

No Text on This Page

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.

No Text on This Page

34.1.4 An attachment cord shall have conductors not smaller than 18 AWG (0.82 mm²).

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.