of products covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components used in the products covered by this standard.

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 Electromagnetic-interference filters, relocatable power taps, and transient voltage surge suppressors that are used in an exhibition display unit to operate on 50 to 60 hertz power circuits shall comply with, in addition to the applicable requirements in this standard, the applicable requirements in the Standards for Electromagnetic Interference Filters, UL 1283, Standard for Relocatable Power Taps, UL 1363, and Surge Protective Devices, UL 1449, respectively.

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 References

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

UL Standards

UL 48
Standard for Electric Signs

UL 67
Standard for Panelboards

UL 94
Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 98
Standard for Enclosed and Dead-Front Switches

UL 153
Standard for Portable Electric Lamps

UL 217
Standard for Smoke Alarms

UL 299
Standard for Dry Chemical Fire Extinguishers

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

UL 498
Standard for Attachment Plugs and Receptacles

UL 711
Standard for Rating and Fire Testing of Fire Extinguishers

UL 723
Standard for Test for Surface Burning Characteristics of Building Materials

UL 746A
Standard for Polymeric Materials – Short Term Property Evaluations

UL 746C
Standard for Polymeric Materials – Use in Electrical Equipment Evaluations

UL 969
Standard for Marking and Labeling Systems

UL 1004-1
Standard for Rotating Electrical Machines – General Requirements

UL 1004-2
Impedance Protected Motors

UL 1004-3
Thermally Protected Motors

UL 1283
Standards for Electromagnetic Interference Filters

UL 1363
Standard for Relocatable Power Taps

UL 1439
Standard for Test for Sharpness of Edges on Equipment

UL 1449
Standard for Surge Protective Devices

UL 1573
Standard for Stage and Studio Luminaires and Connector Strips

UL 1574
Standard for Track Lighting Systems

UL 5085-1
Standard for Low Voltage Transformers Part 1 General Requirements

UL 5085-3
Standard for Low Voltage Transformers Part 3; Class 2 and Class 3 Transformers

UL 1598
Standard for Luminaires

UL 1975
Standard for Fire Tests for Foamed Plastics Used for Decorative Purposes

UL 2108
Standard for Low Voltage Lighting Systems

ANSI[1] Standards

ANSI C101,
American National Standard for Leakage Current for Appliances

ANSI Z97.1,
Standard Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings

ASTM[2] Standards

ASTM B117,
Standard Practice for Operating Salt Spray (Fog) Apparatus

NEMA[3] Standards

NEMA WD6,
Standard for Wiring Devices – Dimensional Requirements

NFPA[4] Standards

NFPA 10,
Standard for Portable Fire Extinguishers

NFPA 70,
National Electrical Code

NFPA 101,
Life Safety Code

NFPA 701,
Standard Method of Fire Tests for Flame Propagation of Textiles and Films

NFPA 703,
Standard for Fire Retardant Impregnated Wood and Fire Retardant Coatings for Building Materials

[1]American National Standards Institute

[2]American Society for Testing and Materials

[3]National Electrical Manufacturers Association

[4]National Fire Protection Association

PART I – CONSTRUCTION

STRUCTURAL

6 General

6.1 The construction of an exhibition display unit shall comply with the requirements of the Uniform Building Code (UBC), the Americans with Disabilities Act (ADA) Handbook, Chapter 1 as applicable, and with the requirements of this standard.

6.2 For the purpose of evaluating an exhibition display unit for construction and performance, the unit shall not be anchored to the floor of the exhibit facility.

7 Requirements Particular to Glass and Support Brackets

7.1 Glass shall not be less than 0.115 inch (2.92 mm) thick where the length or width of the glass is not greater than 12 inches (305 mm). Glass having a dimension greater than 12 inches shall not be less than 1/8 inch (3.2 mm) thick and the glass shall comply with the following:

a) Be a non-shattering or tempered type that, when broken, complies with the Standard Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings, ANSI Z97.1; and

b) Comply with Glass Panel Tests, Section 38 or Mechanical Strength Tests, Section 42, as applicable.

8 Requirements Particular to Towers 8 Feet (2.44 m) or Greater

8.1 A tower, as specified in 2.31, shall comply with the applicable requirements in this standard and the requirements in this Section.

8.2 Certified engineering calculations, including a height to weight ratio, shall be provided to verify the structural integrity for a load-bearing surface of a tower.

Exception: A height to weight ratio is not required to be provided where other means of support, such as guying, is provided.

8.3 Unless the engineering calculations specified in 8.2 include a height to weight ratio that accounts for a specified number of occupants, a tower shall not be intended for occupancy. Where the engineering calculations for a tower provide for occupancy, the requirements in Sections 11 – 13 shall be applied, as applicable.

8.4 The area within a tower, lower than 8 feet (2.44 m), is able to be used for storage of transient material.

8.5 For the purpose of evaluating a tower for construction and performance, the unit shall not be anchored to the floor of the exhibit facility.

8.6 A tower, as described in 2.31, shall comply with Stability Tests Particular to Towers, Section 40.

9 Requirements Particular to Kiosks

9.1 A kiosk-type structure shall comply with the requirements of this standard as applicable.

10 Requirements Particular to Hanging Components

10.1 General

10.1.1 A hanging component, as described in 2.17, that forms part of the exhibition display unit or as a separate component shall comply with all applicable requirements in this Standard and the requirements in this Section.

10.1.2 Water shall be capable of freely passing through all materials of an overhead fabric structure or the parts of a hanging component such as a sign or graphic.

10.1.3 Certified engineering calculations shall be used to determine the structural integrity of a hanging component.

Exception: This requirement does not apply to a lightweight hanging component, such as a banner, that complies with 10.1.4(a).

10.1.4 A hanging component shall be classed in accordance with the following:

a) Class I: Materials less than 100 pounds (45.4 kg);

b) Class II: Materials greater than 100 pounds and less than 500 pounds (226.8 kg); or

c) Class III: Materials 500 pounds and over.

10.1.5 A Class I hanging component shall be constructed with a minimum of two hanging pick points and one hoisting pick point which, together, shall be capable of supporting 5 times the weight of the component when the component is suspended.

10.1.6 The hanging pick point is the point on a hanging component at which the means for attaching a suspending cable to the component is located. The hoisting pick point is the point at which the cables used to hang a component come together to suspend the component from a suspending means, such as a beam.

10.1.7 A Class II hanging component shall be constructed with a minimum of two hanging pick points. The means for attaching the cable at each pick point shall be capable of supporting 5 times the weight of the component when the component is suspended.

10.1.8 When a Class II hanging component is constructed with more than two hanging pick points, the means for attaching the cable at each pick point shall be capable of supporting the weight of the component when the component is suspended.

10.1.9 When one hoisting pick point is used to suspend a Class II hanging component, the means for suspending the component shall be capable of supporting 5 times the weight of the component when the component is suspended.

10.1.10 A Class III hanging component shall be constructed with a minimum of four hanging pick points. The means for attaching the cable at each pick point shall be capable of supporting 5 times the weight of the component when the component is suspended.

10.1.11 When a Class III hanging component is constructed with more that four hanging pick points, the means for attaching the cable at each pick point shall be capable of supporting the weight of the component when the component is suspended.

Exception: A Class III triangle-shaped hanging component is able to have three hanging pick points when each point is capable of holding 6 times the weight of the component when the component is suspended.

10.1.12 When one hoisting pick point is used to suspend a Class III hanging component, the means for suspending the component shall be capable of supporting 5 times the weight of the component when the component is suspended.

10.1.13 A hanging component shall be suspended within the area that the exhibition display unit occupies. The component shall be suspended a minimum distance in from the front of the exhibition display unit equal to 25 percent of the straight linear distance from the back to front of the unit. The distance on each side of the component, when suspended, shall not be greater than the distance equal to 50 percent of the straight linear distance of the width or length of the unit over which the component is suspended.

10.1.14 A component shall be suspended from load-bearing points of the facility structure designated for such use by the exhibit facility. A hanging component shall not be suspended from piping, sprinklers, or ductwork systems of the exhibit facility.

10.1.15 Cable used to hang components shall be a minimum 1/4 inch multi-stranded type wire rope, guy wire, or aircraft cable.

10.1.16 Tie wire shall not be used to suspend hanging components.

10.1.17 Written instructions and drawings shall be provided with a hanging component that specifies the floor plan for the exhibition display unit, the exact location and height at which the component is to be suspended, and a view of the hanging component that details the assembly steps required to assemble the component as intended.

10.2 Hanging Fabric Ceilings and Canopies

10.2.1 Unsupported hanging fabric ceilings, canopies, and other similar structures shall be limited to Class I as specified in 10.1.4(a).

Exception: When a frame, truss, or similar supporting means is used to support a hanging fabric ceiling, canopy, or similar structure, the structure is able to be Class II or Class III in accordance with 10.1.4(b) and (c).

10.3 Hanging signs

10.3.1 A sign and outline lighting system, feeder circuit, or branch circuit supplying a sign or outline lighting system, shall have an externally operable disconnect means that opens all ungrounded conductors. For a disconnecting means not integral to a sign or outline lighting system, the disconnect means shall be within sight of the exhibition display unit.

Exception: A sign or outline lighting system provided with a flexible cord and attachment plug for connection to the supply circuit is not required to have the specified disconnect means.

11 Requirements Particular to Decks and Multiple-Story Exhibition Display Units

11.1 General

11.1.1 A deck or the first story of a multiple-story exhibition display unit shall have the load-bearing floor surface located 3 feet, 6 inches (1.07 m) or higher above the exhibit facility floor.

11.1.2 The open area below a deck or below the floor of the first story of a multiple-story exhibition display unit shall not be accessible to persons.

Exception No. 1: This requirement does not apply to a deck or exhibition display unit that complies with 11.8.1.

Exception No. 2: This requirement does not apply to qualified personnel servicing the unit.

11.2 Straight stairway

11.2.1 The rise of a straight stair shall not be greater than 7 inches (178 mm) and shall not be less than 4 inches (102 mm).

11.2.2 The tread of a straight stair shall not be less than 11 inches (279 mm). The run shall be measured horizontally between the vertical planes of the furthermost projections of adjacent treads or stair nosing. (See 2.27).

11.2.3 Stair treads shall be of uniform size and shape.

11.2.4 The stair nosing of a straight stair shall not protrude greater than 1-1/2 inches (38.1 mm) beyond the riser.

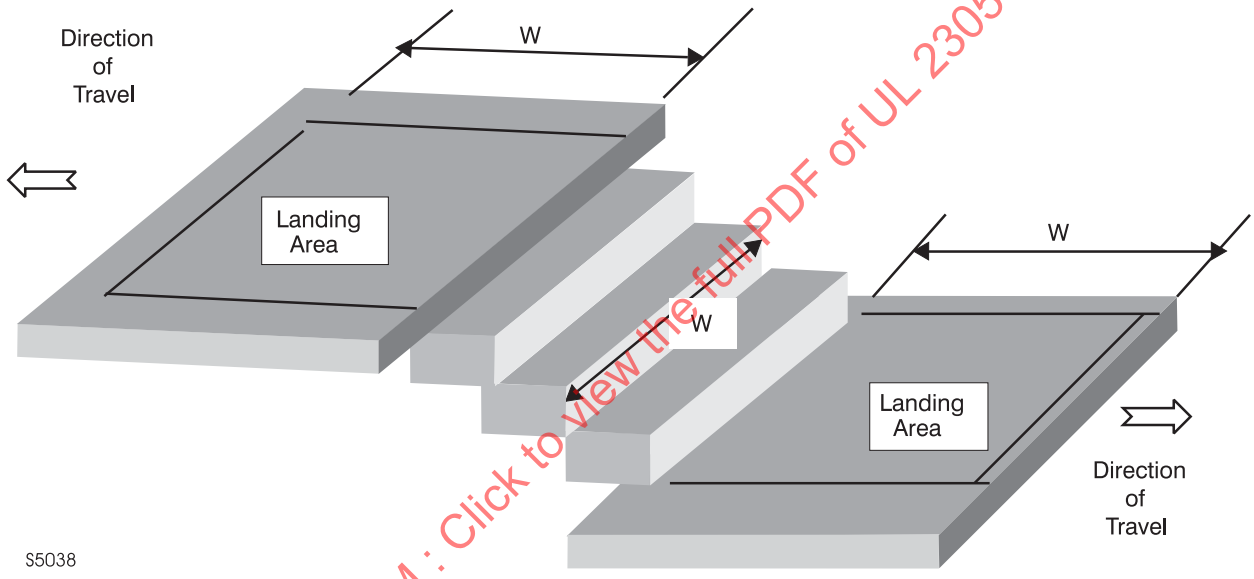
11.2.5 The head clearance under a straight stairway shall be a minimum of 6 feet, 8 inches (2.03 m).

11.2.6 For an exhibition display unit with an occupancy level of 49 or less, the minimum width of a stair shall be 36 inches (914 mm).

11.2.7 For a exhibition display unit with an occupancy level of 50 or more, the minimum width of a stair shall be 3 feet, 6 inches (1.07 m).

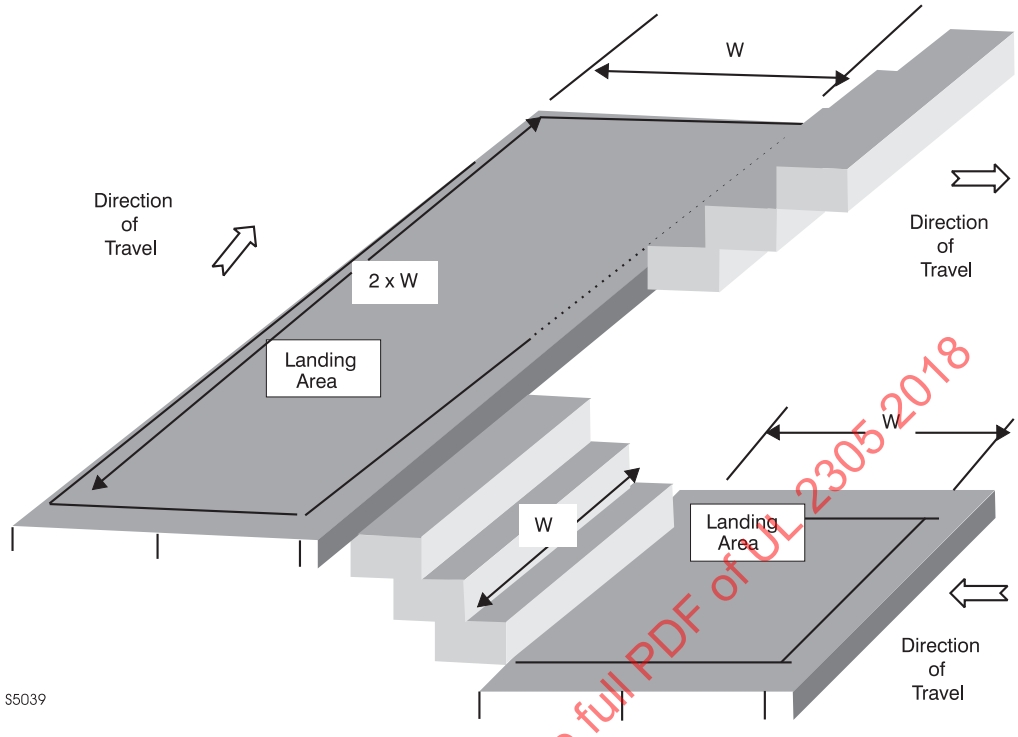
11.2.8 A landing area shall be provided at the top and bottom of each stairway or stair run. Each landing shall be a dimension measured in the direction of travel and not less than the width of the stairway. See Figure 11.1.

Figure 11.1
Dimensions for stairway landings



11.2.9 An intermediate landing for a stairway that provides for a change in direction of travel of 180 degrees shall be double the width of the landing area specified in 11.2.8. See Figure 11.2.

Figure 11.2
Dimensions for stairway landings with change of direction



11.2.10 An intermediate landing shall be provided for every 12 foot (3.66 m) rise of stairs.

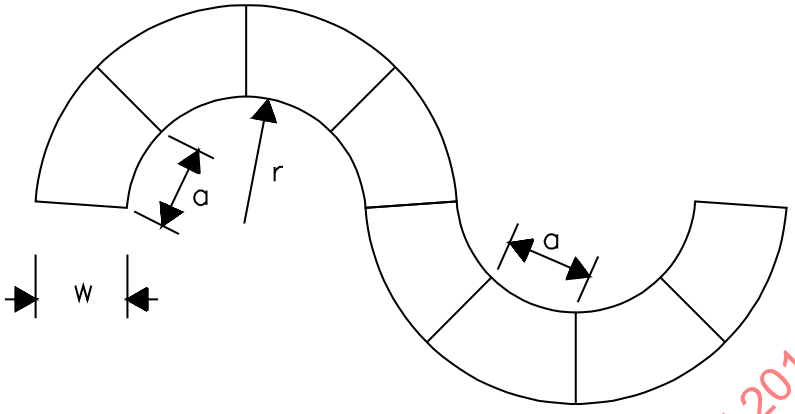
11.3 Spiral, winding, and curved (circular) stairway

11.3.1 A spiral or winding stairway shall not be used for access to a second or greater story of an exhibition display unit.

Exception: A winding or spiral stairway intended for use only by service personnel complies with the requirement. A winding or spiral stairway intended for use by service personnel shall not be used or designated as an exit in accordance with 11.7.

11.3.2 For a curved (circular) stairway, the minimum run distance on the inside curve shall not be less than 10 inches (254 mm). The smaller stairway radius shall not be less than twice the width of the stairway. All other dimensions shall be in accordance with 11.2. See Figure 11.3.

Figure 11.3
Minimum run distance for curved or circular stairway



w = width of stair

a = inside dimension for each stair tread (not less than 10 inches)

r = radius (not less than twice the width)

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11.3.3 The head clearance under a curved (circular) stairway shall be a minimum of 6 feet, 8 inches (2.03 m).

11.4 Stairway handrails

11.4.1 A stairway with an adjacent wall shall have a minimum of one handrail. A stairway with no adjacent wall shall have a minimum of two handrails.

11.4.2 The unobstructed clearance between two opposing handrails or one handrail and an opposite wall shall not be less than 36 inches (914 mm).

11.4.3 The handrail of a stairway shall not be less than 34 inches (864 mm) and not greater than 38 inches (965 mm) above the stair tread. The height shall be measured from the front edge of the stair tread to the top of the handrail.

11.4.4 The diameter of a handrail of a stairway shall not be less than 1-1/4 inches (31.8 mm) and not greater than 2 inches (50.8 mm).

11.4.5 For a wall mounted handrail and for a handrail that is mounted parallel to a wall, the minimum distance from the wall to the handrail shall be 1-1/2 inches (38.1 mm).

11.4.6 The triangular openings formed by the riser, tread and bottom element of a guardrail at the bottom of a handrail at the open side of a stairway shall not be greater than 6 inches (152 mm) as determined by attempting to pass a 6 inch diameter sphere through any opening.

11.4.7 An open handrail shall have intermediate rails, balusters, an ornamental pattern, infill panels or similar constructions such that the open spaces are not greater than 12 inches (305 mm) apart as determined by attempting to pass a 12 inch (305 mm) diameter sphere through any opening.

11.4.8 The requirements in 11.4.4 and 11.4.5 do not apply to handrails that have a plexiglass shield permanently attached to the handrail. The area around the shield shall comply with 11.4.6 and 11.4.7.

11.5 Guardrails

11.5.1 A guardrail shall comply with Stairway Handrails, Section 11.4, and with the requirements of this section.

11.5.2 An unenclosed floor or roof opening, landing, ramp, balcony or porch, which are 14 inches (356 mm) or greater above the grade or floor below, shall be enclosed by a guardrail.

Exception: An unenclosed floor or roof opening, landing, ramp, balcony or porch, that is not accessible to the general public is not required to be enclosed by a guardrail.

11.5.3 A guardrail for an exhibition display unit shall be a minimum of 3 feet, 6 inches (1.07 m) high. The height of a guardrail shall be measured from the floor of the deck to the top of the guardrail.

11.5.4 The horizontal distance from the top of the deck floor to the bottom of a guardrail shall not be greater than 4 inches (102 mm).

11.5.5 An open guardrail shall have balusters, intermediate rails, an ornamental pattern, infill panels, or similar constructions such that the open spaces are not greater than 12 inches (305 mm) apart as determined by attempting to pass a 12 inch (305 mm) diameter sphere through any opening.

11.5.6 The open space between vertical elements in a guardrail shall not be greater than 4 inches (102 mm) apart.

11.5.7 Where a guardrail meets a handrail, the opening shall not be greater than 4 inches (102 mm) apart as determined by attempting to pass a 4 inch (102 mm) diameter sphere through the opening.

11.6 Load-bearing surfaces

11.6.1 General

11.6.1.1 Certified engineering calculations shall be used to determine the load-bearing capacity of a load-bearing surface of a deck or multiple-story exhibition display unit.

11.6.2 Handrails and Guardrails

11.6.2.1 A handrail and guardrail shall comply with Handrail and Guardrail Test, Section 42.3.

11.6.3 Deck, floor, and all other unit surfaces

11.6.3.1 Any point on an exhibition display unit intended for occupancy shall have a minimum live load of 50 pounds per square foot (244 kg/m^2) at a maximum vertical deflection as determined using the following equation:

$$\partial = l/280$$

in which:

∂ *is the deflection*

l is the length between supports

11.6.3.2 Any point on an exhibition display unit intended for occupancy shall support lateral loads equal to 5 percent of the minimum live load specified in 11.6.3.1.

11.7 Exits and exit access

11.7.1 Not less than two exits shall be provided for each floor of an exhibition display unit that is 1000 square feet (92.9 m^2) or greater or having an occupancy capacity of 10 or more.

11.7.2 With reference to 11.7.1, the two exits shall be spaced apart not less than one-half the distance of the largest linear diagonal of the deck or floor space. The unit diagonal is determined by measuring two points on the unit that are the furthest distance apart.

11.8 Floor height

11.8.1 The unobstructed height above and below the second or higher story of an exhibition display unit shall not be less than 6 feet, 8 inches (2.03 m).

Exception: This requirement does not apply to areas of a unit that are not intended for occupancy.

11.9 Ceilings

11.9.1 A ceiling constructed of lightweight material, such as fabric, shall comply with Requirements Particular to Hanging Components, Section 10.

11.9.2 Certified engineering calculations shall be used to determine the load-bearing capacity of a ceiling in a multiple-story exhibition display unit.

11.9.3 A ceiling material or structure shall support the dead load weight of itself and any material setting on or attached to the ceiling material or structure.

11.9.4 A ceiling material or structure that is subject to live load weight shall have a minimum live load capacity of 20 pounds per square foot (97.7 kg/m^2).

11.10 Fire protection devices

11.10.1 A single-story exhibition display unit with a ceiling, and each story of a multiple-story exhibition display unit that is constructed with a ceiling, shall be provided with a smoke detector or detectors that are intended for use in the specified area of the unit. The smoke detectors shall be located so that the entire area under the ceiling, including closets, is protected. A smoke detector shall be located in a clearly visible and readily accessible area for each enclosed portion of each story of the unit.

11.10.2 With reference to 11.10.1, the smoke detector shall be powered by batteries integral to the detector.

11.10.3 With reference to 11.10.1, the smoke detector shall comply with the Standard for Smoke Alarms, UL 217. |

11.10.4 With reference to 11.10.1, the smoke detector alarm shall be audible to persons located outside the exhibition display unit. The alarm shall also be audible to persons using a hearing aid.

11.10.5 An enclosed area under a stairway in a multiple-story exhibition display unit, used for storage or for the installation of electrical equipment, shall be provided with a smoke detector.

11.10.6 A single-story exhibition display unit constructed with a ceiling, and each story of a multiple-story exhibition display unit that is constructed with a ceiling, shall be provided with a minimum 2-1/2 pound (1.13 kg) multipurpose-type fire extinguisher or extinguishers that are intended for use in the specified area of the unit. An extinguisher shall be located in a clearly visible and readily accessible area for each 500 square feet (46.45 m^2) of enclosed portion of the unit.

11.10.7 With reference to 11.10.6, a fire extinguisher shall comply with the Standard for Dry Chemical Fire Extinguishers, UL 299, the Standard for Portable Fire Extinguishers, NFPA 10, and Standard for Rating and Fire Testing of Fire Extinguishers, UL 711.

11.10.8 All enclosed areas of an exhibition display unit that house electrical components shall have vents to the exterior of the unit.

Exception: This requirement does not apply to enclosed areas that house convenience receptacles only.

11.10.9 The top story of an exhibition display unit shall not be covered or have a ceiling.

Exception: A cover or ceiling for the top story of a unit complies when a sprinkler system is provided for each story of the unit. An open-grate or drop-out panel type ceiling or cover is determined to comply with the requirement.

11.10.10 An exhibition display unit with a height greater than 30 feet (9.14 m) and with an enclosed area greater than 5000 square feet (464.5 m^2) shall be provided with an automatic sprinkler system intended for use in the specified enclosed area of the exhibition display unit.

11.10.11 An exhibition display unit that complies with 11.10.10 is able to be provided with a cover or ceiling for the top floor.

12 Requirements Particular to Platforms and Raised Floors

12.1 General

12.1.1 Certified engineering calculations shall be used to determine the load-bearing capacity of a platform or raised floor.

12.1.2 A raised floor shall have its load-bearing floor surface located not greater than 7 inches (178 mm) above the floor of an exhibit facility.

12.1.3 A platform shall have its load-bearing floor surface not less than 8 inches (203 mm) and not greater than 3 feet, 5 inches (1.04 m) above the floor of an exhibit facility. An exhibition display unit greater than 3 feet, 5 inches in height is determined to be a deck and shall comply with Requirements Particular to Decks and Multiple-Story Exhibition Display Units, Section 11.

12.1.4 The open area below a platform of an exhibition display unit shall not be accessible to persons.

Exception: This requirement does not apply to qualified personnel servicing the unit.

12.1.5 The load-bearing surfaces of a raised floor or platform shall comply with 11.6.3.1 and 11.6.3.2.

12.1.6 The unenclosed areas of a platform of an exhibition display unit, 7 inches (178 mm) or greater in height, shall be enclosed by a guardrail that complies with 11.5.

Exception: The requirement does not apply to a platform that is intended to be used for other than public access, such as for actors or speakers.

12.1.7 Where stairs are required for access to a raised floor or platform, the stairway shall be constructed with handrails that comply with Stairway Handrails, Section 11.4, and Exits and Exit Access, Section 11.7.

12.1.8 The load-bearing surfaces of a stairway handrail or guardrail of a raised floor or platform shall comply with Handrail and Guardrail Test, Section 42.3.

13 Requirements Particular to Modular-Type Systems

13.1 General

13.1.1 An exhibition display unit constructed using a modular-type system shall comply with the applicable requirements in Requirements Particular to Towers 8 Feet (2.44 m) or Greater, Section 8, Requirements Particular to Decks and Multiple-Story Exhibition Display Units, Section 11, and Requirements Particular to Platforms and Raised Floors, Section 12.

13.1.2 Certified engineering calculations shall be provided to verify the structural integrity for an exhibition display unit or parts of a unit that are constructed of modular-type system elements and that are 12 feet (3.66 m) or greater in height.

13.1.3 An exhibition display unit constructed using a modular-type system shall comply with the applicable performance tests specified in Sections 38 – 47, in addition to the requirements specified in 13.2 – 13.8.

13.2 Load-bearing surfaces

13.2.1 Certified engineering calculations shall be used to determine the load-bearing capacity of a load-bearing surface of an exhibition display unit constructed using a modular-type system.

13.3 90 degree (tee) connections of modular-system elements

13.3.1 The center-to-center measurement for one section of a system wall element forming a 90 degree (tee) connection shall not be greater than 3 feet, 3 inches (1 m).

13.3.2 The wall element described in 13.3.1 shall comply with 90 Degree (Tee) Connection of Modular-System Elements Slip Resistance Test, Section 39.1, 90 Degree (Tee) Connection of Modular-System Elements Pull-Out Strength Test, Section 39.2, and 90 Degree (Tee) Connection of Modular-System Elements Twisting-Moment Test, Section 39.3.

13.4 End-to-end (splice) connection of modular-system elements

13.4.1 An end-to-end (splice) connection of modular-system elements shall comply with End-to-End (Splice) Connection of Modular-System Elements Deflection Test, Section 39.4 and End-to-End (Splice) Connection for Modular-System Elements Pull-Out Strength Test, Section 39.5.

13.5 Modular-type system used as a cantilever

13.5.1 For an exhibition display unit constructed using a modular-type system that has a cantilever-type structure connected to the unit, the horizontal distance of the cantilever shall not be greater than 3 feet, 3 inches (1 m).

Exception: A cantilever-type structure greater than 3 feet, 3 inches complies when additional support is provided.

13.5.2 The cantilever structure described in 13.5.1 shall comply with Cantilevers Constructed From Modular-Type Systems Load Test, Section 39.6.

13.6 Modular-type system used as ceiling-grid structures

13.6.1 For a single ceiling grid constructed using a modular-type system, the grid area shall not be greater than 3 feet, 3 inches by 3 feet, 3 inches (1 m by 1 m).

13.6.2 For a ceiling grid structure housing two or more ceiling grids with no support provided, the ceiling grid structure shall not be greater than 16 feet, 4 inches by 16 feet, 4 inches (5 m by 5 m).

13.6.3 The ceiling grid structure described in 13.6.2 shall comply with Ceiling-Grid Structure Constructed From Modular-Type Systems Deflection Test, Section 39.7 and Ceiling-Grid Structure Constructed From Modular-Type Systems Load Test, Section 39.8.

13.7 Modular-type system used for luminaire enclosures

13.7.1 An attachment plug or receptacle used to connect custom luminaires in a modular-type system structure shall not have a general- or specific-purpose configuration described in the Standard for Attachment Plugs and Receptacles, UL 498. The connection shall be keyed and interlocked.

13.7.2 Luminaire fixtures and attachments used with modular-type system construction shall comply with applicable requirements in Exhibition Display Lighting, Section 34.

13.7.3 A sign forming part of a modular-type system construction or as a separate component of a modular construction shall comply with applicable requirements in Hanging Signs, Section 10.3, Neon Signs, Section 34.2.5, and Light Boxes, 34.2.6.

13.8 Modular-type system used as hanging components

13.8.1 A hanging component forming part of a modular-type system construction or as a separate component of a modular construction shall comply with the applicable requirements in this Section and in Requirements Particular to Hanging Components, Section 10.

13.8.2 For a graphic substrate that is supported by elements of a modular-type system, the weight of the substrate material shall not be greater than 1 pound per square foot (5 kg/m^2).

14 Requirements Particular to Portable Exhibition Display Units

14.1 Other than the requirements in Sections 6, 11, 12, 24, 40, 64 and 65, a portable exhibition display unit, as described in 2.12, shall comply with the requirements in this standard.

15 Requirements Particular to Custom-Design Exhibition Display Unit

15.1 A custom-design exhibition display unit shall comply with the requirements in this Standard as they apply to the individual unit being investigated.

16 Flammability of Materials

16.1 All materials used in the construction of an exhibition display unit shall have a flame-spread index of 200 or less, and smoke-developed index of 200 or less when tested in accordance with Standard for Test for Surface Burning Characteristics of Building Materials, UL 723. Accessories such as wall hangings, display stands, and shelving are included with these construction materials and shall comply with this requirement.

Exception No. 1: This requirement does not apply to plywood and solid wood with a thickness of 3/8 inch (9.5 mm) or greater.

Exception No. 2: Decorative material that complies with 16.3 is not required to comply with this requirement.

Exception No. 3: Decorative foamed plastics that comply with the Standard for Fire Tests for Foamed Plastics Used for Decorative Purposes, UL 1975 are not required to comply with this requirement.

16.2 Samples are to be prepared for the test in accordance with the requirement for mounting methods in Standard for Test for Surface Burning Characteristics of Building Materials, UL 723.

16.3 A decorative molding, base cord channel cover, shelf, top cap, or similar part that is formed of polymeric material and is mechanically contiguous across and runs not less than the full width of one unit shall be Class V-0 or 5V in accordance with Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

Exception: A work surface trim Class HB or better complies with the requirement.

16.4 A molding connector, shelf, or similar part, consisting of painted metal or wood is able to be used without test.

16.5 Decorative plastic, painted steel, wood moldings, shelves, or similar parts, including contiguous parts, that constitute greater than 15 percent of the area on the front or back surface of an exhibition display unit, shall comply with the requirement in 16.1.

16.6 To determine the percentage specified in 16.5, a representative exhibition display unit or drawing is to be used. The representative exhibition display unit is to have front and back surface dimensions of 4 feet by 4 feet (1.22 mm by 1.22 mm). Decorative parts that are normally provided on an exhibition display unit are to be placed on the unit, or depicted on the drawing. The area is to be calculated using the two adjacent surfaces forming the largest area exposed after mounting the decorative part.

16.7 A polymeric material used to form a small decorative part or mechanical connector shall be classed HB or better, in accordance with Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

16.8 All exhibition display unit fabric and plastic film used as canopies, tents, awnings, curtains, draperies, or similar structures shall comply with the the Standard Method of Fire Tests for Flame Propagation of Textiles and Films, NFPA 701.

ELECTRO-MECHANICAL

17 General

17.1 Each electrical component of an exhibition display unit and insulated conductor shall have a voltage rating at least equal to the voltage that is applied to it during intended use. Each electrical component of an exhibition display unit shall have an ampere rating and each insulated conductor shall be sized for the maximum current to which it is subjected during intended use.

17.2 Conductors shall be fused or protected at a rating not greater than the conductors' rated ampacity.

17.3 A circuit breaker shall not have conductors tapped off the line side terminals of the circuit breaker. Conductors on the load side of the overcurrent protection, transformers, or current limiting devices shall be insulated.

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

17.5 The following components shall not be used on or in an exhibition display unit:

a) An open pin socket;

b) Duplex or triplex lamp cord wire in a display;

c) Two-wire cord;

Exception: Two-wire cord is able to be used with Class 2, low-voltage wiring.

d) Squeeze- or spring-loaded type lighting device;

e) An open attachment plug; and

f) A Class 1 low-voltage transformer without a secondary overcurrent protection device that is rated 5 A or greater.

17.6 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 exhibition display unit.

18 Mechanical Assembly

18.1 General

18.1.1 An exhibition display unit system shall be constructed so that when adjacent units are connected, disconnected, or moved to form varying angles with each other as during intended operation, a risk of fire, electric shock, or injury to persons is not introduced. See Sections 41, 42, 43.4, and 45 – 47.

18.1.2 A switch, attachment-plug receptacle, or other component that is intended to be handled by the user shall not turn, loosen, or otherwise become disengaged from its mounting panel.

18.1.3 Friction between surfaces shall not be used as the only means to reduce the risk of the turning and loosening specified in 18.1.2. For example, a lock washer that is applied as intended is a means to not allow a device having a single-hole mounting means to turn.

18.2 Cord channels

18.2.1 A cord channel shall be supported through individual exhibition display units and between mechanically contiguous parts of the unit.

18.2.2 Parts that make up a cord channel shall butt tightly together or overlap.

Exception No. 1: Where clearance is required for the placement of a component, such as the face of a receptacle or a similar component, the clearance shall not be greater than 0.03 inch (0.8 mm) between the component and the adjacent enclosure edge.

Exception No. 2: A clearance in the form of a slot, gap, or opening between a component and the adjacent enclosure edge not greater than 0.09 inch (2.3 mm) wide complies with the requirement when the cord channel is provided with a secondary cover that reduces the risk of entrance of debris.

18.3 Mechanical connectors

18.3.1 A mechanical connector shall be constructed to withstand the strain to which it is subjected during intended use.

19 Frame and Enclosure (Electrical and Mechanical)

19.1 General

19.1.1 An exhibition display unit shall be formed and assembled to have the strength, stability, and rigidity to resist the abuses to which it is subjected without resulting in a risk of fire, electric shock, or injury to persons. See Strength of Cord Channel Enclosure Tests (Electrical and Mechanical), Section 43.

19.1.2 A sheet-metal enclosure shall have a minimum thickness as specified in Tables 19.1 and 19.2.

Exception: A sheet-metal enclosure with a minimum thickness less than that specified in Tables 19.1 and 19.2 shall comply with Strength of Cord Channel Enclosure Tests (Electrical and Mechanical), Section 43.

Table 19.1
Thickness of sheet-metal for enclosures of carbon steel or stainless steel

Without supporting frame				With supporting frame or equivalent reinforcing				Minimum thickness[c]	
Maximum width[a]		Maximum length[b]		Maximum width[a]		Maximum length[b]			
Inches	(mm)	Inches	(mm)	Inches	(mm)	Inches	(mm)	Inches	(mm)
18.0	(457.0)	Not limited		27.0	(686.0)	Not limited		0.053	(1.3)
20.0	(508.0)	25.0	(635.0)	29.0	(737.0)	36.0	(914.0)	0.053	(1.3)
22.0	(559.0)	Not limited		33.0	(838.0)	Not limited		0.060	(1.5)
25.0	(635.0)	31.0	(787.0)	35.0	(889.0)	43.0	(1092.0)	0.060	(1.5)
25.0	(635.0)	Not limited		39.0	(991.0)	Not limited		0.067	(1.7)
29.0	(737.0)	36.0	(914.0)	41.0	(1041.0)	51.0	(1295.0)	0.067	(1.7)
33.0	(838.0)	Not limited		51.0	(1295.0)	Not limited		0.080	(2.0)
38.0	(965.0)	47.0	(1194.0)	54.0	(1372.0)	66.0	(1676.0)	0.080	(2.0)
42.0	(1066.8)	Not limited		64.0	(1625.6)	Not limited		0.093	(2.4)
47.0	(1193.8)	59.0	(1498.6)	68.0	(1727.2)	84.0	(2133.6)	0.093	(2.4)
52.0	(1320.8)	Not limited		80.0	(2032.0)	Not limited		0.108	(2.7)
60.0	(1524.0)	74.0	(1879.6)	84.0	(2133.6)	103.0	(2616.2)	0.108	(2.7)
63.0	(1600.2)	Not limited		97.0	(2463.5)	Not limited		0.123	(3.1)
73.0	(1854.0)	90.0	(2286.0	103.0	(2616.0)	127.0	(3226.0)	0.123	(3.1)

[a] The smaller dimension of a rectangular sheet-metal piece that is part of an enclosure. Adjacent surfaces of an enclosure that have supports in common and are made of a single sheet, comply with the requirement.

[b] Not limited applies only where the edge of the surface is flanged not less than 1/2 inch (12.7 mm) or fastened to adjacent surfaces not normally removed during use.

[c] The minimum thickness refers to the base material and does not include a coating thickness.

Table 19.2
Minimum thickness of sheet-metal for enclosures of aluminum, copper, or brass

Without supporting frame				With supporting frame or equivalent reinforcing				Minimum thickness	
Maximum width[a]		Maximum length[b]		Maximum width[a]		Maximum length[b]			
Inches	(mm)	Inches	(mm)	Inches	(mm)	Inches	(mm)	Inches	(mm)
18.0	(457.0)	Not limited		42.0	(1066.8)	Not limited		0.075	(1.9)
20.0	(508.0)	25.0	(635.0)	45.0	(1143.0)	55.0	(1397.0)		
25.0	(635.0)	Not limited		60.0	(1524.0)	Not limited		0.095	(2.4)
29.0	(737.0)	36.0	(914.0)	64.0	(1625.6)	78.0	(1981.2)		
37.0	(939.5)	Not limited		87.0	(2209.8)	Not limited		0.122	(3.1)
42.0	(1066.8)	53.0	(1346.2)	93.0	(2362.2)	114.0	(2895.6)		
52.0	(1320.8)	Not limited		123.0	(3124.2)	Not limited		0.153	(3.9)
60.0	(1524.0)	74.0	(1879.6)	130.0	(3302.0)	160.0	(4064.0)		

[a] The smaller dimension of a rectangular sheet-metal piece that is part of an enclosure. Adjacent surfaces of an enclosure that have supports in common and are made of a single sheet-metal piece, comply with the requirement.

[b] Not limited applies only where the edge of the surface is flanged not less than 1/2 inch (12.7 mm) or fastened to adjacent surfaces not normally removed during use.

19.1.3 A part such as a splice, tap, wire, transformer, capacitor, ballast, current-carrying part, or device with an exposed current-carrying part shall be contained in an enclosure constructed of metal, glass, ceramic, porcelain, or polymeric material so that the part is not accessible during routine maintenance and intended use.

Exception No. 1: A current-carrying part of a wiring device (such as the screw shell and center contact of a lampholder and 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 exhibition display unit 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 exhibition display unit other than at the connection point to internal components.

19.1.4 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, and not be so sharp as to result in a risk of injury to persons during intended use and maintenance of the product. Compliance shall be determined in accordance with the Standard for Test for Sharpness of Edges on Equipment, UL 1439.

19.1.5 A polymeric material used in the construction of an enclosure shall comply with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

19.2 Enclosures and guards

19.2.1 When the operation and maintenance of an exhibition display unit by the user or bystanders involves the risk of injury to persons, protection shall be provided to reduce the risk.

19.2.2 When investigating an exhibition display unit with respect to 19.2.1, conditions of foreseeable misuse shall be evaluated.

19.2.3 A functional attachment that is made available or specified by the manufacturer for use with an exhibition display unit shall be included in the investigation of the unit. Unless the manufacturer specifies the use of two or more attachments at the same time, only one attachment at a time is to be investigated with the exhibition display unit.

19.2.4 Whether a guard, a release, an interlock, or similar device is required and whether such a device performs its intended function shall be determined from an investigation of the complete exhibition display unit, its operating characteristics, and the 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.

19.2.5 The rotor of a motor, a pulley, belt, gear, fan, or other moving part that presents a risk of injury to persons shall be enclosed or provided with other means to reduce the risk of unintentional contact. Such a part shall not be contacted by the probe illustrated in Figure 21.1.

Exception: A part or portion of a part that is necessarily exposed to maintain functionality is not required to be enclosed. Guarding shall be provided when required. See 19.2.8.

19.2.6 During the investigation of an exhibition display unit to determine compliance with 19.2.5, the part of an enclosure that is removable without the use of a tool (to attach an accessory, to make an operating adjustment, or for other reasons) is to be opened or removed.

Exception: A part is not required to be opened or removed when the exhibition display unit is marked in accordance with 50.6.

19.2.7 Among the factors to be evaluated with respect to both intended operation of the exhibition display unit 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 a moving part;

c) The risk of unintentional contact;

d) The speed of the moving part; and

e) The risk that a part of the body is endangered or that clothing is able to be entangled by a moving part, resulting in a risk of injury to persons.

19.2.8 Features of guards that are to be evaluated include:

a) Removability without the use of a tool;

b) Removability for servicing;

c) Strength and rigidity;

d) Completeness;

e) Risk of injury to persons produced from elements of construction such as a pinch point;

f) Additional handling because of required service, such as cleaning, unjamming, or similar service; and

g) Self-restoring properties.

19.2.9 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.

19.2.10 When complete guarding of a moving part that results in a risk of injury to persons defeats the utility of an exhibition display unit, a control, such as a momentary contact switch, shall be provided and a marking shall be provided in the instruction manual warning the user of the potential risk. See 53.1.

19.2.11 The material of a part adjacent to a moving part involving a risk of injury to persons, or the breakage or deterioration of which results in a risk of injury to persons, shall have such properties as to withstand the expected loading conditions.

19.3 Cord channels of metallic materials

19.3.1 A metal cord channel employed as the enclosure for current-carrying parts and as the only means provided to reduce the risk of electrical components being mechanically damaged shall be of sheet-metal complying with the dimensions specified in Table 19.3, or of other sheet-metal providing protection for wiring equivalent to that provided by the sheet-metal specified in Table 19.3. Equivalency shall be determined by the equivalence of thickness tests specified in Strength of Cord Channel Enclosure Tests (Electrical and Mechanical), Section 43.

Exception: For a sheet-metal cord channel that is recessed or otherwise protected from mechanical abuse so that a 2-inch (50.8-mm) diameter sphere is not able to contact the cord channel, and has a minimum wall thickness as specified in Table 19.4 complies with the requirement.

Table 19.3
Dimensions of sheet-metal cord channel

Material	Minimum thickness							
	Break-off areas		Knockouts and other points of connection for a wiring system		Elsewhere than at break-off areas of points of connection for a wiring system		Maximum width of break-off areas	
	Inch	(mm)	Inch	(mm)	Inch	(mm)	Inch	(mm)
Steel or iron sheet or coil	0.017	(0.43)	0.036	(0.91)	0.025	(0.64)	1/32	(0.8)
Sheet aluminum	0.024	(0.61)	0.050	(1.27)	0.035	(0.89)	1/32	(0.8)

Table 19.4
Thickness of recessed metal cord channel

Material	Minimum thickness	
	inch	(mm)
Uncoated sheet steel	0.023	(0.58)
Sheet aluminum	0.029	(0.74)

19.3.2 A cord channel or fitting base shall have a uniform wall thickness throughout its entire length, other than at points of reduced thickness that facilitate removal of knockouts. Both inside and outside surfaces of each length of an iron or steel cord channel or fitting base shall be free of scale and rust and shall be in a condition that enables the protective coating to adhere firmly and have a smooth surface.

19.3.3 A metal cap or cover for a cord channel shall not be less than the thickness specified in Table 19.3, and shall comply with the applicable requirements in this Section.

19.3.4 A cast metal cord channel shall not be less than the thickness specified in Table 19.5.

Table 19.5
Thickness of cast metal cord channel

Material	Minimum thickness	
	inch	(mm)
Malleable iron	3/32	(2.4)
Iron other than malleable iron	1/8	(3.2)
Die-cast nonferrous:		
Part is ribbed or otherwise reinforced	1/16	(1.6)
Part is not ribbed or otherwise reinforced	3/32	(2.4)
Cast nonferrous other than die-cast	3/32	(2.4)

19.4 Cord channels of polymeric materials

19.4.1 A cord channel (for example, a snap-on wire router) employed or supplied for the purpose of routing the flexible cord of accessories or portable appliances used with the system shall:

a) Be securely fastened to and supported by a single unit or work surface of the system, or the equivalent;

b) Be smooth and free of burrs, sharp edges, or other projections that damage the insulation on the cord;

c) Provide for cord routing only from a work surface or similar area to a receptacle on the work surface or the unit to which the surface is mounted, or on an immediately adjacent exhibition display unit; and

d) Have provision without the use of tools, for the cord to be disconnected from the source of supply and examined for the entire length of the cord.

19.5 Barriers

19.5.1 The enclosure of a motor-operated exhibition display unit shall reduce the risk of molten metal, burning insulation, flaming particles, or similar materials from falling on combustible materials, including the surface upon which the exhibition display unit is supported, or on the floor of the exhibit facility.

19.5.2 With reference to 19.5.1, a switch, a relay, a solenoid, or similar device shall be individually and completely enclosed, other than 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 exhibition display unit enclosure. It also necessitates the use of a barrier:

a) Under a motor unless:

1) The structural parts of the motor or of the exhibition display unit 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 exhibition display unit 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) The motor is provided with a thermal motor protector that complies with the Standard for Rotating Electrical Machines – General Requirement, UL 1004-1, the Standard for Impedance Protected Motors, UL 1004-2 or the Standard for Thermally Protected Motors, UL 1004-3; or

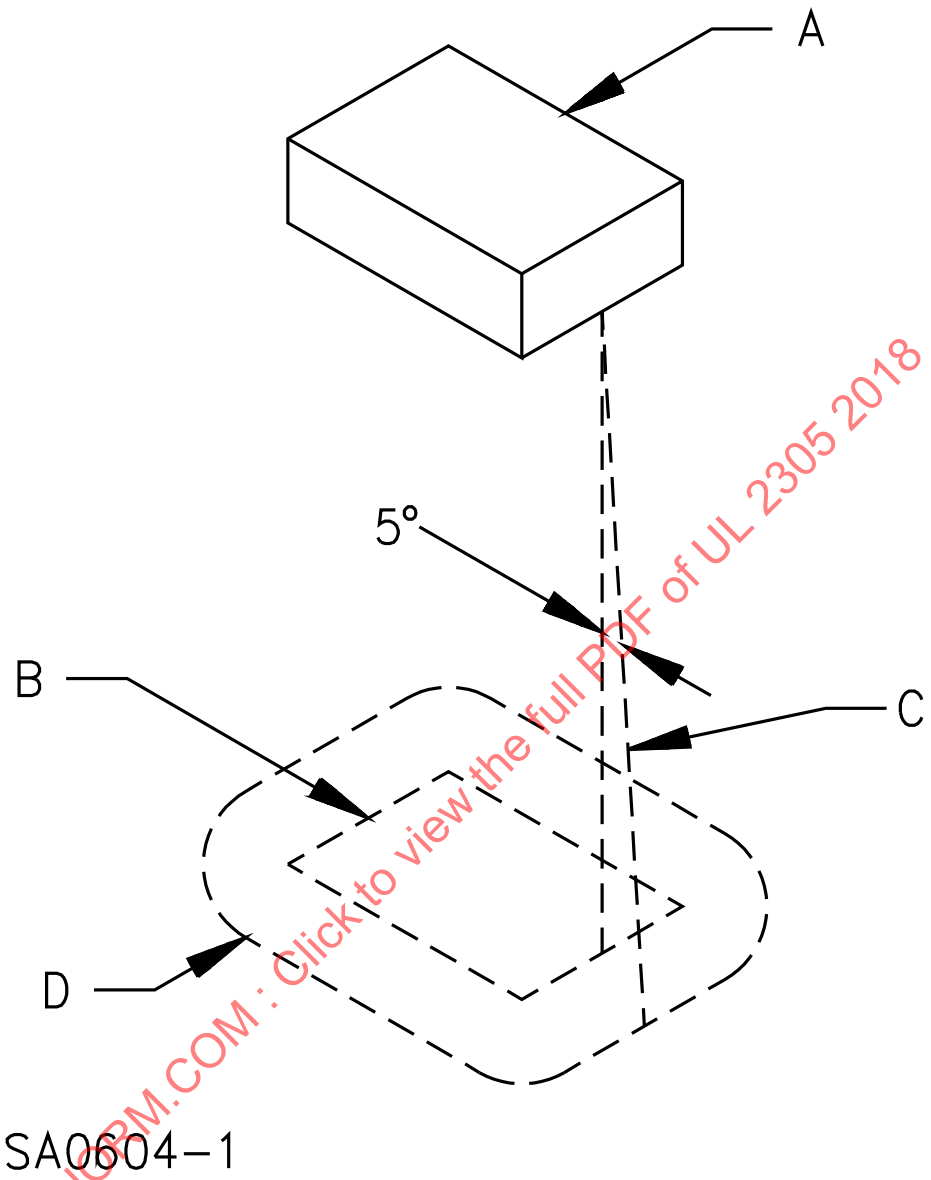
4) The motor complies with the Standard for Rotating Electrical Machines – General Requirement, UL 1004-1, the Standard for Impedance Protected Motors, UL 1004-2 or the Standard for Thermally Protected Motors, UL 1004-3, and the temperature of the motor winding is not greater than 150°C (302°F) during the first 72 hours of operation with the rotor of the motor locked.

b) Under wiring, unless it is neoprene, cross-linked polyethylene, or thermoplastic-insulated.

19.5.3 The barrier specified in 19.5.2 shall comply with the internal barriers section of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C and shall have a maximum comparative tracking index (CTI) of 3.

19.5.4 The barrier specified in 19.5.2 shall be horizontal, shall be located as illustrated in Figure 19.1, and shall have an area not less than that as determined in accordance with Figure 19.1. An opening that is intended for drainage or ventilation shall be such that molten metal, burning insulation, or similar material does not fall onto combustible material.

Figure 19.1
Location and extent of barrier



A – Region to be shielded by barrier. This consists of the entire component when it is not otherwise shielded and consists of the unshielded portion of a component that is partially shielded by the component enclosure or equivalent.

B – Projection of outline of component on horizontal plane.

C – Inclined line that traces out minimum area of barrier. The line is always tangent to the component, 5 degrees from the vertical, and oriented so that the area traced out on a horizontal plane is maximum.

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

19.6 Doors or covers

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

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

19.6.3 An opening provided for mounting an element of an exhibition display unit intended for mounting, shall be located or guarded such that a nail, hook, or similar part does not displace a part that creates a risk of fire or electric shock, and does not contact one of the following:

a) An uninsulated current-carrying part;

b) Magnet wire;

c) Internal wiring; or

d) Any other part that creates a risk of fire or electric shock.

20 Corrosion Protection

20.1 To reduce the risk of corrosion, a cord channel or fitting shall be enameled, galvanized, plated or similarly treated, when corrosion of such unprotected parts results in a risk of fire, electric shock, or injury to persons.

20.2 To reduce the risk of corrosion, an iron or steel part other than a cord channel or fitting shall be enameled, galvanized, plated or similarly treated, when corrosion of such unprotected 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.

20.3 To determine compliance with 20.1 and 20.2, ferrous-metal parts shall comply with Resistance To Corrosion Test, Section 47.

20.4 When deterioration of a liquid container provided as a part of an exhibition display unit 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.

21 Accessibility of Uninsulated Current-Carrying Parts and Film-Coated Wire

21.1 Current-carrying parts of an exhibition display unit shall be enclosed to reduce the risk of fire, electric shock, and injury to persons.

Exception No. 1: A part in a Class 2 circuit is not required to be enclosed.

Exception No. 2: A contact opening of a receptacle that complies with 23.1 is not required to be further enclosed.

21.2 To reduce the risk of unintentional contact involving a risk of electric shock from an uninsulated current-carrying part or film-coated wire, an opening in an enclosure shall comply with (a) or (b).

a) For an opening that has a minor dimension (see 21.6) less than 1 inch (25.4 mm), the uninsulated current-carrying part or film-coated wire shall not be contacted by the probe illustrated in Figure 21.1.

b) For an opening that has a minor dimension of 1 inch or more, the uninsulated current-carrying part or film-coated wire shall be spaced from the opening as specified in Table 21.1.

Exception: A motor is not required to comply with these requirements when the motor complies with 21.3.

Figure 21.1
Articulate probe with web stop

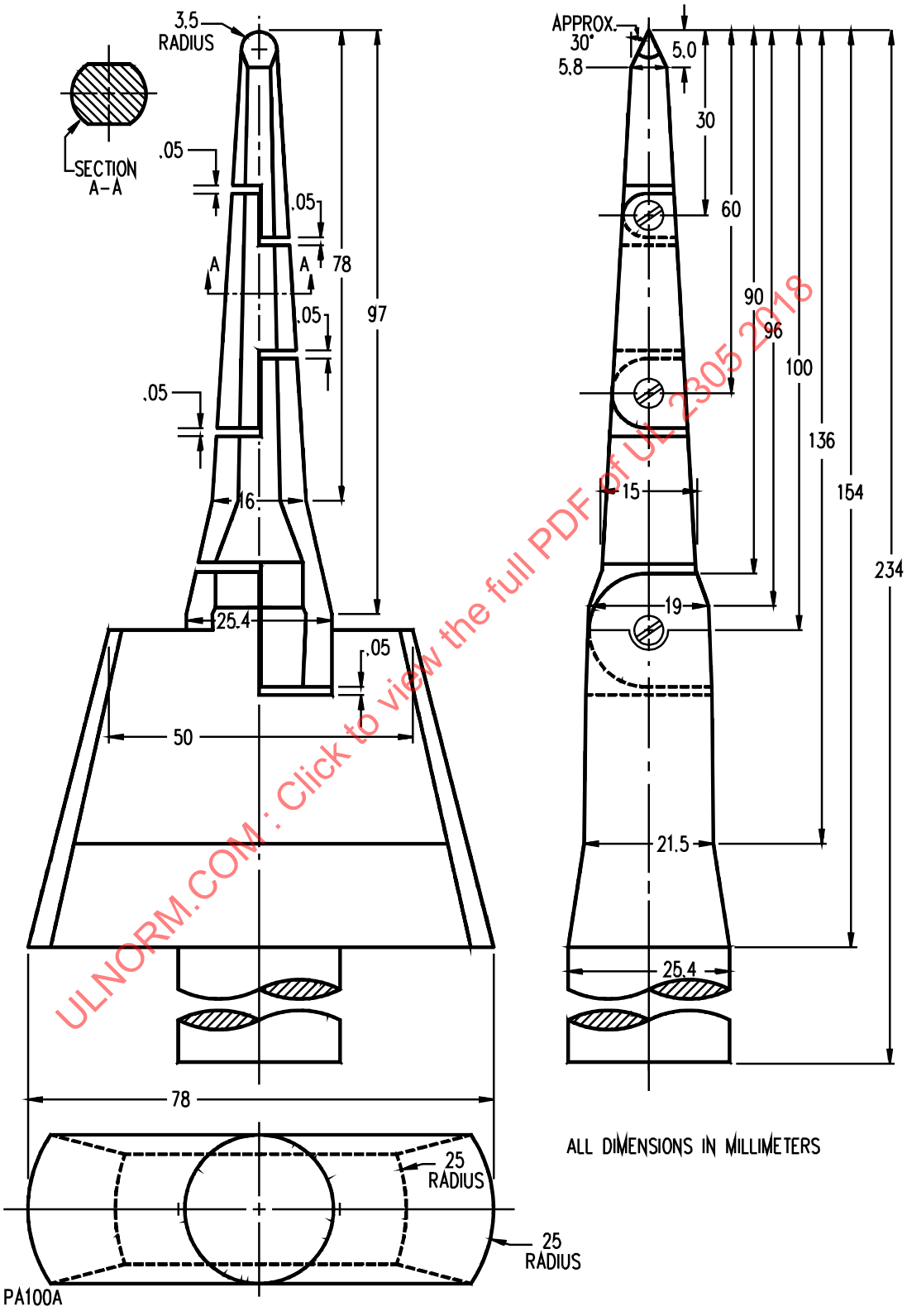


Table 21.1
Minimum required distance from an opening to a current-carrying part or film-coated wire involving a risk of electric shock

Minor 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]	(25.4)	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]		30	(762)

[a] See 21.6.

[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] Greater than 2-1/8 inches (54.0 mm), and not greater than 6 inches (152 mm).

21.3 With respect to a part or wire as specified in 21.1 and 21.2, in an integral enclosure of a motor as specified in the Exception to 21.2:

a) The use of an opening that has a minor dimension (see 21.6) less than 3/4 inch (19.1 mm) complies with the requirement when:

1) Film-coated wire is not able to be contacted by the probe illustrated in Figure 21.3;

2) In a directly accessible motor (see 21.7), an uninsulated current-carrying part is not able to be contacted by the probe illustrated in Figure 21.3; and

3) In an indirectly accessible motor (see 21.7), an uninsulated current-carrying part is not able to be contacted by the probe illustrated in Figure 21.2.

b) An opening that has a minor dimension of 3/4 inch or more is able to be used when an uninsulated current-carrying part or film-coated wire is spaced from the opening as specified in Table 21.1.

21.4 The probe specified in 21.1 – 21.3 and illustrated in Figure 21.1 – Figure 21.4 shall be applied to any depth that the opening enables, 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 21.1 and Figure 21.4 shall be applied in any possible configuration; and, when required, the configuration shall be changed after insertion through the opening.

21.5 The probes specified in 21.4 and 21.6 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. The probe shall be applied with the minimum force required to determine accessibility.

Figure 21.2
Tapered probe

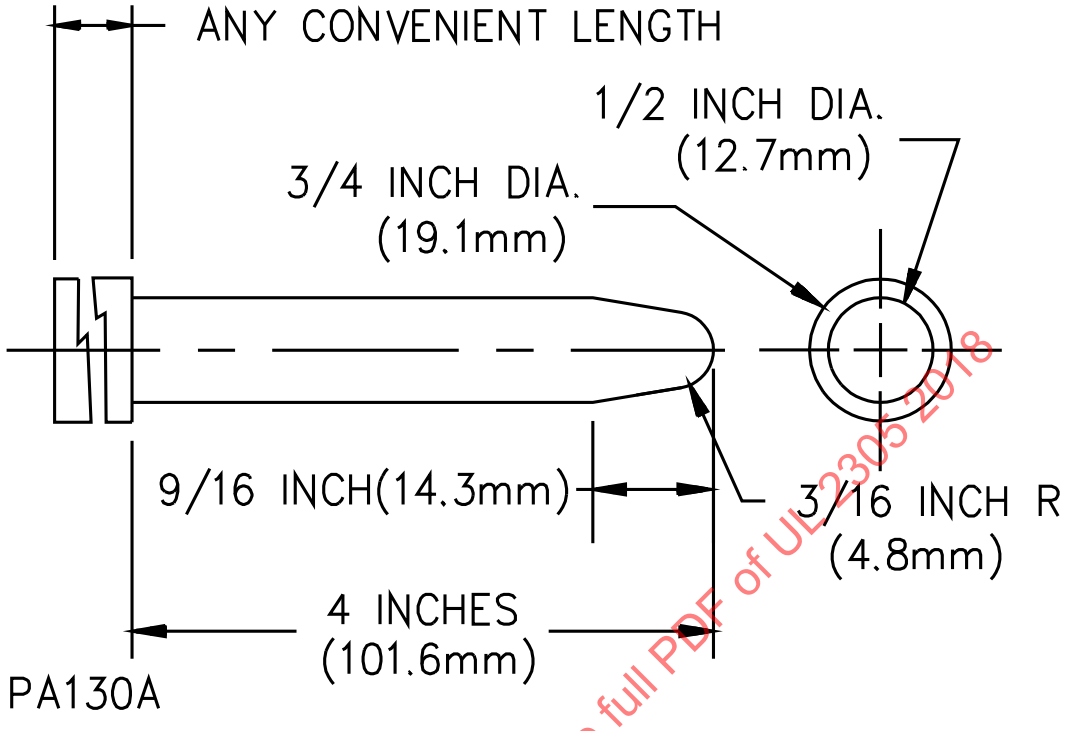


Figure 21.3
Radius probe

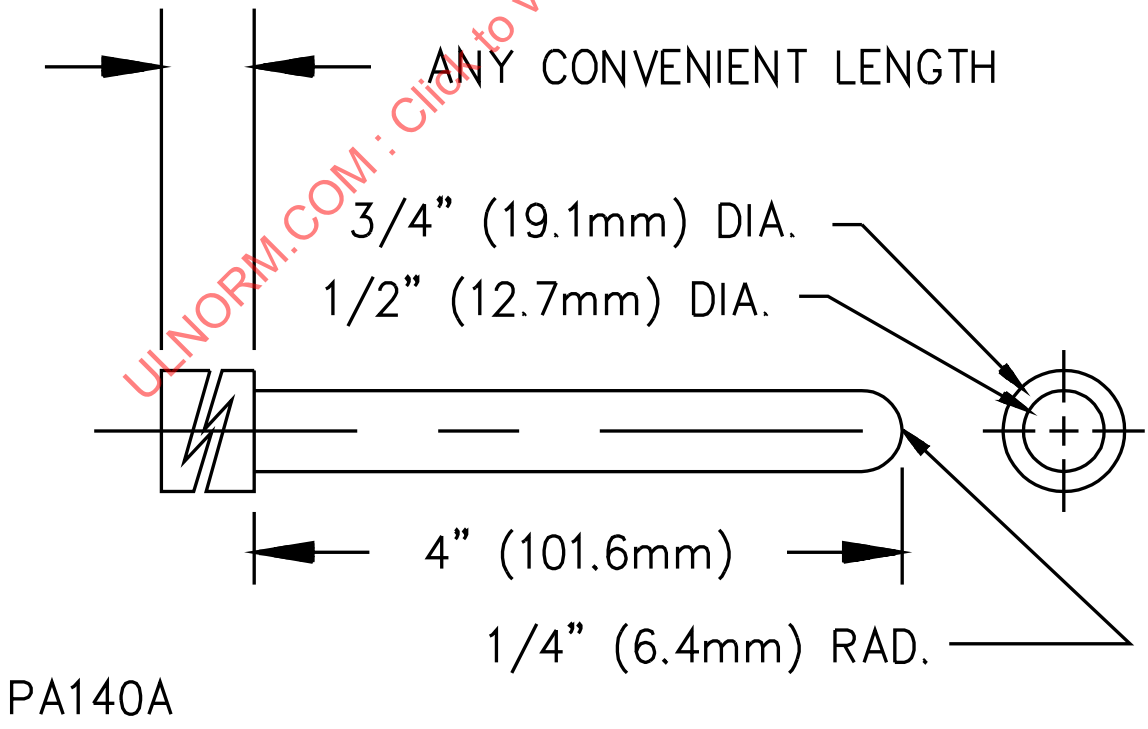
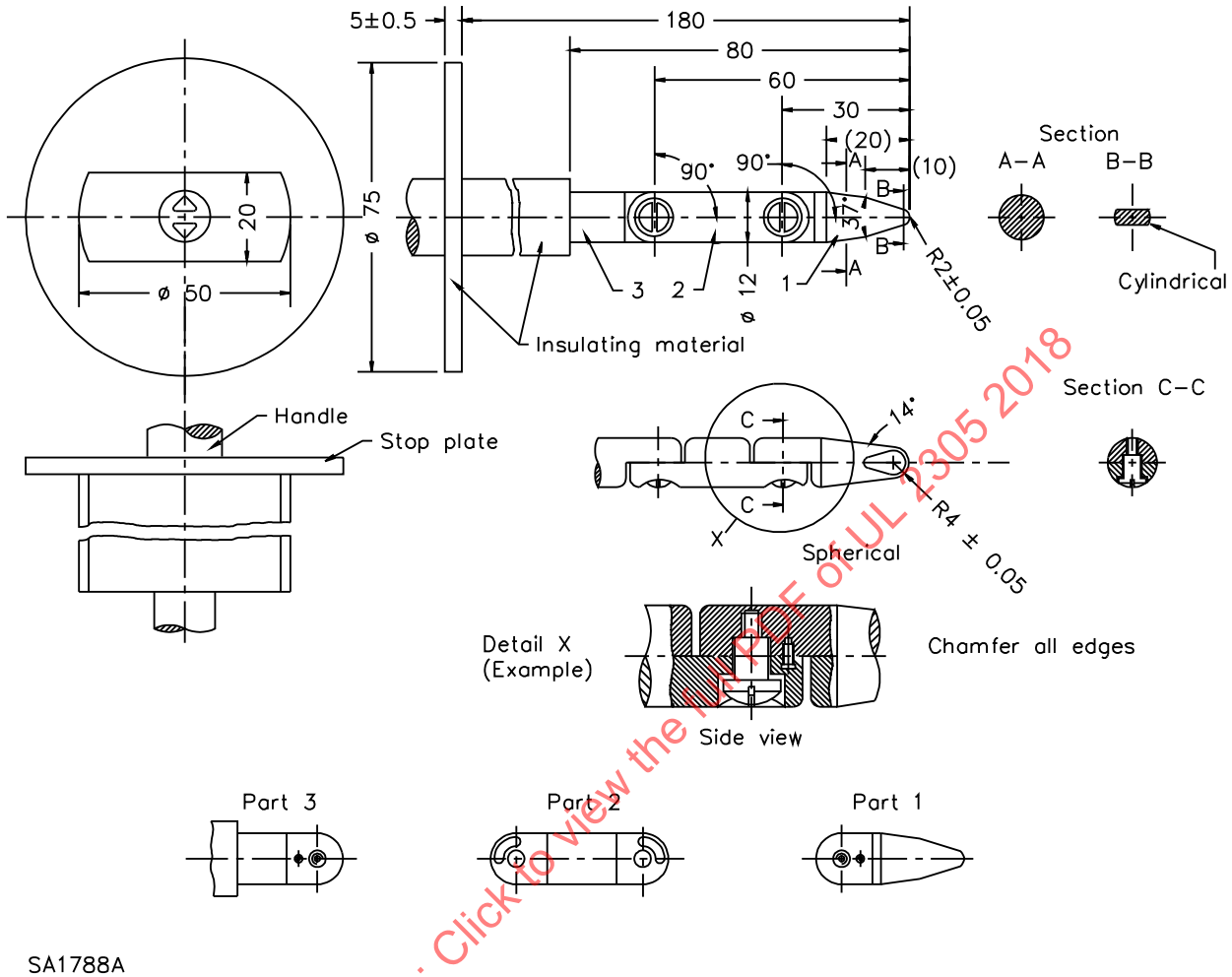


Figure 21.4
IEC articulate accessibility probe with stop plate



Note: All dimensions in millimeters

21.6 With reference to 21.1 – 21.3, 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.

21.7 With reference to 21.3, an indirectly accessible motor is a motor that is only accessible 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 the use of a tool. An indirectly accessible motor is also determined to be a motor that is located at such a height or is otherwise guarded or enclosed so that it is not contacted. A directly accessible motor is a motor that is able to be contacted without opening or removing any part or that is located where it is accessible to contact.

21.8 During the examination of an exhibition display unit to determine compliance with 21.1, 21.2 or 21.3, the part of the enclosure that is able to be opened or removed by the user without a tool (to attach an accessory, to make an operating adjustment, or for other reasons) is to be opened or removed.

21.9 With reference to 21.1 – 21.3, an insulated brush cap is not required to be additionally enclosed.

21.10 A cord channel enclosing uninsulated current-carrying parts shall be complete and shall require the use of a tool or tools to gain access to those parts.

21.11 A cord channel enclosing functionally insulated current-carrying parts shall be complete and reliably secured in place.

21.12 A snap-fit cover, a cover secured by 1-1/4 turn screws, or similar cover, that is secured to a rigidly-supported cord channel member and used as the enclosure of functionally insulated wiring complies with the intent of 21.1 when:

a) The cover:

1) Complies with Strength of Cord Channel Enclosure Tests (Electrical and Mechanical), Section 43; and

2) For metallic construction, is securely connected to the ground return path by means other than simple friction between surfaces; and

b) The cover and rigidly-supported cord channel together comply with one of the following:

1) The installation of communication or low-voltage cable or wiring does not require access to the enclosed functionally insulated wiring; or

2) Functionally insulated wiring that is accessible when installing communication or low-voltage wiring is reliably held in place so that it is not unintentionally displaced or require handling during the installation of the communication or low-voltage wiring.

22 Protection of Personnel

22.1 An uninsulated current-carrying part of a high-voltage circuit within the enclosure shall be located, guarded, or enclosed so as to reduce the risk of unintentional contact by persons performing service functions while the equipment is energized.

22.2 The requirements specified in 22.1 are not satisfied by a part of the enclosure that:

a) Is removed to provide access to a user to make intended operating adjustments; or

b) Is removed without the use of tools.

22.3 An electrical component that requires examination, replacement, adjustment, servicing, or maintenance while the product is energized shall be located and mounted with respect to other components and with regard to grounded metal so that the component is accessible for service. The access location for service shall not subject service personnel to the risk of electric shock from adjacent uninsulated high-voltage current-carrying parts.

22.4 The following are not identified as being uninsulated current-carrying parts:

a) Coils of relays and solenoids, and transformer windings, where the coils and windings are provided with insulating overwraps rated for the potentials encountered;

b) Terminals and splices with insulation rated for the potential encountered; and

c) Insulated wire.

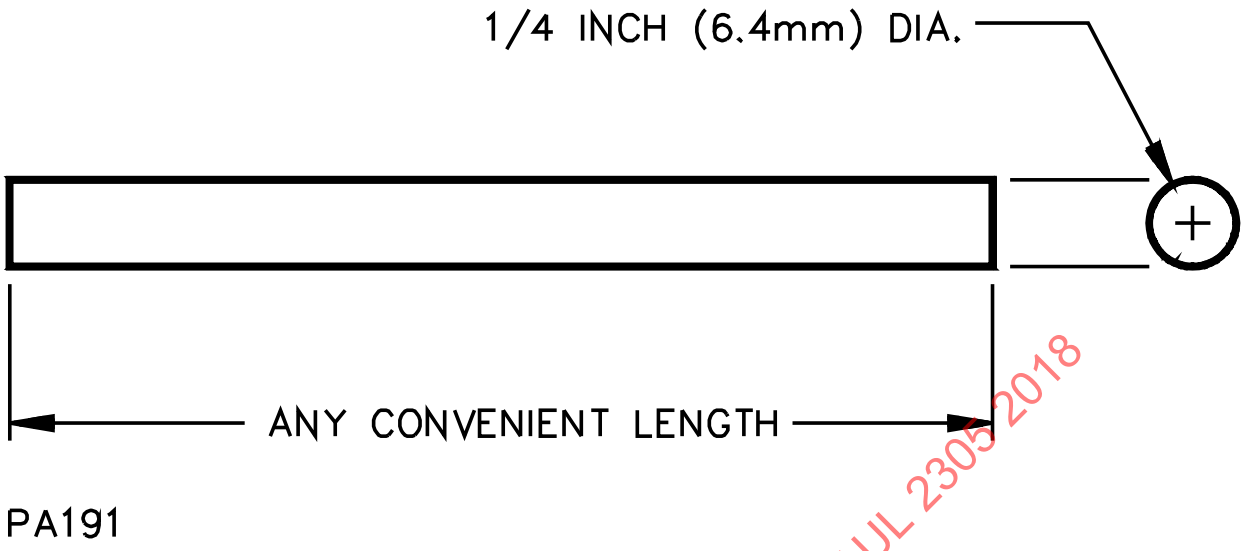
23 Contacts

23.1 A contact opening in a connector employed for quick assembly of power between two panels, between a panel and a top or base feed, or similar assembly, shall not allow the probe illustrated in Figure 23.1 to contact an uninsulated current-carrying part when:

a) An attempt is made to insert the probe through the contact opening; or

b) The mating plug is partially inserted into the connector.

Figure 23.1
Accessibility probe



24 Power Sources

24.1 A panelboard used for the control and protection of electric luminaires, appliance branch-circuits, and power-circuits, including feeder distribution panelboards, for an exhibition display unit shall comply with the requirements for the Standard for Panelboards, UL 67. Overcurrent protection shall be used at 80 percent of its rating, e.g., 100-ampere service shall only provide 80 amperes of power.

24.2 A circuit-breaker used within a panelboard or exhibition display unit shall not be greater than the maximum rating and shall comply with the Standard for Molded Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures, UL 489.

24.3 The ampere rating for a panelboard and exhibition display unit shall not be greater than 200 amperes for a supply voltage of 120/208 volts, and 400 amperes for a supply voltage of 480 volts.

25 Power-Supply Connections

25.1 General

25.1.1 An exhibition display unit shall have provision for connection of a wiring system in accordance with the National Electrical Code, NFPA 70.

25.1.2 A supply cable, fitting, and cable connector shall be constructed so that stresses that occur during the installation and intended use do not result in a risk of fire or electric shock. See Strain-Relief Test, Section 45.

25.2 Cord-connected exhibition display units

25.2.1 An exhibition display unit intended to be connected to the power-supply circuit of the exhibit facility by means of a flexible cord shall be provided with a flexible cord and an attachment plug for connection to the supply circuit.

Exception: An attachment plug is not required to be provided when the flexible cord is rated a minimum of 15 ampere and is intended to be wired at the exhibit facility with a specific plug arrangement or wired within a junction box.

25.2.2 The flexible cord specified in 25.2.1 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 25.1.

Table 25.1
Size of power-supply cord

Cord size (AWG)	Maximum rating, amperes	
	3 current-carrying conductors	2 current-carrying conductors
12	20	25
14	15	18
16	10	13
18	7	10

25.2.3 An exhibition unit provided with a convenience receptacle shall be provided with a 12 AWG (3.3 mm^2) cord when the product is rated 20 amperes or 14 AWG (2.1 mm^2) cord when the product is rated 15 amperes or less.

25.2.4 The attachment plug shall have a rating not less than the rated current of an exhibition unit, or the input current under maximum normal load conditions, whichever is greater, and a voltage rating equal to the rated voltage of the exhibition unit. When an exhibition unit is adaptable for use on two or more different values of voltage by field alteration of internal connections, the attachment plug provided with the exhibition unit shall be rated for the voltage to which the exhibition unit is connected when shipped from the factory.

25.2.5 A flexible cord intended to contact the floor shall be of a type intended for extra-hard usage, Type S, SO, SEO, ST or the equivalent.

Exception No. 1: The use of a flexible cord above floor level that is of the type intended for hard usage, Types SJ, SJT, SJO or SJTO, or the equivalent, complies with the requirement.

Exception No. 2: The requirement does not apply for a luminaire fixture, appliance, or other equipment that is part of a complete exhibition display unit, including the cord, that has been investigated and found to comply with the requirements for that equipment.

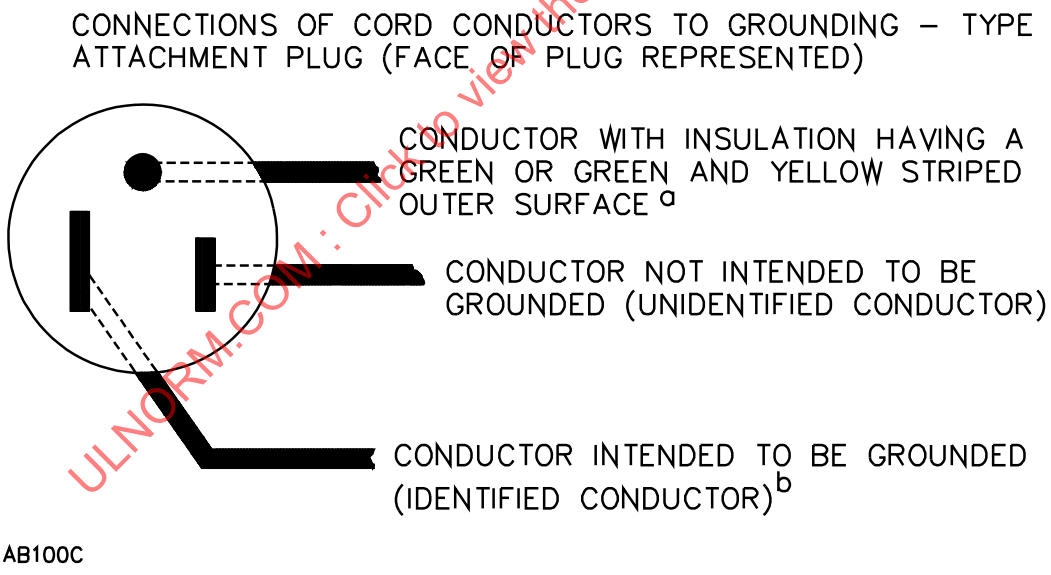
25.2.6 An exhibition display unit cord shall be a minimum of 36 inches (914 mm) in length as measured from the exit of the exhibition display unit or the point of strain-relief to the attachment plug face.

25.2.7 The attachment plug specified in 25.2.4 shall be of one of the configurations covered in the Standard for Wiring Devices – Dimensional Requirements, ANSI/NEMA WD6.

25.2.8 The attachment plug of an exhibition display unit intended to be connected to a nominal 120-volt circuit shall be a grounded polarized type.

25.2.9 The connections to the attachment plug shall be in accordance with Figure 25.1. The polarity identification of the supply cord shall be in accordance with Table 25.2.

Figure 25.1
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.

Table 25.2
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 A stripe, ridge or groove on the exterior surface of the cord	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 28.2.1 and Figure 25.1.
[b] The grounded conductor is the neutral supply conductor.
[c] Only for cords having no braid on any individual conductor.
[d] For jacketed cords.

25.2.10 An exhibition display unit that is required to employ a grounding-type polarized attachment plug, as specified in 25.2.8, and that is provided with a separate or detachable cord set, shall also employ a grounding-type polarized connector.

25.2.11 The exhibition display unit shall be constructed so that the cord or attachment plug is not damaged when the exhibition display unit is placed against a wall.

25.2.12 A flexible cord or cable shall be continuous and shall not be spliced.

25.2.13 A flexible multi-conductor cord or cable shall have a grounding conductor.

25.3 Strain relief

25.3.1 A strain-relief means shall be provided so that mechanical stress placed on a flexible cord or flexible conduit (such as a pull or twist) is not transmitted to terminals, splices, or internal wiring. Where a clamp is employed with a cord, auxiliary insulation is required where the clamp is able to damage the cord insulation.

25.3.2 To determine compliance with 25.3.1, a strain-relief means is to comply with the applicable tests specified in Strain-Relief Tests, Section 45.

25.3.3 Means shall be provided so that a flexible cord or flexible conduit is not able to be pushed into the product through the cord-entry hole.

25.3.4 A flexible cord or flexible conduit shall comply with Push-Back Relief Test, Section 46.

26 Separation of Circuits

26.1 Insulated factory-installed conductors in Class 2 or Class 3 circuits shall be separated from electric light, power supply, Class 1, and non-power-limited fire alarm circuit conductors by barriers:

a) When used in different internal wiring circuits; and

Exception: Conductors provided with insulation rated for the highest voltage involved is not required to be separated.

b) When uninsulated current-carrying parts are connected to different circuits.

26.2 With reference to 26.1, separation of internal conductors shall be accomplished by clamping, routing, or an equivalent means that provides a minimum permanent 1/4-inch (6.4-mm) separation from an insulated conductor or an uninsulated current-carrying part of a different circuit.

26.3 The equipment shall be constructed so that a field-installed conductor of any circuit shall be separated by a barrier from:

a) Field-installed conductors connected to any other circuit, unless:

1) Both circuits are Class 2 or Class 3, or both circuits are other than Class 2 or Class 3; and

2) Both circuits are insulated for the maximum voltage of either circuit.

b) Uninsulated current-carrying parts of any other circuit of the equipment, and from any uninsulated current-carrying parts that results in a risk of fire or electric shock when short-circuited.

c) Factory-installed conductors connected to any other circuit, unless the conductors of both circuits will be insulated for the maximum voltage of either circuit.

26.4 With reference to 26.3(a), when the intended uses of the equipment are such that in some applications a barrier is required while in some other applications a barrier is not required, a removable barrier or one having openings for the passage of conductors is not prohibited from being employed. Instructions for the use of such a barrier shall be a permanent part of the equipment. Complete instructions in conjunction with a wiring diagram shall be provided in lieu of a barrier when, upon investigation, the combination is determined to comply with these requirements.

26.5 Field-installed conductors are able to be separated from each other by arranging the location of the openings in an enclosure for the various conductors – with respect to the terminals or other uninsulated current-carrying parts – so that a minimum permanent 1/4-inch (6.4-mm) separation of the conductors is provided. This means of separation is also able to be used to separate field-installed conductors from uninsulated current-carrying parts or factory installed conductors of the device connected to different circuits.

27 Transformers

27.1 Transformers supplying Class 2 circuits or systems shall comply with the Standard for Low Voltage Transformers Part 1 General Requirements, UL 5085-1 and Low Voltage Transformers Part 3; Class 2 and Class 3 Transformers, UL 5085-3. The output of the Class 2 transformer shall not be greater than 100-volt amperes.

Exception: The use of a transformer with an output greater than 100-volt amperes complies with the requirement when the transformer is connected to a low-voltage distribution panel.

27.2 Plug-in type Class 2 transformers shall not be greater than 60-volt amperes.

27.3 With reference to the Exception to 27.1, the distribution panel shall not have circuits with ampere ratings greater than Class 2. The transformer and low-voltage distribution panel shall be wired in accordance with Class 1 specifications, and be housed in a enclosure rated for the application.

Exception: Wiring the load side of the distribution panel in accordance with Class 2 specifications complies with the requirement.

27.4 The primary installation of a low-voltage transformer shall be in accordance with Class I wiring. The transformer shall be installed in an enclosure rated for the application. The power-supply to the primary of the transformer or transformers, where not hard wired, shall have a 3-wire grounded cord with a mechanical connector intended for use with the cord.

28 Grounding and Bonding

28.1 Grounding

28.1.1 An exhibition display unit shall have provision for grounding in accordance with 28.1.3.

28.1.2 Exposed dead metal parts and dead metal parts within the enclosure that are exposed to contact during any user servicing operation and are able to become energized during or after a fault condition, shall be securely connected to the means for grounding.

28.1.3 The means for grounding for an exhibition display unit intended to be cord channel connected shall be an equipment-grounding terminal or lead. See 28.1.8.

28.1.4 The means for grounding for an exhibition display unit intended to be cord connected shall be provided in the power-supply cord.

28.1.5 The grounding conductor of a supply cord shall be secured to the frame or enclosure of the exhibition display unit 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 exhibition display unit by a qualified service representative. The opposite end of a grounding conductor of a cord-connected exhibition display unit shall be connected to the grounding member of an attachment plug.

28.1.6 A separable connection, such as that provided by an attachment plug and a mating connector or receptacle, shall be so that the equipment-grounding connection is made before connection to, and broken after 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 specified grounding connection.

28.1.7 When an exhibition display unit is intended to be grounded and is provided with means for separate connection to more than one power supply, each such connection shall be provided with a means for grounding.

28.1.8 A terminal intended solely for the connection of an equipment-grounding conductor shall secure a conductor of the size required in accordance with the National Electrical Code, NFPA 70.

28.2 Grounding identification

28.2.1 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.

28.2.2 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 marked in accordance with 50.7. The wire-binding screw or pressure wire connector shall be located so that it does not require removal during normal servicing of an exhibition display unit. A sheet-metal screw shall not be used for connection of an equipment-grounding conductor.

28.3 Bonding

28.3.1 A ground path for electrical current shall be provided between parts of a metal cord channel containing electrical parts or wiring.

28.3.2 Flexible metal conduit longer than 6 feet (1.83 m) shall not be relied upon for the ground path through an individual exhibition display unit or between parts of exhibition display units that are interconnected.

Exception: One continuous length of flexible metal conduit, not greater than 6 feet is able to be used for a single interconnection between separate parts of an exhibition display unit.

28.3.3 The grounding means through an individual exhibition display unit and between parts of exhibition display units that are interconnected during installation shall have an ampere rating not less than that of the power-supply conductors.

28.3.4 An exhibition display unit that employs quick-connect means for electrically connecting the branch-circuit power supply from unit to unit shall be constructed so that the grounding connection is made prior to or at the same time that all other supply connections are made.

28.3.5 A dead metal part that has the potential to become energized shall be bonded to the ground return path by means of a conductor with a wire gauge not smaller than the power-supply wires of the exhibition display unit.

Exception: A conductor with a wire gauge smaller than the supply wires and not smaller than 18 AWG (0.82 mm^2) complies with the requirement where the length is less than 6-inches (150 mm).

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29 Internal Wiring

29.1 The wiring and connection between parts within an exhibition display unit shall be enclosed. See Accessibility of Uninsulated Current-Carrying Parts and Film-Coated Wire, Section 21.

Exception: Cords are able to be used for the interconnection of units parts.

29.2 The cord length for components used in the exhibition display units and not connected to the wall receptacle shall be long enough to reach the next component and the cord shall be routed away from heat sources and protected from mechanical damage.

29.3 A hole through which insulated wires pass in a sheet-metal wall within the overall enclosure shall be provided with a smooth, rounded bushing or shall have smooth surfaces, free of burrs, fins, projections and sharp edges, upon which the wires bear to so that the insulation does not abrade.

29.4 Wiring shall be routed away from projections, sharp edges, screw threads, burrs, fins, moving parts, drawers, and similar parts so that the wire insulation is not abraded or otherwise damaged.

29.5 A metal clamp or tool used for routing internal wiring shall be provided with smooth, rounded edges. Auxiliary nonconducting mechanical protection shall be provided under a clamp at where pressure is exerted on an insulated conductor.

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

29.7 Internal wiring shall consist of wires of a type or types that comply when investigated with the intended conditions of use, such as flexibility, mechanical abuse, temperature, ampacity, and voltage.

29.8 Wires that are electrically connected between parts of an exhibition display unit and that have the flexibility to form various angles with respect to each other shall be stranded-conductor type.

Exception: The use of solid conductors between exhibition display units complies with the requirement when they form fixed angles and the cord channel enables the inspection and replacement of the wiring when configurations are changed.

29.9 Conductors from electric luminaire and power circuits shall be separated from conductors of low-voltage circuits by:

a) Enclosing the luminaire and power conductors in a separate wiring channel;

b) Providing a partition of grounded metal or material that complies with the requirements for internal barriers in Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C between conductors of the different systems when both systems are in the same cord channel;

c) Providing physical separation of not less than 1/4 inch (6.4 mm) between conductors of the different circuits. The separation shall be maintained during intended use, such as vibration; or

d) Insulation provided on conductors is rated for the highest voltage involved of any conductor.

29.10 A splice or connection shall be mechanically secure and provide electrical continuity. 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. A splice shall be provided with insulation equivalent to that of the wires involved.

29.11 Thermoplastic tape used as insulation shall not be wrapped over a sharp edge.

29.12 The effects of factors such as dielectric properties, normal-operating temperature, and similar characteristics shall be evaluated during the investigation to determine compliance of splice insulation consisting of coated-fabric, thermoplastic, or other type of tubing.

29.13 Stranded internal wiring that is connected to a wire-binding screw shall be connected so that loose strands of the wire does not reduce spacings, contact other current-carrying parts not always of the same polarity as the wire, and contact dead-metal parts. The strands of wire shall be restrained by means of a pressure-type spade terminal connector with turned-in or turned-up ends, a closed-loop connector, or other equivalent means.

29.14 Color-coded functional insulation shall be used for internal wiring. Each circuit shall be identified by a particular color. The grounded supply conductor shall be colored white or gray. An insulated grounding conductor shall be green or substantially green with one or more yellow stripes. Color coding of a supply conductor or conductors that are visible during installation shall be consistent for parts of the same exhibition display system.

Exception: Wiring is not required to be color coded where it is not accessible during intended use and maintenance of the system.

29.15 Low-voltage wiring shall be designated Class 1 or Class 2 in accordance with the National Electrical Code, NFPA 70. Low-voltage wiring that does not comply with the requirements for Class 2 wiring shall be installed in accordance with the requirements for Class 1 wiring.

30 Overcurrent Protection

30.1 Where current is limited in Class 2 circuits or systems by a means of overcurrent protection, such protection and its mounting means shall be rated for the application. Overcurrent protection of different ratings shall not be of the interchangeable type. An overcurrent-protective device integral to a transformer shall be rated for the application.

31 Switches and Controls

31.1 A switch or other control device shall have a current and voltage rating not less than that of the load that it controls.

31.2 In an exhibition display unit rated 125 or 125/250 volts or less, a switch or an overcurrent-protective device of the single-pole type, shall be electrically connected in the ungrounded conductor of the supply circuit.

31.3 A manually-operated motor-control switch shall be provided in a cord-connected motor-operated exhibition display unit that employs a motor rated 1/3 horsepower (250 W) or greater.

Exception: A manually-operated motor-control switch is not required for a motor when the exhibit facility provides for disconnection of the motor.

31.4 A switch that controls an incandescent lampholder of other than a pilot or indicating lamp shall be rated for use with tungsten-filament lamps.

Exception: Providing a switch integral with a lampholder complies with the requirement.

32 Convenience Receptacles

32.1 A receptacle provided for the connection of a small appliance, a work luminaire, or similar product, shall comply with the Standard for Attachment Plugs and Receptacles, UL 498.

32.2 A receptacle as specified in 32.1 shall be of a grounding-type configuration rated 125- or 250- volts, 15-amperes. The grounding contact of the receptacle shall be electrically connected to dead metal that is grounded when the exhibition display unit is in use.

32.3 A convenience receptacle shall be visible to the user.

Exception: The receptacle is not required to be visible where:

a) The receptacle is made visible by opening a hinged door or similar cover, or is located in an area not accessible to the public; and

b) The location of the receptacle does not result in abrasion of the power-supply cord of an appliance connected to the receptacle.

32.4 A convenience receptacle shall be oriented in a position so its face is in an upward vertical plane.

Exception: A convenience receptacle mounted with its face oriented on a horizontal plane complies with the requirement when the receptacle is located in an area not subject to damp or wet conditions.

32.5 The face of a receptacle shall:

a) Be flush with, or project from, faceplates or cord channel covers of insulating material; and

b) Project a minimum of 0.015 inch (0.38 mm) from faceplates.

32.6 A general-use receptacle rated for use on a nominal 120-volt circuit shall be of a grounding-polarized type. The grounded supply conductor (neutral) shall be connected to the terminal that is white in color or otherwise marked to indicate that it is intended for connection to the grounded supply conductor (neutral).

33 Motors

33.1 Construction

33.1.1 A motor shall be capable of handling the maximum normal load of the exhibition display unit without a risk of fire, electric shock, or injury to persons and shall comply with the Standard for Rotating Electrical Machines – General Requirement, UL 1004-1, the Standard for Impedance Protected Motors, UL 1004-2 or the Standard for Thermally Protected Motors, UL 1004-3.

33.2 Overload protection

33.2.1 A motor-operated exhibition display unit shall incorporate thermal or overload protection in accordance with the Standard for Rotating Electrical Machines – General Requirement, UL 1004-1, the Standard for Impedance Protected Motors, UL 1004-2 or the Standard for Thermally Protected Motors, UL 1004-3.

33.2.2 A motor rated 3/4 horsepower (559 W) or more shall be provided with a safety switch that complies with the Standard for Enclosed and Dead-Front Switches, UL 98.

34 Exhibition Display Lighting

34.1 General

34.1.1 A luminaire attachment shall be a minimum three-wire grounded connection, shall be rated for the intended use, and shall comply with requirements in the following Standards, as applicable:

a) The Standard for Luminaires, UL 1598;

b) The Standard for Low Voltage Lighting Systems, UL 2108;

Exception: The load side of a low-voltage lighting system is able to use a 2-wire connection.

c) The Standard for Portable Electric Lamps, UL 153;

d) The Standard for Track Lighting Systems, UL 1574; or

e) The Standard for Stage and Studio Luminaires and Connector Strips, UL 1573.

34.1.2 A Class 2 lighting system rated 30 volts or less, in accordance with National Electrical Code, NFPA 70, Article 411, shall be used as a complete system from one manufacturer and shall not be used with parts of a lighting system produced from a different manufacturer.

34.1.3 With respect to 34.1.1(c), a squeeze- or spring-loaded type lighting device or a two-wire cord shall not be used in exhibition display unit lighting.

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34.1.4 An attachment cord shall have conductors not smaller than 18 AWG (0.82 mm^2).

34.1.5 An attachment cord shall be routed away from sharp edges, burrs, fins, moving parts, and similar parts, that present a risk of abrading or otherwise damaging the attachment cord.

34.1.6 All transformer secondary gas tube oil (GTO) wiring shall not be greater than the transformer manufacturer's length specifications and shall be installed in cord channels and enclosures rated for the application.

34.1.7 Conductors with wiring above 600 volts shall be installed in a conduit, electrical metallic tubing, or flexible metal conduit. Insulated bushings that comply with the Standard for Insulating Bushings, UL 635 shall be used where the gas tube cable enters or leaves the conduit or tubing.

34.2 Lampholders and lamps

34.2.1 General

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

34.2.1.2 A luminaire shall be constructed such that lamps are replaceable without disturbing any supply wires, or without subjecting any other wiring, component, or part to mechanical damage.

34.2.1.3 A lampholder shall have a ceramic-porcelain or molded composition type of neck shell.

34.2.1.4 A lampholder shall be equipped with a guard attached to the lampholder or the handle where a spotlight or lamp is subject to physical damage, damp places, or comes into contact with combustible material.

34.2.2 Incandescent

34.2.2.1 A lamp-supported lampholder shall be provided with stranded wiring.

34.2.2.2 The screwshell or screwshell contact of an Edison-screw lampholder shall be connected to the terminal or lead that is intended to be connected to the grounded conductor of the power-supply circuit or the grounded conductor of the power-supply cord.

34.2.3 Fluorescent

34.2.3.1 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 and the rating is greater than the marked secondary voltage to ground, the rating of the lampholder is able to be less than the marked output voltage.

34.2.4 Ballasts

34.2.4.1 A fluorescent luminaire shall use a Class P ballast. A luminaire is able to use:

a) A single simple Class P reactance-type ballast without a power-factor correction capacitor in series;

b) A single Class P ballast with an output voltage not greater than 150 volts; or

Exception: A ballast with an output voltage in excess of 150 volts is able to be used when:

1) An output voltage marked on the ballast is not over 300 volts; and

2) An equipment-grounding conductor is provided.

c) More than one ballast as specified in (a) or (b) when the spacing between any two ballasts is not less than 1 inch (25.4 mm) when arranged end-to-end and not less than 4 inches (102 mm) when arranged otherwise.

34.2.4.2 When an external ballast is connected in the power-supply cord, the overall length of the power-supply cord, including the ballast, shall not be less than 5 feet (1.52 m), and the ballast shall not be less than 24 inches (610 mm) from the attachment plug.

Exception: When a direct plug-in ballast is used, the overall length of the power-supply cord shall not be less than 5 feet from the point where the power-supply cord emerges from the body of the luminaire to the ballast.

34.2.5 Neon signs

34.2.5.1 A neon sign display that is erected 8 feet (2.44 m) or less above the floor of the exhibit facility shall have a plexiglass shield that does not allow access to neon tubing from the front of the sign. The shield shall be mounted and arranged to provide for ventilation and protection.

34.2.6 Light boxes

34.2.6.1 A lightbox shall comply with the applicable requirements in this standard and with the lighting requirements in 34.1 and 34.2.

35 Spacings

35.1 Other than at wiring terminals, the spacing between uninsulated current-carrying parts of opposite polarity and between an uninsulated current-carrying part and a dead 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 35.1.

Exception No. 1: The inherent spacings of a component of the exhibition display unit, 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 35.8.

Table 35.1
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 current-carrying 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 dead metal part complies with the requirement.

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

35.3 When an isolated dead metal part is interposed between, or is in close proximity to, current-carrying parts of opposite polarity, to a current-carrying part and an exposed dead metal part, or to a current-carrying part and a dead metal part that is able to be grounded, the spacing shall not be less than 3/64 inch (1.2 mm) between the isolated dead metal part and any one of the other parts previously specified, when the total spacing between the isolated dead metal part and the two other parts complies with the value specified in Table 35.1.

35.4 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 located so that the intended functioning of the barrier or liner is not affected by arcing.

Exception No. 1: The use of vulcanized fiber not less than 1/64 inch (0.4 mm) thick in conjunction with an air spacing of not less than 50 percent of the spacing required for air alone complies with the requirement.

Exception No. 2: The use of thinner vulcanized fiber or other insulating material complies with the requirement, when the fiber complies with the Internal Barriers section of Standard for Polymeric Materials – Use in Electrical Equipment Evaluation, UL 746C.

35.5 All uninsulated current-carrying parts connected to different line- or low-voltage circuits shall be spaced from one another as though they were parts of opposite polarity, in accordance with 35.1 and 35.8 and shall be investigated on the basis of the highest voltage involved.

35.6 The spacing between uninsulated current-carrying parts of opposite polarity and between uninsulated current-carrying parts and dead metal that is able to be grounded during service is not specified for parts of low-voltage circuits, Class 2 circuits.

35.7 The spacing between wiring terminals of opposite polarity, and between a wiring terminal and any other uninsulated metal part – dead or current carrying– not of the same polarity, shall not be less than that specified in Table 35.2.

Table 35.2
Spacings at wiring terminals

	Minimum spacings					
	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	
Potential involved, volts	Inch	(mm)	Inch	(mm)	Inch	(mm)
250 or less	1/4	(6.4)	1/4	(6.4)	1/4	(6.4)
Greater 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] The use of a spacing not less than 3/8 inch (9.5 mm), through-air and over surface, complies with the requirement at wiring terminals in a wiring compartment or terminal box when the compartment or box is integral with a motor.

35.8 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 35.2 when these devices are positioned so that minimum spacings between opposite polarity and dead metal exist.

36 Mating Connectors

36.1 Wiring connections shall be configured so that the receptacle is the energized member. When disconnected, the exposed blades of the plug shall not be energized.

36.2 Mating connectors:

a) Shall be reliably keyed by a physical or mechanical means to maintain correct polarity consistent with the wiring diagram on the power-feed of connected parts and the intended interconnection of parts.

b) Shall be rated for the application.

c) Shall comply with the direct-support requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. Connectors totally enclosed in a metal cord channel shall be Class HB or better and connectors not so enclosed shall be Class V-2 or better in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

Exception: This requirement does not apply to connectors that comply with the Standard for Attachment Plugs and Receptacles, UL 498.

d) Shall have the grounding-terminal conductors connect before or at the same time mating supply conductors connect when two or more connectors are being mated as intended. During disconnection of mating connectors, the supply conductors shall disconnect before or at the same time the grounding conductor disconnects.

e) Shall not subject mating parts to tension during intended use of the product.

f) Shall be latched or otherwise secured together to provide electrical continuity between mating parts.

37 Electrical Insulation Material

37.1 An insulation material shall have a Performance Level Category (PLC) that is not greater than the value specified in Table 37.1. The specified values are derived from the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Exception: This requirement does not apply to an insulation material used in Class 2 circuits.

37.2 The base for a ceramic-type fixture shall not be less than 1/2 inch (12.7 mm) thick.

37.3 A live screw head, rivet, or nut on the underside of a base intended for surface mounting shall be countersunk not less than 1/8 inch (3.2 mm) in the clear, and covered to a depth of not less than 1/8 inch with a waterproof, insulating sealing compound that does not soften at a temperature of 90°C (194°F) as determined by the Test for Softening Point by Ring and Ball Apparatus in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

Exception No. 1: The test is not required for a thermosetting material.

Exception No. 2: A sealing compound is not required where the screw or nut is not able to be loosened by the following means:

a) By being staked or upset; or

b) By a lockwasher, or by other means;

37.4 With respect to 37.3, Exception No. 2, sealing compound is not required for a screw or nut that is insulated from the mounting surface by material other than sealing compound. Sealing compound is also not required for a screw or nut that is spaced through-air from the mounting surface not less than indicated in Tables 35.1 and 35.2.

Table 37.1
Maximum performance level category (PLC) for insulation materials other than insulating barriers

Test specified[a]	Flammability rating of material[b]			
	V-0	V-1	V-2	HB
Comparative Tracking Index Under Moist Conditions (CTI)[c,d]	3[e]	3[e]	3[e]	3[e]
High-Current Arc Resistance to Ignition (HAI)[d,f]	3	2	2	1
Hot-Wire Ignition (HWI)[d,f]	4	3	2	2

[a] The following parameters shall be evaluated:

Property	Tests	Method[d]	Units	Minimum levels related to flammability classification
Distortion Under Load and Mold Stress Relief	Heat Deflection Temperature, or	UL 746A	Minimum °C	10°C greater than use temperature and not less than 90°C, or
	Vicat Softening Point, or	UL 746A	Minimum °C	25°C greater than use temperature and not less than 105°C, or
	Ball Pressure Temperature	UL 746A	Minimum °C	Greater than the use temperature by the difference between 40°C and the ambient, and not less than 95°C

[b] These flammability ratings are derived from the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

[c] Refer to figurative examples 1 and 2 of Figure 37.1 for application of this requirement.

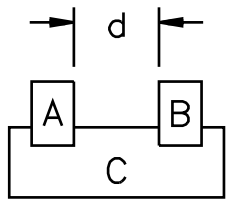
[d] See the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A, for this specified test.

[e] For a voltage of 250 volts or less, the use of a material having a comparative tracking index PLC complies.

[f] Refer to figurative examples 1 – 3 of Figure 37.1 for application of this requirement.

Figure 37.1
Figurative examples for performance level category

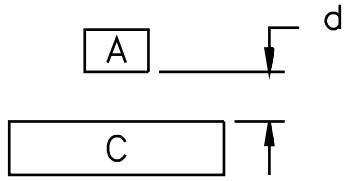
1.



In which:

d < 1/2 inch (12.7mm)
d = over-surface spacing requirement

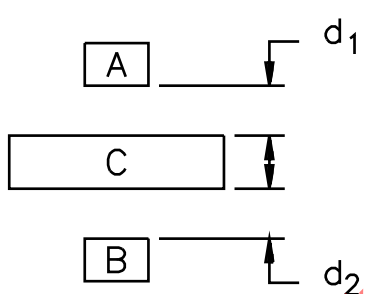
2.



In which:

d < 1/2 inch
d = through-air spacing requirement

3.



In which:

d_1, d_2 = Through-air spacing
$d_1 + d_2 < Sa$

and Sa = Applicable through-air spacing requirement

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A – An uninsulated current-carrying part.

B – One of the following:

1) An uninsulated current-carrying part having a difference in potential from part A; or

2) A dead metal part that is able to be grounded in service or that is exposed to contact.

C – The polymeric material being investigated.

PART II – PERFORMANCE

PERFORMANCE TESTS

38 Glass Panel Tests

38.1 Impact test

38.1.1 With reference to 7.1(b), as a result of the test specified in 38.1.2, a glass panel shall not crack or break to the extent that a piece of panel is released or drops from its normal position.

38.1.2 A solid steel sphere 2 inches (50.8 mm) in diameter and weighing 1.18 pounds mass (0.54 kg) is to fall through the distance required to strike the surface with an impact of 5 foot-pounds (6.8 J). The sample is to be supported by an exhibition display unit or clamped in a position simulating intended use without restricting possible movement of components on the side opposite the impacts.

38.2 Retention test

38.2.1 As a result of the test specified in 38.2.2, a glass panel shall not become dislodged or displaced from its mounting means.

38.2.2 The glass panel is to be mounted in the intended manner. A sand-filled ball having a 30.0 ±0.5 inch (762 ±12.7 mm) circumference and a weight of 20 pounds (9.07 kg) is to fall as a pendulum through the distance that produces a 35 foot-pounds (47.4 J) impact on any point on the panel.

39 Modular-Type Systems Tests

39.1 90 degree (tee) connection of modular-system elements slip resistance test

39.1.1 A part of an exhibition display unit, constructed from a modular-type system where a 90 degree angle is formed from the connection of a horizontal element connected between two vertical elements, shall be tested as specified in 39.1.2 and 39.1.3. For the test, the exhibition display unit is to rest in a vertical orientation on a smooth, solid horizontal surface.

39.1.2 The horizontal element shall not slip out of the groove of the vertical element when a 200 pound (90.7 kg) dead-load weight is applied to the element. The weight is to be applied evenly on the horizontal element of the angled structure.

39.1.3 The horizontal element shall not slip out of the groove of the vertical element when a 100 pound (45.4 kg) dead-load weight is applied to the element. The weight is to be applied at various points along the horizontal element, including at the point where the horizontal element connects with the vertical element of the angled structure.

39.2 90 degree (tee) connection of modular-system elements pull-out strength test

39.2.1 A part of an exhibition display unit, constructed from a modular-type system where a 90 degree angle is formed from the connection of a horizontal element and a vertical element, shall be tested as specified in 39.2.2. The horizontal element shall not disconnect (pull-out) from the vertical.

39.2.2 For the test, the exhibition display unit is to rest in a vertical orientation on a smooth, solid horizontal surface. A tensile force of 440 pound (221 N) is to be applied directly to the point of connection of the vertical and horizontal elements.

39.3 90 degree (tee) connection of modular-system elements twisting-moment test

39.3.1 A part of an exhibition display unit, constructed from modular system elements where a 90 degree angle is formed from the connection of a horizontal element and a vertical element, shall be tested as specified in 39.3.2. The horizontal and vertical elements shall not become deformed or damaged to a degree that the element is not able to be used in future structural configurations.

39.3.2 For the test, the exhibition display unit is to rest in a vertical orientation on a smooth, solid horizontal surface. A torque of 450 pound force per inch (50.8 N•m) is to be applied directly at the point of connection of the vertical and horizontal elements by means of a torque converter, dynamometer, or similar means. The testing device is to be applied as close to the point of connection of the vertical and horizontal elements that the testing device enables.

39.4 End-to-end (splice) connection of modular-system elements deflection test

39.4.1 A part of an exhibition display unit, constructed from modular system elements where two elements are spliced end-to-end, shall be tested as specified in 39.4.2. The two elements shall not separate and shall not deflect a greater distance than 0.4 inch (10.2 mm).

39.4.2 For the test, the two opposing ends of the horizontal element that includes the splice shall be suspended as intended for use. A direct downward force of 45 pounds (200 N) is to be applied directly to the spliced joint through a rod having a 1/2 inch by 1/2 inch (12.7 mm by 12.7 mm) flat steel face and the deflection distance from the horizontal element is to be measured.

39.5 End-to-end (splice) connection for modular-system elements pull-out strength test

39.5.1 A part of an exhibition display unit, constructed from modular system elements where two elements are spliced end to end, shall be tested as specified in 39.5.2. The spliced joint shall not separate.

39.5.2 For the test, the exhibition display unit is to rest in a vertical orientation on a smooth, solid horizontal surface. The end opposite the point of the application of force shall be fixed to a vertical support in the manner as intended for use. A pull-out force of 220 inch pound-force (24.9 N•m) is to be applied for 1 minute to both elements forming the splice joint.

39.6 Cantilever constructed from modular-type systems load test

39.6.1 A part of an exhibition display unit, constructed from modular system elements, and forming a cantilever structure, shall be tested as specified in 39.6.2. The cantilever structure shall not separate from the main structure or deflect a greater distance than 0.4 inch (10.2 mm).

39.6.2 For the test, the exhibition display unit is to rest in a vertical orientation on a smooth, solid horizontal surface. A 45 pound (20 kg) dead-load weight is to be applied directly to the point on the cantilever structure that is furthest from the main structure. The deflection distance from the horizontal element is to be measured.

39.7 Ceiling-grid structure constructed from modular-type systems deflection test

39.7.1 A ceiling-grid structure, as described in 13.6.2, shall be tested as specified in 39.7.2. The ceiling-grid shall not deflect a greater distance than 0.4 inch (10.2 mm) under its own weight when mounted as intended for use.

39.7.2 For the test, the ceiling grid structure is to be assembled as specified in the manufacturers instructions and mounted as intended for use and the deflection distance from the horizontal member shall be measured.

39.8 Ceiling-grid structures constructed from modular-type systems load test

39.8.1 A ceiling-grid structure, as described in 13.6.2, shall be tested as specified in 39.8.2. The ceiling-grid structure shall not deflect more than 0.4 inch (10.2 mm).

39.8.2 For the test, the ceiling grid structure is to be assembled as specified in the manufacturers instructions and mounted as intended for use. A 285 pound (129 kg) dead-load weight is to be applied to the center of the ceiling grid structure.

40 Stability Tests Particular to Towers

40.1 General

40.1.1 A tower as described in 2.31 shall be tested as described in 40.2 and 40.3. The tower shall not tip over or incur damage that presents a risk of fire, electric shock, or injury to persons. Additional tests are required to evaluate individual features that create additional weights or moments when the tower is extended.

40.1.2 Instruction manuals and other literature provided by the manufacturer are to be investigated to determine tower configurations that are implicitly or explicitly specified. Configurations that are the least stable are to be determined and used for the tests described in this Section. The results of the tests on the least stable configuration is determined to be representative of all other configurations. Figures 40.1 and 40.2 illustrate a typical test configuration.

40.1.3 The configuration of the tower to be tested is to be assembled on a smooth hardwood surface or on a carpet as described in 40.1.4 in accordance with the manufacturer's instruction manual, whichever is determined to be a more severe condition of use. When provided, the glides, feet, casters, 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 tower.

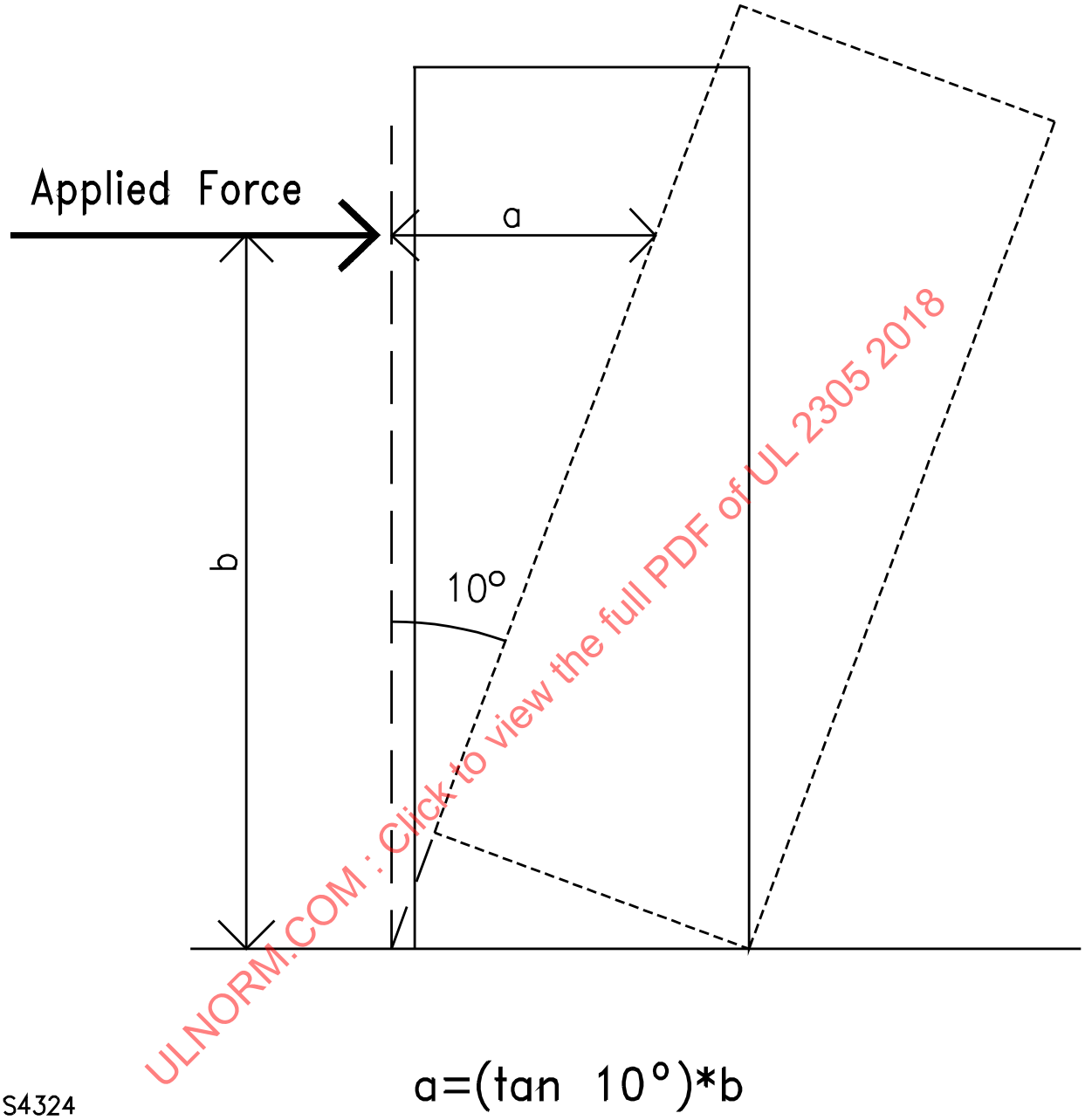
40.1.4 The carpet employed for tests is to be level-looped, woven-through-the-back type, having a 216 pitch, eight wires per 1 inch (25.4 mm), 1/4 inch (6.4 mm) high three-ply wool yarn fiber pile. The carpet is to have a finished weight of 74.7 ounces per square yard (2.5 kg/m^2), consisting of a face weighing 43.9 ounces per square yard (1.5 kg/m^2), and backed by a synthetic and jute material weighing 15.4 ounces per square yard (0.5 kg/m^2). The use of an alternative test carpet that provides equivalent performance characteristics to the carpet described for this test, complies with the intent of this requirement. The carpet is to be installed over 60 – 68 ounces per square yard (2.0 – 2.3 kg/m^2) sponge rubber padding.

40.1.5 Each test tower is to be loaded and tested using the configuration that results in the least stable condition with the maximum and minimum weight specified in the manufacturer's instruction manual.

40.2 Force stability test

40.2.1 The configuration is to be subjected to a gradually increasing horizontal force applied through the center of an 8-inch (203-mm) diameter disc at any location centered along a horizontal line of the tower. The force is to be increased until the tower inclines to an angle of 10 degrees without tipping over. The force is then to be gradually reduced to zero. See Figure 40.1

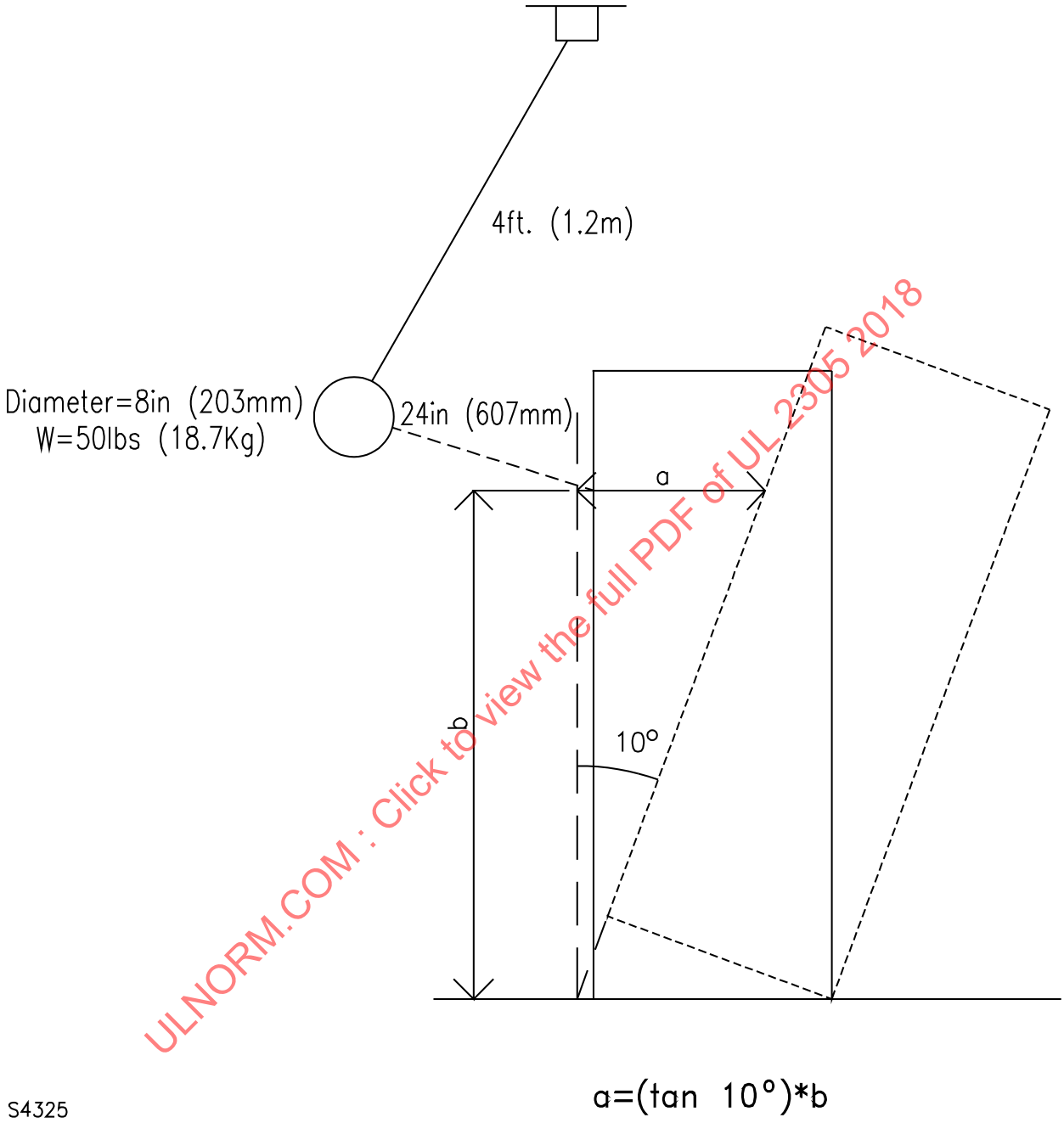
Figure 40.1
Force stability test for towers



40.3 Impact stability test

40.3.1 The tower is to be subjected to the 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 (23 kg). The bag is to fall as a pendulum from a pivot point 4 feet (1.2 m) above the point of impact so as to traverse a horizontal distance of 24 inches (610 mm) and strike the tower. The point of impact is to be at any location centered along a horizontal line 4 feet, 4 inches (1.3 m) above the floor or 4 inches (102 mm) below the top of the tower, whichever is lower. See Figure 40.2.

Figure 40.2
Impact stability test for towers



41 Stability Tests (All Other Structures)

41.1 General

41.1.1 An exhibition display unit, or part of a unit, as described in 2.8, shall be tested as specified in 41.2 and 41.3. The exhibition display unit or part of a unit shall not tip over or incur damage that presents a risk of fire, electric shock, or injury to persons. Additional tests are required to evaluate individual features that create additional weights or moments when extended.

41.1.2 Instruction manuals and other literature provided by the manufacturer are to be investigated to determine exhibition display unit configurations that are implicitly or explicitly specified. Configurations that are the least stable are to be determined and used for the tests specified in this Section. The results of tests on the least stable configuration is determined to be representative of all other configurations. Figures 41.1 and 41.2 illustrate a typical test configuration.

41.1.3 The configuration of an exhibition display unit to be tested is to be assembled on a smooth hardwood surface or on a carpet as specified in 41.1.4 in accordance with the manufacturer's instruction manual, whichever is determined to be a more severe condition of use. The glides, feet, casters, 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 unit.

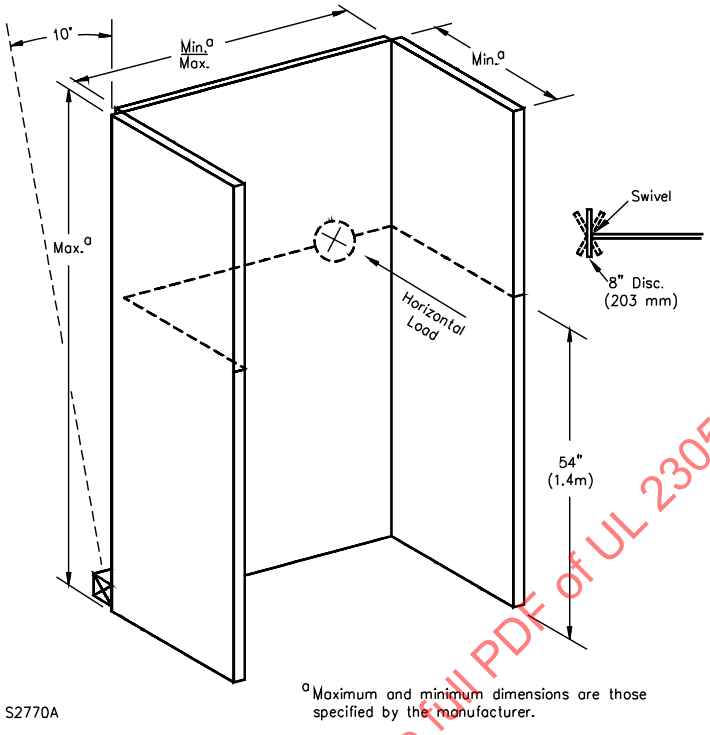
41.1.4 The carpet employed for tests is to be level-looped, woven-through-the-back type, having a 216 pitch, eight wires per 1 inch (25.4 mm), 1/4 inch (6.4 mm) high three-ply wool yarn fiber pile. The carpet is to have a finished weight of 74.7 ounces per square yard (2.5 kg/m^2), consisting of a face weighing 43.9 ounces per square yard (1.5 kg/m^2), and backed by a synthetic and jute material weighing 15.4 ounces per square yard (0.5 kg/m^2). The use of an alternative test carpet that provides equivalent performance characteristics to the carpet specified for this test complies with the intent of this requirement. The carpet is to be installed over 60 – 68 ounces per square yard (2.0 – 2.3 kg/m^2) sponge rubber padding.

41.1.5 Each exhibition display unit or unit part sample is to be loaded and tested using the configuration that results in the least stable condition with the maximum and minimum weight specified in the manufacturer's instruction manual.

41.2 Force stability test

41.2.1 The test configuration of the exhibition display unit or part of the unit is to be subjected to a gradually increasing horizontal force applied through the center of an 8-inch (203-mm) diameter disc at any location centered along a horizontal line 4 feet, 6 inches (1.4 m) above the floor or 4 inches (102 mm) below the top of the exhibition display unit, whichever is lower. The horizontal force is to be increased until a 40-pound (178-N) force is attained or the assembly inclines to an angle of 10 degrees without tipping over, whichever occurs first. The horizontal force is then to be gradually reduced to zero. See Figure 41.1

Figure 41.1
Force stability test

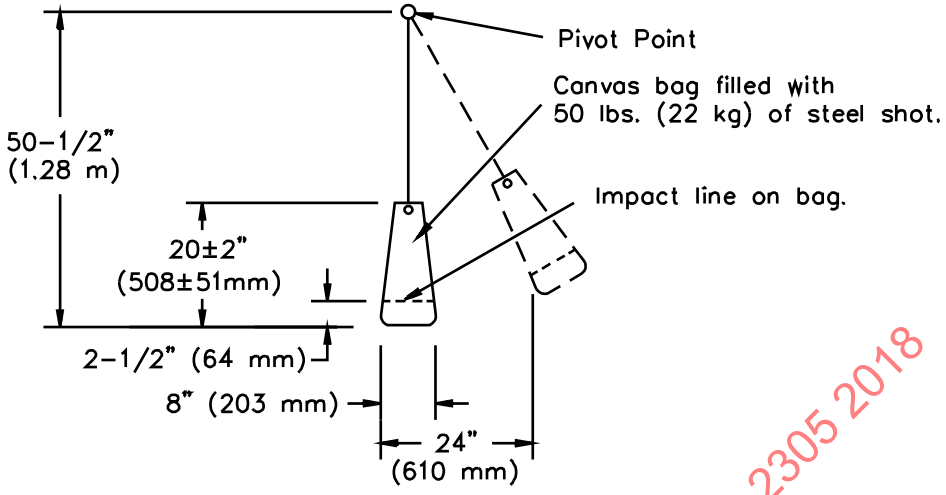


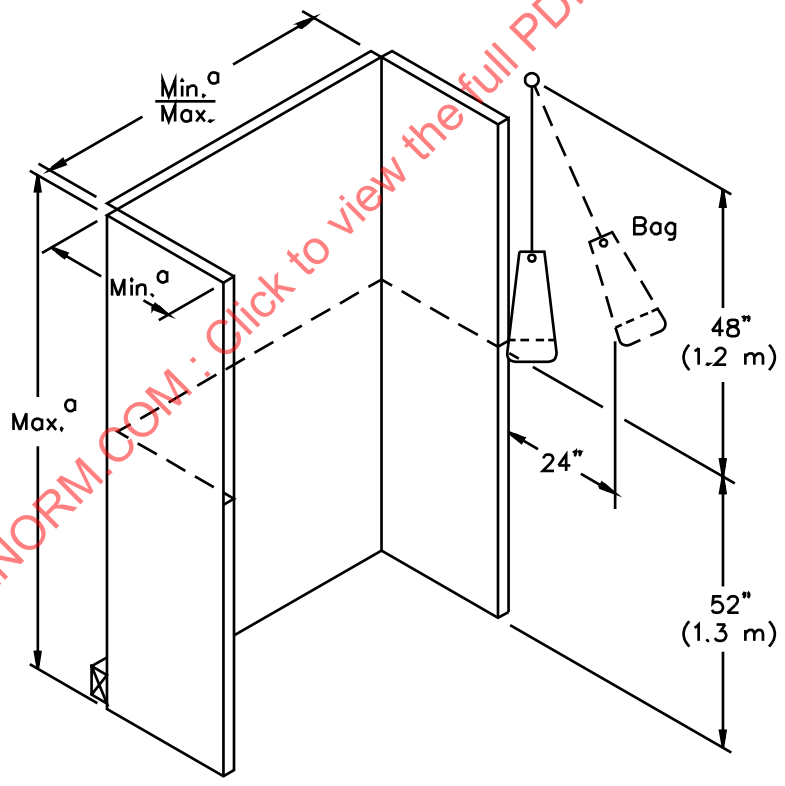
[a]Maximum and minimum dimensions are those specified by the manufacturer.

41.3 Impact stability test

41.3.1 Each exhibition display unit or part of the unit is to be subjected to the 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 (23 kg). The bag is to fall as a pendulum from a pivot point 4 feet (1.2 m) above the point of impact so as to traverse a horizontal distance of 2 feet (610 mm) and strike the exhibition display unit. The point of impact is to be at any location centered along a horizontal line 4 feet, 4 inches (1.3 m) above the floor or 4 inches (102 mm) below the top of the exhibition display unit, whichever is lower. See Figure 41.2.

Figure 41.2
Impact stability test





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

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42 Mechanical Strength Tests

42.1 General

42.1.1 An exhibition display unit or part of the unit shall comply with the applicable tests specified in this Section. As a result of these tests, the exhibition display unit or part of the unit shall not collapse or deform to such a degree that results in a risk of injury to persons. The unit or part of the unit shall not collapse or deform to such a degree that components are damaged or electrical spacings are reduced below minimum required values resulting in a risk of fire, electric shock, or injury to persons.

42.1.2 With reference to 42.1.1:

a) A risk of injury to persons exists when the exhibition display unit or part of a unit is completely displaced from its support system or when the exhibition display unit or support system is damaged to the extent that there are sharp edges or corners exposed which do not comply with Standard for Test for Sharpness of Edges on Equipment, UL 1439; and

b) Electrical components within the exhibition display unit shall comply with Accessibility of Uninsulated Current-Carrying Parts and Film-Coated Wire, Section 21.

42.1.3 Additional tests are to be performed when it is determined that a single configuration is not representative of particular components, combinations of components, configurations of systems, alternate supporting means, and similar cases, that involve unusual loading conditions.

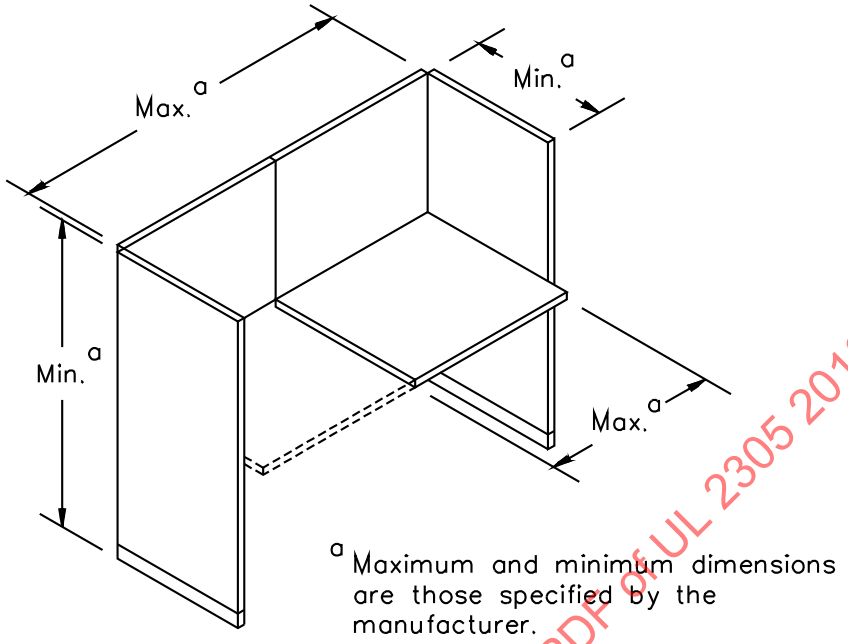
42.2 Load-bearing surface test

42.2.1 The largest load-bearing surface of an exhibition display unit supplied by the manufacturer instructions is to be assembled as specified by the manufacturer and tested as specified in 42.2.2. See Figure 42.1. The configuration tested is to be that in which the surface is least supported. Other configurations specified by the manufacturer that involve unusual loading conditions shall be evaluated.

42.2.2 A load equal to the width of the surface in inches (mm) times 7 pounds (3.18 kg), or a 300 pound (136 kg) load, whichever is greater, is to be gradually applied to an area along the entire usable width of the surface, centered along a line located 8 inches (203 mm) in from the least-supported edges of the surface. The load is to be maintained for 15 minutes after complete loading is attained.

Exception: Where a maximum load is specified in the manufacturer's installation instructions, using a test load of four times the specified weight complies with the intent of this requirement.

Figure 42.1
Configuration for load-bearing surface test



S2768A

42.3 Handrail and guardrail test

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

42.3.2 An infill panel between supports of a handrail or guardrail shall withstand a lateral load of 25 pounds per square foot (122.05 kgs/m^2).

42.3.3 A decorative element of a handrail or guardrail is able to have a load bearing capacity of less than those specified in 42.3.1 and 42.3.2.

42.4 Shelving test

42.4.1 The largest shelves for each support size of an exhibition display unit supplied by the manufacturer are to be attached to the exhibition display unit as specified by the manufacturer. The maximum number of shelves determined by the construction, is to be assembled to the exhibition display unit. The test is to be performed as described in 42.4.2.

42.4.2 Each load is to be uniformly applied along the entire width of the shelf, centered on the line at the mid-depth of the shelf or 4-1/4 inches (108 mm) in from the most extended edge of the shelf, whichever is farthest from the back edge. The loads are to be gradually increased from zero to the specified value, and maintained for 5 minutes after complete loading is attained. The loads are to be as specified in (a) – (c):

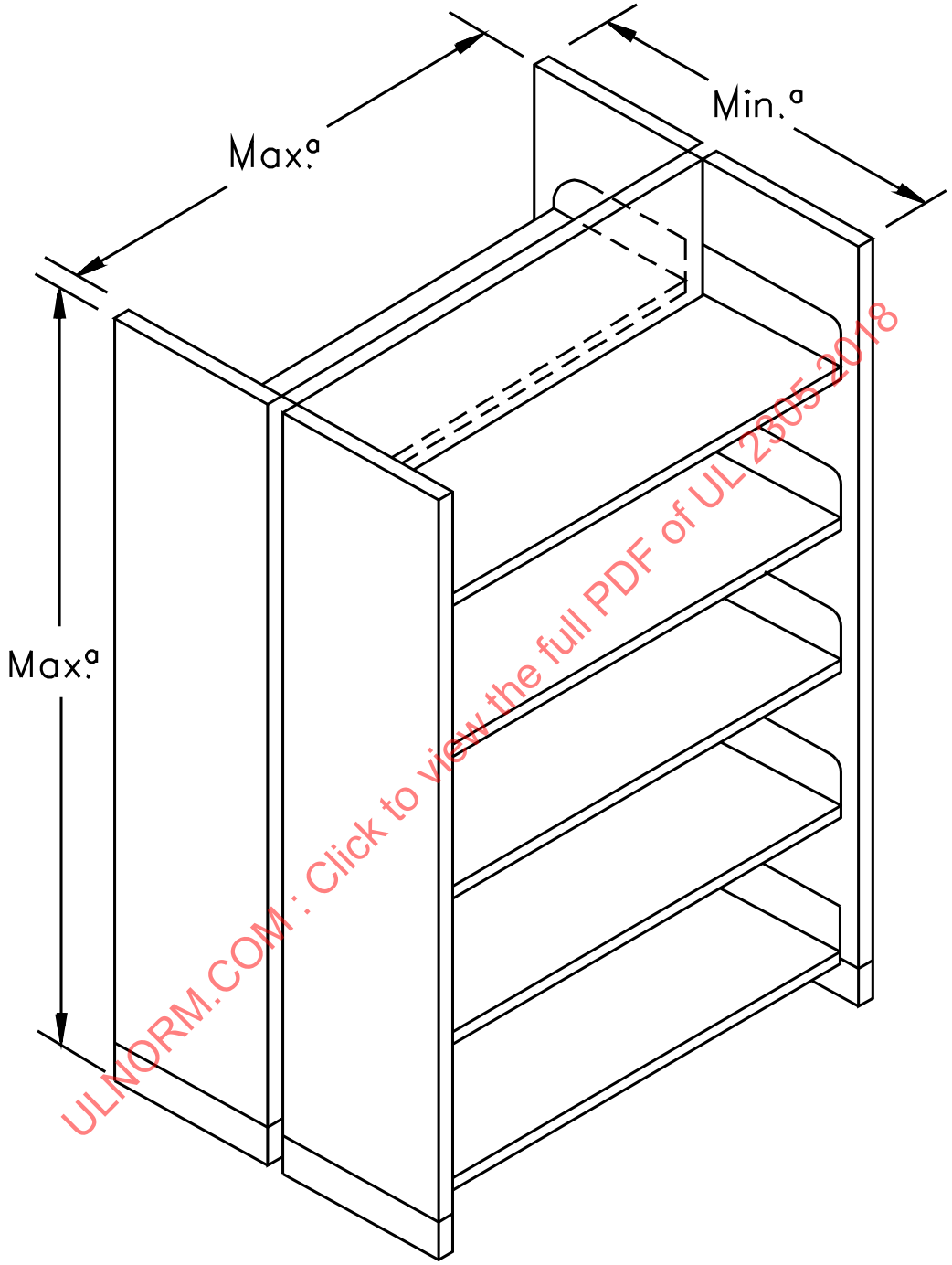
a) Each shelf less than 8 inches (203 mm) in depth is to be subjected to a load equal to the width of the shelf in inches (mm) times 3 pounds (1.4 kg);

b) Each shelf greater than 8 inches and not greater than 16 inches (406 mm) in depth is to be subjected to a load equal to the width of the shelf in inches (mm) times 5 pounds (2.3 kg); and

c) Each shelf greater than 16 inches in depth is to be subjected to a load equal to the width of the shelf in inches (mm) times 7 pounds (3.2 kg).

Exception: Where a maximum load is specified in the manufacturer's installation instructions, using a test load of four times the specified weight complies with the intent of this requirement.

Figure 42.2
Configuration for shelving test



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

S2769A

43 Strength of Cord Channel Enclosure Tests (Electrical and Mechanical)

43.1 Impact test – enclosures

43.1.1 A cord channel enclosure having a thickness less than the applicable value specified in Table 19.3 shall be tested as specified in 43.1.2 and 43.1.3. There shall be no distortion of parts that:

a) Reduce spacings between current-carrying parts of opposite polarity below the minimum specified level in Spacings, Section 35;

b) Interferes with the intended operation of the product; or

c) Results in accessibility of current-carrying parts when investigated in accordance with Figure 21.1.

43.1.2 Three samples of the complete cord channel enclosure, including decorative and snap-fit covers and similar parts, shall comply with the test specified in 43.1.3. Each sample is to be impacted not less than three times, with each impact at a different location determined to be vulnerable to impact. Not less than one impact on each sample is to be at a point adjacent to (and not directly on) a general-use receptacle, when provided.

43.1.3 A solid-steel sphere 2 inches (53.8 mm) in diameter and weighing 1.18 pounds (0.54 kg) is to fall through the distance required to strike the surface of the sample enclosure with an impact of 5 pounds per foot (6.8 N/m). The sample is to be supported by an exhibition display unit or clamped in a position simulating intended use without restricting possible movement of components on the side opposite the impacts.

43.2 Compression test

43.2.1 A metallic cord channel having a thickness less than the applicable value specified in Table 19.3 or a polymeric cord channel shall comply with the test specified in 43.2.5. The cord channel shall have strength and rigidity not less than that of a reference cord channel constructed of sheet metal complying with the thickness specifications in Table 19.3.

43.2.2 The reference cord channel specified in 43.2.1 is to be constructed as follows:

a) The cord channel is to have the same overall dimensions as the candidate cord channel.

b) Seams, joints, or splices at corners or back edges of the cord channel are to be closed:

1) By overlapping integral flanges formed of sheet metal from which the cord channel is made;

2) By metal surfaces overlapping adjacent surfaces or supporting frame;

3) By separate overlapping integral flanges; or

4) By continuous welding that provides a construction equivalent to an integral-flanged construction.

c) A flange joining adjacent sides, including top and bottom, of the cord channel is to have not less than one fastener for every 3 inches (76.2 mm), or fraction thereof, of channel depth. One such fastener is to be located no greater than 1.5 inches (38.1 mm) from the front edge of the channel.

Exception: A cord channel having integral flanges and that is not over 4 inches (102 mm) deep is representative when it employs a single fastener at each corner of the cord channel to secure adjacent sides, including top and bottom.

d) An integral flange at the back of the cord channel (the side opposite the cover) is to have fastenings located no greater than 1.5 inches (38.1 mm) from each end and no greater than 6 inches (152 mm) apart.

e) A separate flange is not to have less than two fasteners on each side of a seam.

43.2.3 With reference to 43.2.2(b), the overlap is to be not less than 1/4 inch (6.4 mm) and is to extend the full length of the seam.

43.2.4 With reference to 43.2.2 (c), (d), and (e), using fasteners such as rivets, welds, bolts, and screws having machine-screw threads complies with the requirement.

43.2.5 For the test, the cord channel is to rest on a smooth, solid, horizontal surface. A vertical force is to be applied to any point on the rear walls of each cord channel. The values of force and deflection are not specified, and the force on each wall of both the test and reference cord channel is to result in a measurable deflection of the test cord channel. The force is to be applied through a rod having a 1/2 by 1/2 inch (12.7 mm by 12.7 mm) flat steel face.

43.3 Deflection test

43.3.1 A cord channel cover formed of polymeric material or a drawn, embossed, flanged, or similarly strengthened cord channel cover made of metal having thickness less than the applicable value specified in Table 19.3 shall not deflect inward greater than 1/4 inch (6.4 mm) or to a degree that damages enclosed wiring or terminations when a vertical force of 100 pounds (445 N) is applied at any point on the cover.

43.3.2 For the test, the cord channel is to rest on its back on a smooth, solid, horizontal surface with the cover secured as intended. The force is to be applied through a rod having a 1/2 inch by 1/2 inch (12.7 mm by 12.7 mm) flat steel face. When tests at multiple locations are required to determine the point of maximum deflection, use of separate samples for each test meets the intent of this requirement.

43.4 Snap-fit cover test

43.4.1 A snap-fit cover employed as part of an exhibition display unit cord channel shall comply with the tests specified in 43.4.2 or 43.4.3. The snap-fit cover shall not crack or dislodge from the means of support on the cord channel. Any distortion of the snap-fit cover resulting from the tests shall not restrict the normal removal and replacement of the snap-fit cover.

43.4.2 The cord channel is to be clamped in place and oriented so that the covered face of the cord channel 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.

43.4.3 For a snap-fit cover formed of polymeric material, the test specified in 43.4.2 is to be repeated on three additional samples of the snap-fit cover after the samples have been conditioned for 7 hours in a full-draft air-circulating oven that has been preheated at:

a) A temperature of 70°C (158°F); or

b) The intended operating temperature plus 10°C (50°F), whichever is higher.

44 Leakage Current Test

44.1 A cord-connected exhibition display unit shall be tested in accordance with 44.3 – 44.7. Leakage current shall not be greater than:

a) 0.5 mA for a 3-wire (including grounding conductor) cord-and-plug-connected portable exhibition display unit; or

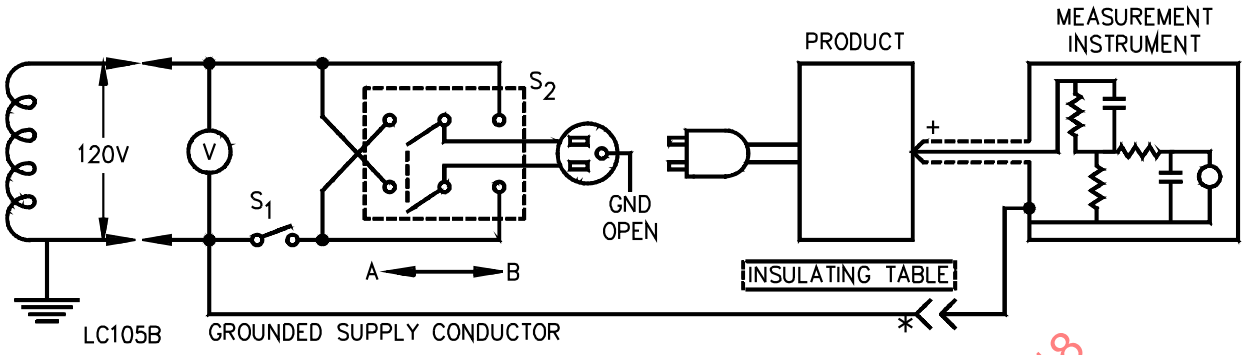
b) 0.75 mA for a 3-wire (including grounding conductor) cord-and-plug-connected stationary exhibition display unit.

44.2 All exposed conductive surfaces are to be tested for leakage current. When simultaneously accessible, the leakage current from exposed conductive surfaces are to be measured to the grounded supply conductor individually as well as collectively, and from one surface to another. A part is identified as an exposed surface unless guarded by an enclosure that complies with Accessibility of Uninsulated Current-Carrying Parts and Film-Coated Wire, Section 21. Surfaces are identified as simultaneously accessible when a person is able to contact two or more surfaces with one or both hands at the same time. These measurements do not apply to terminals operating at voltages that do not present a risk of electric shock.

44.3 When a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using a metal foil having an area of 4 inches by 8 inches (102 mm by 203 mm) in contact with the surface. When the surface is less than 4 inches by 8 inches, the metal foil is to be the same size as the surface.

44.4 The measurement circuit for leakage current is to be as illustrated in Figure 44.1. The measurement instrument is defined in Figure 44.2. The meter that is actually used for a measurement is only required to indicate the same numerical value for a particular measurement as the defined instrument. The meter used is not required to have all the attributes of the defined instrument.

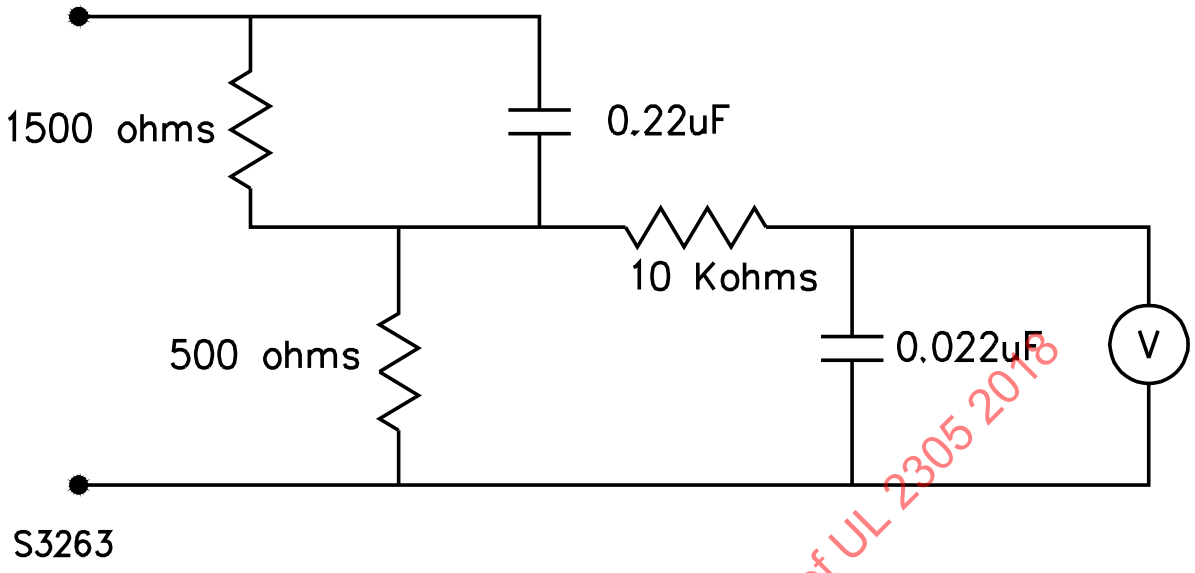
Figure 44.1
Leakage-current measurement circuit



+ = Probe with shielded lead.

* = Separated and used as clip when measuring currents from one part of an exhibition display unit to another.

Figure 44.2
Leakage current measurement instrument



NOTE – Detailed specification and guidance for the calibration of this instrument are given in the American National Standard for Leakage Current for Appliances, ANSI C101.

44.5 Unless the instrument is being used to measure leakage current from one part of a product to another, it is to be connected between accessible metallic parts and the 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 usually the grounded supply conductor.

44.6 When there is no grounded supply conductor (for example, a 240-volt, 2-conductor product supplied by a 120/240 volt source), the instrument return lead is to be connected to the grounded or grounding conductor based on the other electrical loads connected to the branch circuit operating at the time the test is performed. The conductor introducing the least electrical signals (noise), as indicated by the lowest leakage current reading, is to be used. In environments having significant electrical signals (noise) the use of an isolating transformer to reduce the effects of extraneous signals complies with the intent of this requirement.

44.7 A sample of the exhibition display unit or part of the unit is to be tested for leakage current starting with the as-received condition and with the grounding conductor, when provided, open at the attachment plug. The as-received condition is without prior energization, other than as occurs as part of the production-line testing. The supply voltage is to be adjusted to 120 or 240 volts, as applicable. The test sequence, with reference to the measuring circuit of Figure 44.1 is to be as follows:

a) With switch S1 open, the exhibition display unit is to be connected to the measuring circuit. Leakage current is to be measured using both positions of switch S2, and with the exhibition display unit switching devices in all their normal operating positions.

b) Switch S1 is then to be closed, energizing the exhibition display unit, and within 5 seconds, the leakage current is to be measured using both positions of switch S2, with the exhibition display unit switching devices in all their normal operating positions.

c) The leakage current is to be monitored for a period of 4 hours. Both positions of switch S2 are to be used in determining this measurement.

44.8 In most cases, the complete leakage current test program as covered by 44.7 is to be performed without interruption for other tests. However, when requested by the manufacturer, interrupting the leakage current tests to conduct other nondestructive tests complies with the intent of this requirement.

45 Strain-Relief Test

45.1 Unit-to-unit and pass-through-unit electrical connections

45.1.1 The strain-relief means between a connector and the supporting flexible cable is to be tested as specified in 45.1.3. The strain-relief means shall not be displaced, damaged, or damage the cable or cord channel.

45.1.2 Three samples of the connector and associated cable assembly are to be tested.

45.1.3 Wire terminations within the exhibition display unit are to be disconnected for constructions where the connection otherwise supports the applied force. A force of 35-pound (156-N) is to be applied in the direction that tends to pull the connector from the exhibition display unit. The force is to be gradually applied and maintained at the specified value for 1 minute.

45.2 Cord connected exhibition display units

45.2.1 The strain-relief means provided on an attached flexible cord, when tested in accordance with 45.2.2, shall withstand for 1 minute without displacement a direct pull of 35 pounds (15.9 kg) applied to the cord, with the connections within the exhibition display unit disconnected. At the point of disconnection of the conductors, there shall be no movement of the cord indicating that connections were stressed.

45.2.2 A 35-pound (15.9-kg) weight is to be suspended on the cord and supported by the exhibition display unit so that the strain-relief means is stressed from all angles available due to the construction of the exhibition display unit.

46 Push-Back Relief Test

46.1 An exhibition display unit shall be tested as specified in 46.2. As a result of the test, the flexible cord or flexible conduit shall not be able to be pushed in the unit through the cord-entry hole where such displacement:

a) Subjects the cord or conduit to mechanical damage;

b) Exposes the cord or conduit to a temperature higher than that for which it is rated;

c) Reduces spacings below the minimum values; or

d) Damages internal connections or components.

46.2 The attached flexible cord or flexible conduit is to be held 1 inch (25.4 mm) from the point where the cord emerges from the unit and is then to be pushed back into the unit. The cord is to be pushed back in the unit in 1 inch (25.4 mm) increments until the cord buckles or the force to push the cord into the unit exceeds 6 pounds-force (26.7 N). The cord within the unit is to be manipulated to determine compliance.

Exception: Where an integral-cord guard is provided, the push-back force is to be applied 1 inch from the end of the cord guard.

47 Resistance To Corrosion Test

47.1 As a result of the test specified in 47.2, a ferrous metal part shall not show visible corrosion.

Exception No. 1: This test is not required for parts in locations where protection is unable to be provided due to the construction of the part, such as on a sliding surface of a hinge, a shaft, and similar locations.

Exception No. 2: This test is not required for a part where the surface is enameled, galvanized or plated.

47.2 The enclosure or representative parts of the enclosure are to be subjected to a salt spray (fog) for 24 hours in accordance with the Standard Practice for Operating Salt Spray (Fog) Apparatus, ASTM B117. At the end of the test, the samples are to be removed from the chamber, washed in clean running water not warmer than 100°F (38°C) to remove salt deposits from the surface, and dried immediately. Corrosion products are to be removed by light brushing where required in order to observe corrosion of the underlying surface.

MANUFACTURING AND PRODUCTION TESTS

48 Grounding-Continuity Test

48.1 Each cord-connected exhibition display unit, having a grounding conductor, 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 cord channel or other dead-metal parts.

48.2 With respect to 48.1, a single test complies with the intent of the requirement when the construction of the unit is such that accessible metal selected is conductively connected to all other accessible metal.

48.3 To determine compliance with 48.1, a continuity indicating device, such as an ohmmeter, battery- and buzzer-combination, or similar equipment is to be used.

49 Polarity Test

49.1 Each exhibition display unit shall be tested as a routine production-line test to verify that there is electrical continuity between the grounded supply-circuit conductor of the attachment plug 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 visually or through the use of an electrical test. An alternative test method shall be to verify continuity 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).

PART III – MARKING AND INSTRUCTIONS

MARKINGS

50 General

50.1 An exhibition display unit shall be plainly and permanently marked where readily visible with:

a) The name, trade name, trademark, or other descriptive marking by which the organization responsible for the product is identifiable;

b) A distinctive catalog number or the equivalent; and

Exception: A custom-built unit is not required to be marked with a distinctive catalog number or the equivalent.

c) The date or other dating period of manufacture not exceeding any three consecutive months.

Exception No. 1: Using traceable code for the manufacturer's identification when the product is identified by the brand or trademark owned by a private labeler complies with the intent of this requirement.

Exception No. 2: Abbreviating the date of manufacture, or providing the date in a nationally acknowledged conventional code or in a code affirmed by the manufacturer complies with the requirement, when the code does not:

a) Repeat in less than 20 years; and

b) Require reference to the production records of the manufacturer to determine when the product was manufactured.

50.2 An exhibition display unit shall display a certificate of fire retardancy.

50.3 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 the Standard for Marking and Labeling Systems, UL 969. Minimum letter height shall be 3/32 inch (2.4 mm) as measured by characters, such as b, 1, and H. A contrasting background shall be provided for legibility.

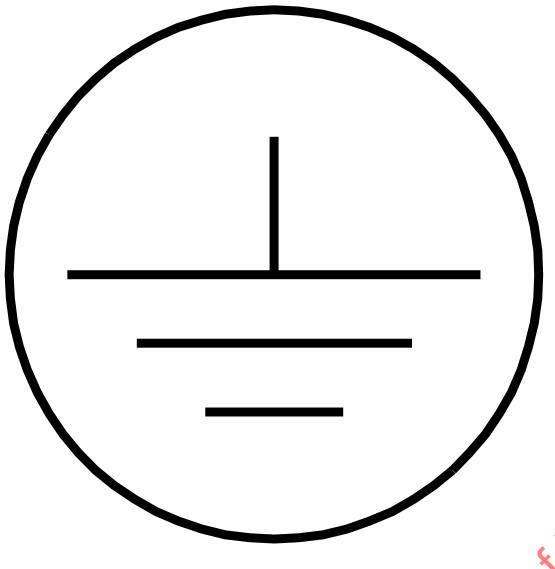
50.4 When a manufacturer produces or assembles exhibition display units at more than one factory, each finished unit shall have a distinctive permanent marking identifying it as the product of a particular factory.

50.5 When the construction of an exhibition unit provides for 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 current-carrying part to unintentional contact, the exhibition display unit shall be plainly and permanently marked to indicate that such servicing or cleaning be done with the exhibition display unit disconnected from the supply circuit.

50.6 An exhibition display unit having a part of an enclosure as described in the Exception to 19.2.6 shall be marked to indicate that such servicing is to be done with the exhibition display unit disconnected from the supply circuit.

50.7 With reference to 28.2.2, a pressure wire connector intended for connection of an equipment-grounding conductor shall be identified by being marked ″G″, ″GND,″ ″Ground,″ ″Grounding,″ with the grounding symbol illustrated in Figure 50.1, a similar marking; or by a marking on the wiring diagram provided with the exhibition display unit.

Figure 50.1
Grounding symbol



51 Motor-Operated Exhibition Display Units

51.1 When the motor nameplate of a dual-voltage motor is used to determined the electrical characteristics of the exhibition display unit, the exhibition display unit shall be additionally and permanently marked to indicate the particular voltage for which it is connected when shipped from the factory. When the exhibition display unit employs an attachment plug, instructions shall be provided to indicate the type of plug that is to be used when the exhibition display unit is connected for the alternate voltage.

51.2 A cord-connected exhibition display unit that employs a motor rated 3/4 horsepower (559 W) or greater and where the manually operated motor-control switch required by 33.2.2 is inaccessible shall be permanently marked with the words: ″A motor control switch rated for the application shall be provided at the time of installation.″

INSTRUCTIONS

52 General

52.1 An exhibition display unit shall be provided with legible installation, operation, and as applicable, user-maintenance instructions, grounding instructions and moving and storage instructions; and instructions pertaining to the risk of fire, electric shock, or injury to persons that is associated with the use of the exhibition display unit. Directions and information required to cover the mechanical and electrical limitations of an exhibition display unit shall also be provided.

52.2 The instructions specified in 52.1 shall be in separate manuals, or shall be combined in one or more manuals. The instructions pertaining to a risk of fire, electric shock, or injury to persons are separated in format and emphasized to distinguish them from the rest of the text.

52.3 Instructions or illustrations shall be provided to identify important parts of the exhibition display unit. The use of an illustration to clarify the intent of a written requirement complies with the intent of this requirement. The illustration shall not replace the written instruction.

52.4 The following items shall be entirely in upper case letters or shall be emphasized to distinguish them from the rest of the text:

a) The headings for the installation, operation, user-maintenance, and moving and storage instructions;

b) The heading for the instructions pertaining to a risk of fire, electric shock, or injury to persons; and

c) The opening and closing statements of the instructions specified in 53.5 ″IMPORTANT SAFETY INSTRUCTIONS″ and ″SAVE THESE INSTRUCTIONS,″ or the equivalent.

52.5 Unless otherwise indicated, the text of the instructions in 53.5 and 54.1 shall be in the words specified or words that are equivalent, clear and understandable. No substitute shall be used for ″WARNING″ or ″DANGER.″

52.6 The instructions shall include the markings, or equivalent, specified in Sections 50 and 51.

52.7 Installation instructions shall be provided with each luminaire provided with an exhibition display unit and shall include caution to the user that the luminaire is not intended for installation in plastic cabinets and to keep the power-supply cord and interconnecting cords from contacting combustibles such as plastic, paper products, and similar materials, the lamp, lampholder, or reflector.

52.8 Any instructions that are provided with a component part of an exhibition display unit shall be provided with the instructions for the exhibition display unit.

52.9 In order to apply the Exception to 42.2.2 or 42.4.2, the instructions shall specify the maximum load for each load-bearing surface.