

UL 48

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Electric Signs

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The following table lists the future effective dates with the corresponding reference.

Future Effective Date	References
January 2, 2004	Paragraphs, 5.3.3, 10.2.1, 10.2.2, 10.3.1, 16.1A.1, 20.1.8, 20.1.9, 20.1.11, 30A.2, Table 16.1, Figure 20.1

The new and/or revised requirements are substantially in accordance with UL's Bulletin on this subject dated February 4, 2000. The bulletin is now obsolete and may be discarded.

Not all proposals from the February 4, 2000 bulletin have been adopted. Some will be revised and repropose at a later date. Additional revisions, editorial in nature, are included.

The revisions dated July 2, 2001 include a reprinted title page (page 1) for this Standard.

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New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover electric signs, referred to as signs, using incandescent lamps, fluorescent lamps, HID lamps, neon tubing and other combinations, for use in accordance with the National Electrical Code, NFPA 70.

1.1 revised July 2, 2001

1.2 The signs covered by these requirements include, and are not limited to, awning signs, channel-letter signs, directional signs, ordinary box signs, recessed signs, trailer-mounted signs, and other similar signs.

1.3 These requirements do not cover units specifically intended for billboard illumination, "EXIT" lights, show-window signs using skeleton neon tubing with exposed wiring, or illuminated clocks in which a potential of 600 volts or less is involved.

1.3 revised July 2, 2001

1.4 These requirements do not cover signs not provided with electrical means for illumination.

1.5 These requirements do not cover signs specifically intended for connection to a circuit of limited power supplied by a Class 2 transformer with 30 volts or less output. These requirements cover signs that incorporate a Class 2 transformer as an integral part of the sign.

1.6 These requirements do not cover the trailer of a trailer-mounted sign.

1.7 These requirements do not cover field-assembled signs for outline lighting. These requirements cover outline lighting that is factory assembled and that is capable of being sectionalized for shipping purposes.

1.8 The following types of signs that do not include words or symbols are also covered by these requirements:

- a) An incandescent-lamp sign provided with a flasher, or means for remote installation of a flasher;
- b) A sign without a face and having a trough, track, or similar parts for field installation of a rigid or a flexible face and advertising material. See 40.1.13;
- c) An illuminated module of a sign used as a spacer between modules containing words or symbols;
- d) An outdoor sign intended for use as outline lighting. See 40.4.1; and
- e) A sign having a blank face that is intended to have advertising material applied prior to the installation of the sign. See 40.1.12.

1.9 These requirements do not cover electronic controls covered by the Standard for Control Centers for Changing Message Type Electric Signs, UL 1433. However, this does not preclude the use of these types of controls in signs when they are used in accordance with 2.1.1.

1.10 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.

1.10 revised July 2, 2001

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.1.2 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.

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

2.1.3 revised July 2, 2001

2.1.4 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.

2.1.4 revised July 2, 2001

2.2 Units of measurement

2.2.1 When a value for measurement is followed by a value in other units in parentheses, the first stated value is the requirement.

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

2.2.2 added July 2, 2001

2.3 Undated references

2.3.1 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.

3 Glossary

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

3.2 ACCESSIBLE PART – A part that is not guarded by its location or by other means and that is capable of being touched by a person.

3.3 AWNING SIGN – A fixed sign having a flexible or rigid plastic face or faces and covering material secured over a supporting frame and which provides protection from weather. Illumination is provided for the signage and may also provide down-lighting on an area intended for pedestrian traffic, a kiosk, or similar types of areas.

3.3 revised July 2, 2001

3.3.1 BARRIER, ACCESSIBILITY– A material provided to limit access to:

- a) Uninsulated live parts,
- b) Dead metal parts that are at a risk of being energized and are not grounded,
- c) Live parts insulated with materials not intended to be subjected to user contact, or
- d) Moving parts that present a risk of injury.

3.3.1 added July 2, 2001

3.3.2 BARRIER, HEAT– A barrier provided to reduce the required spacing, or in place of the required spacing, from a heat producing component.

3.3.2 added July 2, 2001

3.3.3 BARRIER, INSULATING– A barrier provided in place of a required electrical spacing.

3.3.3 added July 2, 2001

3.4 BONDING – The permanent joining of metallic parts to form a positive electrically conductive path that provides electrical continuity between dead metal parts and is capable of conducting any fault current which occurs.

3.5 CANOPY – A device provided with a sign, or separately, that is used to cover an outlet box. A canopy is capable of being secured to an outlet box or to a ceiling.

3.6 CANOPY SIGN – A sign that is supported and suspended from an outlet box by a chain, stem, or cable.

3.7 CIRCUIT TYPES:

a) Class 2 – A circuit involving a potential of not more than 30 volts rms supplied by a primary battery, a Class 2 transformer, or by a combination of a transformer and fixed impedance that, as a unit, complies with all the performance requirements for a Class 2 transformer. A circuit derived from a line-voltage circuit by connecting resistance in series with the supply circuit as a means of limiting the voltage and current is not identified as a Class 2 circuit.

b) Low-Voltage – A circuit involving a potential of not more than 1000 volts, and having characteristics in excess of those of a Class 2 circuit.

c) High-Voltage – A circuit involving a potential of more than 1000 volts.

3.7 revised July 2, 2001

3.8 CONVENIENCE RECEPTACLE – A receptacle that is intended for general use.

3.8 revised July 2, 2001

3.9 DEDICATED RECEPTACLE – A receptacle that is intended for the connection of a specific product.

3.9 revised July 2, 2001

3.10 Deleted July 2, 2001

3.10.1 ENCLOSURE– A material provided to enclose electrical parts and components to contain a risk of fire. All or part of the enclosure may also serve as an accessibility barrier, insulating barrier, or water shield.

3.10.1 added July 2, 2001

3.11 EXPOSED PART – A part that is subjected to handling in normal use without removing a part, such as a door, cover, or other part, the removal of which requires the use of a tool. A live part is determined to be exposed to unintentional contact when it is not guarded or isolated from being inadvertently touched by a person.

3.12 Deleted July 2, 2001

3.13 Deleted July 2, 2001

3.14 GROUNDING – A conductive connection between all exposed dead metal parts capable of becoming energized and all dead metal parts within the enclosure that are exposed to contact during any servicing operation of electrical equipment and the earth or some conducting body that serves in place of the earth.

3.15 GROUND-FAULT CIRCUIT-INTERRUPTER (GFCI) – A device intended for protection of persons that functions to de-energize a circuit, or portion thereof, within an established period of time when a current to ground exceeds a predetermined value that is less than that required to operate the supply-circuit overcurrent protective device.

3.16 HIGH-INTENSITY DISCHARGE (HID) LAMP – A lamp that produces light from an electric discharge between electrodes in a gas or vapor at low or high pressure. Common types include mercury vapor and metal halide lamps.

3.17 ISOLATED PART – A part not readily accessible to persons unless special means for access are used.

3.18 LAMP – Incandescent, fluorescent, or HID lighting used in a sign.

3.19 LIVE PART – A metal or other conductive part that has a potential difference during operation with respect to ground or any other conductive part.

3.19.1 NEON TUBE – A small diameter glass cylinder, evacuated of air and filled with an inert gas such as neon, which emits light when excited by a high voltage neon transformer or power supply.

3.19.1 revised July 2, 2001

3.20 OUTLET BOX – A box used on a wiring system, usually an outlet. It is provided with means for connection to a wiring system and intended primarily to enclose splices and wiring devices, and, where permitted, is not prohibited from use as the support of a sign or other equipment intended for similar installation. This box is or is not provided with studs or a bar hanger or with clamps for securing cable, tubing, or conduit.

3.21 OUTLINE LIGHTING – An arrangement of incandescent lighting, fluorescent lamps, HID lamps or neon tubing that outlines or calls attention to certain features such as the shape of a building or the decoration of a window.

3.21 revised July 2, 2001

3.22 POLYMERIC MATERIAL – A material made of a chemical compound mixture formed by polymerization and consisting of repeating structural units. Polymeric materials include thermoplastic, thermosetting, and elastomeric materials. A thermoplastic material is capable of being easily softened and resoftened by repeated heating. A thermosetting material cures by chemical reaction when heated and, when cured, cannot be resoftened by reheating. An elastomeric material is capable of being stretched at room temperature to at least twice its length under low stress and returns to its original length when the stress is released.

3.23 PRESSURE WIRE CONNECTOR – A device that secures one or more wires to a terminal plate, stud, or similar device without the use of solder.

3.24 QUALIFIED SERVICING – Any servicing performed by persons trained to repair and operate the equipment, and who are familiar with the risks involved. Some examples of qualified servicing include the replacing of components such as ballasts, lampholders, switches, and neon tubing. See 3.38 for "user servicing" operations.

3.24 revised July 2, 2001

3.25 RACEWAY – An enclosed channel designed for holding wires or cables with additional functions in compliance with this standard.

3.26 RECESSED SIGN – A sign intended to be installed in a cavity behind a wall surface so that part of the sign is behind the wall surface.

3.27 SECTION SIGN – A sign consisting of preassembled sections (for shipping purposes) which, when connected in the field, form a complete sign.

3.28 SIGN – A self-contained, cord- or permanently-connected, electrically illuminated product, usually with advertising or other words, numbers, or symbols, intended for use in a nonresidential environment to convey information or attract attention.

3.29 SIGN, FIXED – A sign intended to be permanently connected to an electrical source of supply.

3.29 revised July 2, 2001

3.30 SIGN, PORTABLE – A sign that has a power-supply cord for connection to a power supply circuit. A portable sign is provided with a concealed, nonpermanent, means for mounting, such as keyhole slots.

3.31 SIGN, STATIONARY – A cord-connected sign that is not portable.

3.32 SIGN BODY – An external portion of a sign that is not relied upon to enclose current-carrying parts as required in 5.1.1 and which is not prohibited from providing protection from the weather.

3.33 *Deleted July 2, 2001*

3.34 SPLICE – Any point where one wire is connected to another wire. A wire terminating at a pressure wiring terminal, wire binding screw, or electrode lead is not identified as a splice.

3.35 STRAIN-RELIEF – A knot, bushing, or other means determined to be equivalent as intended to prevent strain from being transmitted to a wire or cord at a termination point inside a sign.

3.36 TEMPERED GLASS – Glass that has been treated so that, when broken, it dices into fragments not larger than 1 square inch (6.5 cm²), without splintering or producing sharp edges on any piece.

3.37 *Revised and relocated as 3.19.1 July 2, 2001*

3.38 USER SERVICING – Any servicing that is performed by persons other than those trained to maintain a particular sign. Replacement of neon tubing is not determined to be user servicing. Some examples of user servicing are:

- a) Attaching an accessory by means of separable connectors, or by means of an attachment plug to a dedicated receptacle.
- b) Resetting or replacing a protective device in a sign or a receptacle circuit that is overloaded by the user.
- c) Resetting a circuit breaker or replacing a fuse, automatic starter, or lamp, that is accessible without the use of a tool.
- d) Changing of advertising material and routine cleaning.

3.38 revised July 2, 2001

3.39 WATER SHIELD– A material relied upon to reduce or prevent the entrance of water into a sign or onto current-carrying parts within a sign.

3.39 added July 2, 2001

CONSTRUCTION

4 General

4.1 A portable, cord-connected sign for outdoor use shall use incandescent or fluorescent lamps, or a combination of the two.

4.2 A sign shall be formed and assembled so that it has the strength and rigidity to resist the abuses to which it is to be subjected, without resulting in a risk of fire, electric shock, or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

4.3 An enclosure, an opening, a frame, a guard, a knob, a handle, or similar parts, shall not be so sharp as to result in a risk of injury to persons in normal operation and user servicing.

4.4 When the construction of a sign is such that the acceptability of the sign cannot be determined due to potentially combustible materials being in close proximity to heat generating components, the sign shall comply with the Temperature Test, Section 36.

5 Frame and Enclosure

5.1 General

5.1.1 All wiring and each current-carrying part shall be enclosed in metal.

Exception No. 1: Lampholder contacts, fluorescent-lamp starters, and starter-holder contacts, and Class 2 circuitry are not required to be enclosed.

Exception No. 2: The integral leads of a lamp-supported lampholder can be exposed for no greater than 4 inches (101.6 mm).

Exception No. 3: The portion of a power-supply cord that is visible during normal operation of a sign, including relamping or changing advertising material, is not required to be enclosed.

Exception No. 4: A live part inside:

- a) An enclosed ballast of an indoor sign,*
- b) A weather-proof ballast, or*
- c) A Type 2 outdoor ballast*

is not required to be additionally enclosed.

Exception No. 5: Flexible cord as specified in Exception Nos. 1 – 4 of 19.1.3.2, and flexible conductors as specified in 19.1.3.1, are not required to be enclosed.

Exception No. 6: Parts are not prohibited from being enclosed in other material that has been investigated and determined to be capable of being used for the purpose.

5.1.2 In a canopy sign supply conductors (including conductors from the sign, outlet box, or from a canopy switch) and the splices between these conductors are determined as being enclosed between the canopy and the building wall or ceiling when:

- a) The conductors and splices are concealed when the sign is installed;
- b) The maximum dimension of the canopy (measured as the diameter of a round canopy, the longest side of a triangular canopy, the diagonal of a square or rectangular canopy, or the longest diagonal of a multisided canopy) is not more than 15 inches (380 mm); and
- c) The conductors are of such length that the splices are capable of being located in the outlet box.

5.1.2 revised July 2, 2001

5.1.3 Among the factors that are to be evaluated when determining whether a nonmetallic enclosure or other part of a sign is capable of being used consist of the following:

- a) Mechanical strength,
- b) Resistance to impact,
- c) Moisture absorptive properties,
- d) Combustibility,
- e) Resistance to arcing,
- f) Resistance to temperatures to which the material is subjected under conditions of normal or abnormal use, and
- g) Aging characteristics.

5.1.4 A polymeric enclosure of a sign shall comply with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

5.2 Thickness of sheet metal enclosures

5.2.1 The thickness of sheet metal shall not be less than specified in Table 5.1 when evaluated in accordance with 5.2.2.

5.2.2 The thickness of a sheet is to be determined from five micrometer readings spaced equally across the width edge (usually the short edge) of the full sheet as rolled. No micrometer reading is to be taken within 1 inch (25.4 mm) of either side, length or edge.

5.2.3 A separate enclosure for a transformer or ballast shall have a wall thickness not less than that required for the enclosure of the sign.

5.3 Openings

5.3.1 Caulking compound used to seal an opening in a sign body shall be nonhardening and shall not be used in a location where it is disturbed during relamping when required for the sign to comply with the Exclusion of Water Test, Section 32.

Table 5.1
Thickness of sheet metal enclosures

Table 5.1 revised July 2, 2001

Type of sign	Minimum thickness					
	Uncoated steel, stainless steel, or terneplate,		Zinc-coated steel,		Aluminum, copper or copper-base alloys,	
	inch	(mm)	inch	(mm)	inch	(mm)
Incandescent lamp other than outline lighting	0.013	0.33	0.016	0.41	0.020	0.51
Fluorescent or HID lamp, or neon tubing with or without incandescent lamps, or a sign for outline lighting ^a	0.016 ^b	0.41	0.019 ^b	0.48	0.025	0.64
	0.020	0.51	0.023	0.58		
Canopy sign having a pull-type canopy switch or a switch knockout in the rim of the canopy	0.025 ^c	0.64	0.025 ^c	0.64	0.025 ^c	0.64
Raised or channel letters supporting any lamp or neon tube ^d						
a) No dimension exceeding 15 inches (381 mm)	0.013	0.33	0.016	0.41	0.020	0.51
b) Any dimension exceeding 15 inches	0.016	0.41	0.019	0.48	0.025	0.64
At a point on a sign where a permanent wiring system (conduit) is to be connected	0.026	0.66	0.029	0.74	0.040	1.02
At a point on a sign where the enclosure acts as a terminal plate for a wire binding screw. See 18.14.	0.050 ^e	1.27	0.050 ^e	1.27	0.050 ^e	1.27
^a For a cord-connected, fluorescent-lamp sign, the thickness of sheet metal provided for other than the electrical enclosure is not prohibited from being less than that specified; and shall not be less than that required for an incandescent-lamp sign. ^b Only when the sheet is ribbed, corrugated, or embossed over its entire surface so as to give strength not less than that of a flat sheet having a minimum thickness of 0.020 inch (0.51 mm). This is accomplished by providing not less than four corrugations per inch and not less than 0.011 inch (0.28 mm) in depth. ^c A lesser thickness is not prohibited from being used when the rim is reinforced by turning: <ol style="list-style-type: none"> 1) The metal 180 degrees or more or 2) A right-angle flange, 1/8 inch (3.2 mm) or more wide, at the rim. 						

Table 5.1 Continued on Next Page

Table 5.1 Continued

Type of sign	Minimum thickness			
	Uncoated steel, stainless steel, or terneplate, inch (mm)	Zinc-coated steel, inch (mm)	Aluminum, copper or copper-base alloys, inch (mm)	
<p>^d When the letter encloses or supports any electrical parts other than neon tubing, the thickness of the metal shall not be less than that specified for the main enclosure.</p> <p>^e A thickness of 0.030 inch (0.76 mm) is not prohibited from being used when tightening the wire-binding screw with a torque of 20 inch-pounds (2.26 N-m) does not strip the threads from the metal.</p>				

5.3.2 The following types of conduit, tubing, and cable are capable of being used as an enclosure of internal wiring of a sign:

- a) Flexible metallic tubing – only for indoor signs and for wiring operating at a potential of 1000 volts or less,
- b) Flexible metal conduit,
- c) Electrical metallic tubing,
- d) Liquid-tight flexible metal conduit,
- e) Intermediate metal conduit,
- f) Rigid metal conduit,
- g) Rigid nonmetallic conduit – only for indoor incandescent and fluorescent signs unless marked for above-ground use,
- h) Armored cable, and
- i) Metal-clad cable.

5.3.3 Rigid conduit, rigid tubing, flexible conduit, and flexible tubing smaller than 1/2 inch (12.7 mm) trade size, shall not be used.

Exception: Factory installed wiring that is internal to a sign body or enclosure that operates at no more than 1000 volts is not prohibited from being installed in 3/8 inch (9.5 mm) trade size flexible conduit or tubing.

Revised 5.3.3 effective January 2, 2004

5.3.4 Fittings and connectors for the connection of conduit, tubing, and cable, as indicated in 5.3.2 shall be provided and identified for use with the specific type of conduit, tubing, and cable to which they are to be connected.

5.3.5 The conduit, tubing, and cable types specified in 5.3.2 (c) – (g) and (i) are not prohibited from being used within signs in which contact with water occurs as a result of the Exclusion of Water Test, Section 32. Unless intended for wet locations, all fittings shall be located or oriented so that contact with water does not occur.

5.3.6 Rigid nonmetallic conduit within a sign body shall not be exposed to sunlight, or to the illumination from neon tubing or a high-intensity-discharge lamp.

Exception: This requirement does not apply to rigid nonmetallic conduit that is marked as intended for exposure to ultraviolet light or has been investigated and determined to be capable of being used for such exposure.

5.3.6 revised July 2, 2001

5.3.7 The conduit, tubing, and cable types specified in 5.3.2 (c) – (f) and (i) are not prohibited from being used in exposed outdoor applications.

5.3.8 Armored cable types are not prohibited from being used in exposed outdoor applications when identified and marked for such use.

5.3.9 The conduit, tubing, and cable indicated in 5.3.2 shall be supported at intervals not greater than those specified in Table 5.2.

Table 5.2
Maximum distance between supports for conduit, tubing, and cable

Type	Feet	(meters)
Rigid nonmetallic conduit	3	0.91
Flexible metallic tubing	3	0.91
Metal-clad cable	6	1.83
All flexible metal conduit and armored cable	4.5	1.37
All rigid metal conduit	10	3.05
Electrical metallic tubing	10	3.05

6 Ventilating Openings

6.1 Ventilating openings shall not affect the strength and rigidity of a sign.

6.2 An enclosure that is not integral to a ballast, transformer, neon transformer or power supply, motor, clock motor, or other similar part shall:

- a) Be provided with no ventilation openings when the ballast, transformer, motor, clock motor, or other similar part is an open core-and-coil device or is a neon transformer or power supply with a Type 1 designation or
- b) Be provided with no ventilation openings on the bottom surface when the ballast, transformer, motor, clock motor, or other similar parts has a coil having its own enclosure (enclosed) or is a neon transformer or power supply with other than a Type 1 designation. The surface identified as the bottom shall be determined with the enclosure in the intended installation orientation.

6.2 revised September 3, 1998

6.3 A ventilating opening is not prohibited from being located in a sign body when the construction complies with the Exclusion of Water Test, Section 32.

6.4 A ventilating opening shall be covered by screening, expanded metal, or other means determined to be equivalent, when the opening is a slot or louver more than 3/8 inch (9.5 mm) wide or more than 1-1/2 square inches (9.68 cm²) in area, or when any other ventilating opening is more than 1/2 inch (12.7 mm) in diameter or 1/4 square inch (1.61 cm²) in area. An opening in the screening, expanded metal, or other means determined to be equivalent shall not permit the passage of a rod having a diameter larger than 1/2 inch.

Exception: The covering is not required when:

- a) The opening does not permit the entrance of a rod with a diameter of 1/2 inch and*
- b) Baffles or overlapping sections of the enclosure, changes in the direction of the path through the opening, orientation of the path, or other means are provided to reduce the likelihood of debris entering the enclosure.*

7 Glass Panels and Letters

7.1 General

7.1.1 Glass panels and letters shall comply with the requirements in 7.1.3 – 7.3.7 or shall have such strength and be supported in a manner determined to be equivalent.

7.1.2 Each glass panel and letter shall be of safety glass or wired glass. See 7.1.3.

Exception: Panels and letters of plain glass are capable of being used when breakage does not permit contact from the exterior with an uninsulated, current-carrying part other than the lamp or contacts of a lampholder.

7.1.3 Glass panels shall not be used in outdoor cord-connected signs to form the enclosure required by 5.1.1.

7.1.4 A sectionalized-glass panel and a leaded-glass panel shall provide strength, rigidity, water exclusion, and protection against corrosion in a manner determined to be equivalent to that of a plain glass panel of the same area.

7.1.5 Glass panels or letters are not required to be mounted in signs prior to shipment but shall be available for inspection.

7.2 Thickness

7.2.1 The thickness of glass used for panels shall not be less than specified in Table 7.1. The glass thickness specified in Table 7.1 is capable of being used as part of any sign enclosure, except as indicated in 7.1.2 and 7.1.3.

Table 7.1
Thickness of glass panels

Maximum size of glass panel				Minimum thickness of glass, ^a			
Any dimension of exposed area,		Exposed area,					
inches	(mm)	square inches	(m ²)	inch	(mm)	inch	(mm)
—	—	150	0.097	0.094	3.2	0.125	3.2
30 ^b	762	500	0.32	0.125	3.2	0.125	3.2
50 ^b	1270	700	0.45	0.188	4.8	0.188	.8
—	—	1000	0.65	0.250	6.4	0.250	6.4
144	3658	3600	2.3	0.250	6.4	0.250	6.4
Over 144	3658	Over 3600	2.3	Investigation required			

^a A minus tolerance of 0.010 inch (0.25 mm) applies to ordinary glass, and a minus tolerance of 0.031 inch (0.79 mm) applies to plate glass.

^b This dimensional limitation does not apply to glass panels in indoor signs unless the thickness is required to be as specified for outdoor signs.

7.2.2 A glass panel that is to be used to form the enclosure, as required by 5.1.1 for an indoor sign, shall be of the thickness specified for outdoor signs in Table 7.1.

7.2.3 The thickness of tempered flat glass, a glass lens, glass that is curved or bent, and glass having a fluted or ribbed surface, shall provide the mechanical strength determined to be equivalent to that of flat glass having the minimum thickness specified in Table 7.1.

7.2.4 The thickness of curved or bent glass shall not be less than that specified in Table 7.1 for the next smaller area range.

7.2.5 The minimum thickness of fluted or ribbed glass is to be measured over the rib unless the dimension of the glass along the rib is less than the dimension transverse to the rib.

7.2.6 The minimum thickness of glass having concentric ribbing is to be measured to the valley and is not to be less than that specified in Table 7.1 for the next smaller area range, and not less than 3/32 inch (2.4 mm).

7.2.7 The thickness of glass used for individually molded letters not more than 30 inches (762 mm) in any dimension shall be 1/8 inch (3.2 mm) or more.

7.2.8 The thickness of a letter larger than 30 inches (762 mm) in any dimension shall be such that it is at least as strong as a 30-inch letter that is 1/8 inch (3.2 mm) thick.

7.3 Support

7.3.1 There shall not be less than one clip on each side of a glass panel for each 6-inch (152-mm) length of glass, and clips shall not be spaced more than 3 inches (76.2 mm) nor less than 1-1/2 inches (38.1 mm) from corners of a glass panel.

Exception No. 1: An indoor sign having an exposed area of a glass panel of not more than 1000 square inches (0.64 m²), with the panel not relied on to provide the enclosure required by 5.1.1, is capable of using one clip for each 8 inches (203 mm) of edge, as determined by dividing the perimeter of the panel in inches by eight. The distance between adjacent edges of any two clips shall be 16 inches (406 mm) or less. A double clip, having a pair of fingers, each of which complies with the requirements in 7.3.3 is identified as being two clips.

Exception No. 2: For clips used with a raised-glass letter that is constructed to fit closely into an opening cut in the sheet-metal face, the spacing between clips is capable of being increased so that one clip is provided for each 8 inches of glass edge. Clips are not prohibited from being omitted on a side edge that is not more than 8 inches long. One clip is capable of being used on a side edge that is not more than 10 inches (254 mm) long. One clip is capable of being used on a top edge and on a bottom edge that is not more than 12 inches (304 mm) long, when each side edge is provided with a clip for every 6 inches of glass edge.

7.3.2 A clip or trough for securing an individually-molded letter in a sign shall overlap the glass not less than 1/2 inch (12.7 mm). The thickness of the clip or trough shall be as indicated in Table 7.2 or 7.3 for an indoor sign having an exposed area of glass of less than 1000 square inches (0.64 m²).

Exception: A raised-glass letter of the 6-inch (152-mm) trade size or smaller and constructed to fit closely into an opening cut in the sheet metal is capable of being held by clips having a 1/4 inch (6.4 mm) overlap when one clip is provided on each edge.

7.3.3 The dimensions of clips for securing glass panels in signs shall be as specified in Table 7.2.

7.3.4 Clips of materials other than steel, copper, aluminum, or alloys of these metals are capable of being used when investigated and determined to comply with the requirements for support.

Table 7.2
Dimensions of clips

Type of sign	Exposed area of glass panel, square inches (m ²)		Minimum dimensions									
			Thickness						Width, inch (mm)		Overlap, inch (mm)	
			Zinc-coated steel,		Uncoated steel,		Aluminum or copper,					
	inch	(m ²)	inch	(mm)	inch	(mm)	inch	(mm)	inch	(mm)	inch	(mm)
Indoor ^a	150 or less	0 – 0.097	0.017	0.43	0.016	0.41	0.020	0.51	3/32	2.4	3/16	4.8
	151 – 500	0.097 – 0.32	0.017	0.43	0.016	0.41	0.020	0.51	1/4	6.4	1/4	6.4
	501 – 1000	0.32 – 0.65	0.017	0.43	0.016	0.41	0.020	0.51	1/2	12.7	1/2	12.7
Outdoor	500 or less	0 – 0.32	0.017	0.43	–		0.020	0.51	1/2	12.7	1/2	12.7
	Over 500	Over 0.32	0.036	0.91	–		0.043	1.09	1/2	12.7	1/2	12.7

^a Shall be as specified for outdoor signs when the panel is relied on to form the enclosure required by 5.1.1.

Table 7.3
Dimensions of troughs

Type of sign	Exposed area of glass panel, square inches (m ²)		Minimum thickness							
			Zinc-coated steel,		Uncoated steel,		Aluminum or copper,		Minimum overlap,	
			inch	(mm)	inch	(mm)	inch	(mm)	inch	(mm)
Indoor ^a	150 or less	0 – 0.097	0.017	0.43	0.016	0.41	0.020	0.51	3/16	4.8
	151 – 500	0.097 – 0.32	0.017	0.43	0.016	0.41	0.020	0.51	1/4	6.4
	501 – 1000	0.32 – 0.65	0.017	0.43	0.016	0.41	0.020	0.51	1/2	12.7
	Over 1000	Over 0.65	0.025	0.64	–	–	0.035	0.89	1/2	12.7
Outdoor	500 or less	0 – 0.32	0.017	0.43	–	–	0.020	0.51	3/8	9.5
	Over 500	Over 0.32	0.025	0.64	–	–	0.035	0.89	1/2	12.7

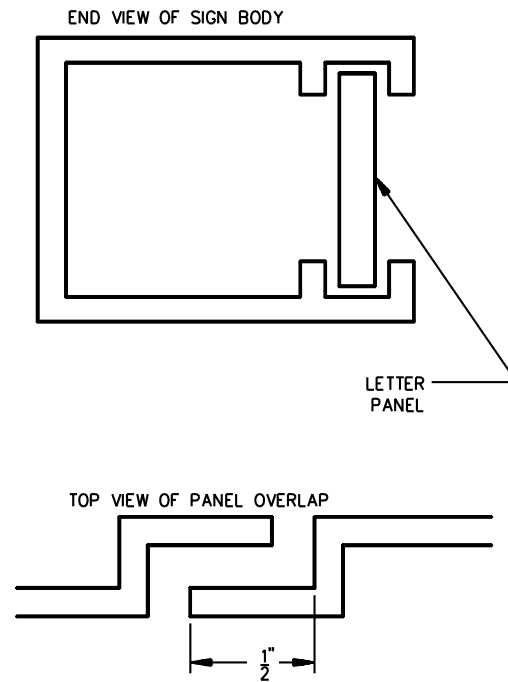
^a The dimensions of troughs for securing glass panels or letters are to be as specified for outdoor signs when the panel or letters form the enclosure required by 5.1.1.

7.3.5 Continuous troughs or glazing angles shall be used when the exposed glass area is more than 1000 square inches (0.64 m²).

7.3.6 The dimensions of a continuous trough for securing a glass panel in a sign shall be as specified in Table 7.3.

7.3.7 Individual sheet-metal sections supporting glass letters or panels, such as are used in signs with interchangeable letters where end clips are not feasible, shall be supported at top and bottom edges by troughs in the sign body. Each letter panel shall have an offset not less than 1/2 inch (12.7 mm) wide extending the length of one vertical edge so as to form a closely fitting overlap with the adjacent panel. See Figure 7.1.

Figure 7.1
Details of panel mounting



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8 Panels and Diffusers Other Than Glass

8.1 General

8.1.1 A diffuser or panel of thermoplastic material shall be securely supported.

8.1.2 A support clip or trough of material other than steel, copper, aluminum, or an alloy of these metals is capable of being used when investigated and determined to comply with the requirements.

8.2 Decorative and structural parts other than glass

8.2.1 Rigid external decorations, letters, and panels of a sign are capable of being of thermoplastic material, wood, or of other material at least as resistant to combustion when all of the following conditions are met:

- a) The material does not contact any neon tube, fluorescent lamp, or fluorescent-lamp starter.
- b) Combustible material is not subjected to temperature higher than the maximum limit; wood shall not be subjected to a temperature of more than 90°C (194°F).
- c) The material is maintained not less than 2 inches (50.8 mm) from a lampholder, starter-holder, the inside of the rim of an electrode receptacle, live metal, incandescent lamp, and other parts that are a source of heat or arcing.

Exception No. 1: In an indoor sign using fluorescent lamps only, the spacing shall not be less than 1/2 inch (12.7 mm).

Exception No. 2: In an indoor cord-connected sign using both fluorescent and incandescent lamps, the spacing from a fluorescent-lamp lampholder only to the material shall not be less than 1/2 inch.

Exception No. 3: A heat barrier of nonabsorptive material that has been determined to be at least as resistant to combustion as phenolic or similar thermosetting material is capable of being used instead of the required spacing when the heat barrier is not removable or constructed so that it must be replaced after repairing or relamping of the sign.

Exception No. 4: A polymeric material that has been investigated and determined to comply with the requirements for polymeric tube supports in 21.3.1 and 21.3.2, is capable of being spaced closer to, or in direct contact with, a neon tube, fluorescent lamp, fluorescent-lamp starter, or other source of heat.

Exception No. 5: The material is capable of being spaced 1 inch (25.4 mm) from a transformer, power supply or ballast when there is only one transformer, power supply or ballast within an enclosed compartment, or spaced 1/2 inch from a transformer, power supply or ballast when the transformer, power supply or ballast is not within an overall enclosure.

8.2.1 revised July 2, 2001

8.2.2 A flexible polymeric material used as external decorations, letters, and panels of a sign shall:

- a) Comply with the requirements in 5.1.3 and 5.1.4 and
- b) Be secured to the sign along the entire periphery of the material.

Exception: A non-continuous clamping or tensioning system for flexible material is not prohibited from being used when the system has been separately investigated and determined to be capable of being used for the application and is resistant to deterioration by aging.

9 HID Lamp Signs

9.1 A HID lamp sign shall comply with the Temperature Test, Section 36, unless all of the following conditions are met.

- a) All ballasts, wiring, and similar components are enclosed in metal. Also see Ballasts and Transformers, Section 27.
- b) The lamp watts-per-cubic foot does not exceed 26 watts per cubic foot (918 W/m³) and is to be determined by the following formula:

$$W/ft^3 = \frac{\text{Total Lamp Watts}}{\text{Length} \times \text{Width} \times \text{Height}}$$

(inside dimensions of lamp compartment)

- c) Spacing between a HID lamp and a polymeric material, between a HID lamp and an adjacent ballast, or a HID lamp and other components, complies with the clearances specified in Table 9.1.
- d) A light diffuser/heat barrier does not have openings exceeding 3/4 inch (19.1 mm) in any direction and has an opening-to-metal ratio not exceeding 1:1.
- e) No individual HID lamp exceeds 400 watts.

Table 9.1
Minimum clearances between HID lamps and components

Maximum lamp size, watts	Interposed metal light diffuser/heat barrier	Clearance,	
		inches	(mm)
250 or less	No	9.0	229
250 or less	Yes	7.0	178
400	No	12.0	305
400	Yes	9.0	229
NOTE – A minimum clearance of 24 inches (610 mm) is required between an HID lamp and combustible material located directly above the lamp.			

9.2 A HID lamp compartment shall be provided and shall be constructed of:

- a) 1/8 inch (3.2 mm) thick minimum tempered glass;
- b) 1/8 inch thick minimum material having a flammability classification of 5VA, 5VB, V-0, or V-1, when tested in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94;

Exception: Any 1/8-inch thick minimum polymeric material is capable of being used when it is positioned such that pieces of a ruptured lamp cannot come to rest on the material.

- c) A metal screen having maximum 1/16 inch (1.6 mm) openings; or
- d) A flexible polymeric material that complies with the requirements of 8.2.2.

9.2 revised May 14, 1999

10 Resistance to Moisture

10.1 Exclusion of water

10.1.1 The sign body, enclosure and doors of an outdoor sign shall exclude water. Seams are not required to be soldered or otherwise treated, and shall be tight and formed to shed water. Openings to accommodate neon tubing or neon tubing receptacles, or bushings shall not be located in the top of the enclosure unless the construction complies with the Exclusion of Water Test, Section 32.

10.1.1 revised July 2, 2001

10.2 Drain openings

10.2.1 An outdoor sign shall be provided with a drain opening at:

- a) The bottom of each of the lowest points of the sign,
- b) Isolated sections of a sign,
- c) Both sides of the pole for pole mounted signs, and
- d) Horizontal troughs or retainers for supporting sign faces, panels or letters.

Additionally, within isolated sections of a sign the distance between drain openings shall not exceed 4 feet (1.22 m) on center.

Exception: The sign body of a sign without a sign face is not required to have drain openings.

Revised 10.2.1 effective January 2, 2004

10.2.2 Each drain opening shall be positioned such that there are no external or internal obstructions and shall be free from burrs. The drain opening shall be on the bottom or bottom edge of the back surface. When circular in shape, a drain opening shall have a diameter of 1/4 – 1/2 inch (6.4 – 12.7 mm). When not circular in shape, a drain opening shall have a minimum dimension of not less than 1/4 inch (6.4 mm) and an area of 0.05 – 0.20 square inch (32.3 – 129.0 mm²). When a drain opening is located at the bottom edge of the back surface of a wall-mounted sign, the construction shall be such that the opening is located at least 1/2 inch (12.7 mm) from the mounting surface of the sign or the sign shall be provided with instructions as specified in Instructions, Section 41, and marked as specified in 40.1.15.

Exception: A barrier provided to block light from exiting the sign through a drain opening shall be spaced at least 1/4 inch (6.4 mm) from the surface provided with the drain opening. The method of securement of the barrier shall not reduce the area of the space between the barrier and the sign to less than the area of the drain opening.

Revised 10.2.2 effective January 2, 2004

10.3 Drain holes

10.3.1 *Deleted effective January 2, 2004*

10.4 Gaskets

10.4.1 A gasket used to seal a joint so that a sign complies with the requirement in 32.1 shall be of a material that is at least as strong and as resistant to aging as the materials described in 10.4.2.

10.4.2 Neoprene, rubber, neoprene-composition, and rubber-composition gasket materials are capable of being used when they have been separately investigated and determined to be:

- a) Rated or capable of being used for the application and
- b) Resistant to aging. See 33.1.

10.4.3 The gasket shall be secured so that it does not loosen from the mounting means.

10.4.4 The gasket of a gasketed joint that must be opened in order to relamp or change advertising material shall be secured in place by:

- a) Rivets, screws, or similar mechanical means or
- b) Adhesive that has been determined to be capable of being used after an evaluation of the flexibility, exposure resistance, shear strength, and peel resistance of the adhesive.

10.4.5 The gasket and securement of the gasket shall not be damaged when the joint is opened.

11 Provisions for Mounting and Support

11.1 Fixed signs

11.1.1 Each fixed sign or section of such a sign forming a complete assembly shall be provided with means for attaching it to a building or to a support or hanging rig.

11.1.1 revised July 2, 2001

11.1.2 The requirement in 11.1.1 requires the use of channel iron, strap iron, or similar reinforcement at points where attachment is to be made.

11.1.3 A canopy sign weighing 50 pounds (22.7 kg) (including lamps) or less shall be provided with supporting means, such as a strap or crossbar not more than 1-1/2 inches (38 mm) wide, or with one or two pairs of holes or keyhole slots for mounting the sign directly to a 3-1/2 inch (89 mm) or 4 inch (102 mm) outlet box.

11.2.1 revised and relocated as 11.1.3 July 2, 2001

11.1.4 A supporting strap or crossbar shall be secured to the sign by two or more fastenings, and shall not be less than 0.053 inch (1.35 mm) thick when of steel or 0.075 inch (1.91 mm) thick when of other metal.

Exception: A supporting strap that is reinforced by flanges along the edge shall be minimum 0.042 inch (1.07 mm) thick, when of steel and 0.058 inch (1.47 mm) thick, when of other metal.

11.2.2 relocated as 11.1.4 July 2, 2001

11.1.5 A canopy sign weighing more than 50 pounds (22.7 kg) (including lamps) shall be provided with means for support that is independent of the outlet box.

11.1.5 added July 2, 2001

11.2 Reserved for future use.

11.2.1 Revised and relocated as 11.1.3 July 2, 2001

11.2.2 Relocated as 11.1.4 July 2, 2001

11.3 Portable signs

11.3.1 A portable sign shall not have any provision for being permanently mounted.

Exception: A portable sign that is intended to be mounted on a cord-connected appliance, such as a refrigerated cabinet or a vending machine, or on portable, nonelectrical display equipment, such as a trailer or a store display, is not prohibited from having provision for permanent mounting.

11.3.1 revised July 2, 2001

11.3.2 A portable sign intended to be hung on a wall or other support shall be provided with:

- a) An exposed ring or hole having an inside diameter of 1/2 inch (12.7 mm) or more for wall mounting, or an exposed ring or hook hanger for chain mounting or
- b) A keyhole slot, a notch, or a hanger hole that is to be concealed when the sign is hung in the intended manner, and that is not accessible without removing the sign from the support.

11.3.2 revised July 2, 2001

11.3.3 A keyhole slot or notch shall not be located in the enclosure of a sign. It shall be located on, or in, the body of the sign so that a supporting screw or similar parts do not contact an uninsulated live part of the sign, such as a contact of a fluorescent lampholder.

11.4 Pendant support

11.4.1 A sign provided with a pendant shall have the pendant mechanically supported by chain or cable, or by a similar method.

Exception: Flexible cord as specified in Exception No. 2 of 19.1.3.2 is not prohibited from being used as the sole support of the pendant portion of a sign. See also Exception No. 5 of 5.1.1.

11.4.1 added July 2, 2001

12 Protection Against Corrosion

12.1 All sheet metal or other mechanical parts of iron or steel shall be zinc-coated, cadmium-plated, or otherwise protected against corrosion. Structural iron or steel parts shall be zinc-coated, cadmium-plated, enameled, painted, or provided with other means determined to provide equivalent protection against corrosion on all surfaces.

12.2 All zinc-coated exterior surfaces of an outdoor sign shall be painted.

Exception: Hot-dip galvanizing is capable of being used as the sole corrosion protection of sheet steel.

12.3 The exterior surfaces referenced in 12.2 are those surfaces on the outside of the complete sign that are exposed to the atmosphere.

12.4 The use of metal plating on a hinge, a bolt, or a similar small part shall be determined by means of a visual inspection of the plating.

12.5 A metal coating other than zinc on a sign face, a filler, or other large area is capable of being used when it is investigated and determined to be at least as resistant to corrosion as zinc-coated steel sheet rated for that purpose.

12.6 Painting of sheet metal is capable of being used as sole protection for an indoor sign only. Welds in iron or steel (other than stainless steel) shall be painted or provided with other means determined to provide an equivalent protection against corrosion.

12.7 Copper, stainless steel, aluminum, and similar materials having inherent resistance to atmospheric corrosion are not required to be additionally protected.

12.8 Lead-coated sheet steel, known as terneplate, is not required to be additionally protected on the inside surface of an indoor sign. The outside surfaces of such a sign shall be protected as required for uncoated sheet steel.

12.9 Vitreous enamel is not prohibited from being used as the only protective coating for sheet steel having a thickness of 0.031 inch (0.79 mm) or more.

12.10 Vitreous enamel is not prohibited from being used as the only protective coating for sheet steel having a thickness less than 0.031 inch (0.79 mm) when:

- a) The sheets are formed into channels or are otherwise reinforced and
- b) The coating is tested and determined to be capable of being used.

13 Fastenings

13.1 Each joint and edge in sheet metal shall be fastened, such as by welds, rivets, bolts, or screws, to form an assembly constructed for its intended use; or shall be a well-made, tight-fitting joint as illustrated in Figure 13.1.

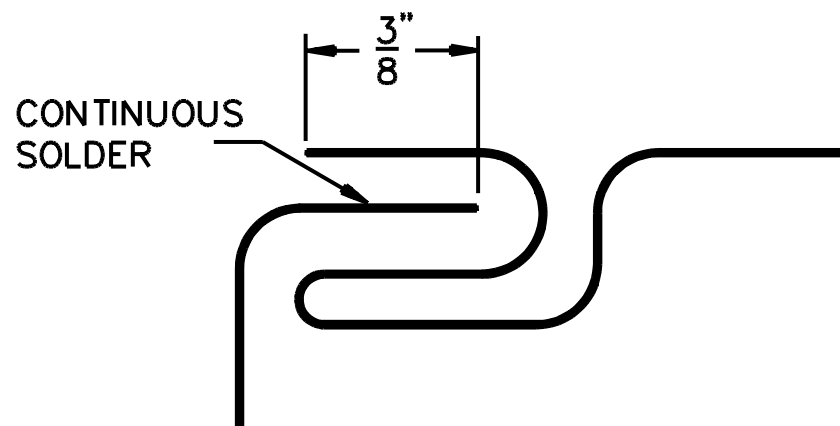
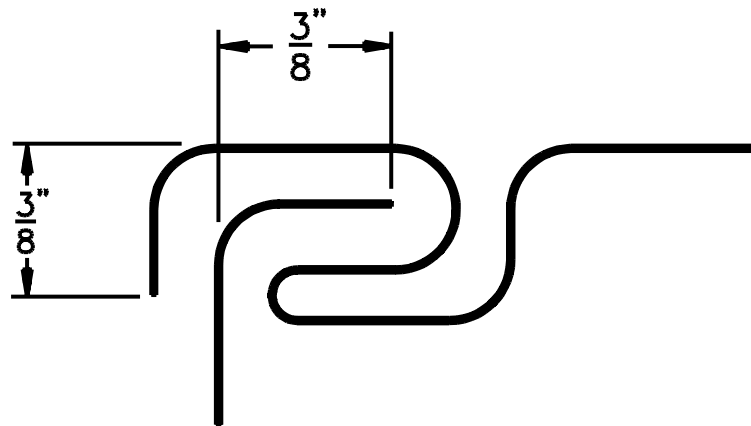
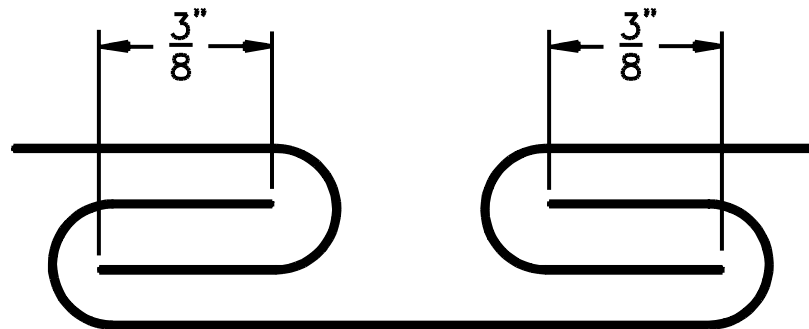
13.2 In a metal box sign, the requirement in 13.1 requires spacing of fastenings at intervals not exceeding:

- a) Eight inches (205 mm) for metal less than 0.031 inch (0.79 mm) thick;
- b) Twelve inches (305 mm) for:
 - 1) Metal not less than 0.031 inch thick, and less than 0.050 inch (1.27 mm) thick; and
 - 2) Metal less than 0.031 inch thick and mounted on a structural iron framework or where a hook seam (a seam in which at least three thicknesses of metal are engaged by the fastener) is used.
- c) Twenty-four inches (610 mm) for:
 - 1) Metal 0.050 inch thick or more; and

2) Metal less than 0.050 inch thick when the sheet-metal joints are locked and the sheet metal is mounted on a structural iron framework, and two rows of rivets or bolts are staggered.

Exception: An indoor cord-connected sign is capable of having fastenings spaced at greater distances when a reliable assembly is obtained.

Figure 13.1
Joints in sheet metal



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13.3 A sign face that completes the electrical enclosure of a sign or that is intended to exclude water and complies with the Exclusion of Water Test, Section 32, shall be secured to the sign body as specified in 13.1 and 13.2, or by a method determined to be equivalent by a separate investigation.

Exception No. 1: When one or more hinges are used, the number of fastenings is not prohibited from being less than that required by 13.1 and 13.2, when the construction provides a reliable enclosure.

Exception No. 2: A glass or thermoplastic panel is capable of being hinged when the construction complies with the requirements in 13.3; Mechanical Assembly, Section 15; and the Exclusion of Water Test, Section 32.

13.4 A sheet-metal nut of heat-treated (hardened) steel is capable of being used in place of a machine nut on a machine screw or bolt that is 1/4 inch (6.4 mm) or less in diameter, and that is used to fasten:

- a) Joints or edges in sheet metal or
- b) A part, such as a transformer, a ballast, a lampholder, or similar components.

13.5 In an outdoor sign, sheet-metal nuts shall be protected against corrosion in accordance with 12.1.

13.6 A self-threading or sheet-metal screw shall not be used in sheet aluminum, copper, or aluminum- or copper-base alloys.

Exception: Such a screw is capable of being used when the screw:

- a) Passes through an aluminum, a copper, or an aluminum- or copper-base alloy sheet, and threads into steel or*
- b) Threads into sheet aluminum, copper, or an aluminum- or copper-base alloy sheet, when the threads cannot be stripped with the screw drawn up as tightly as possible, using an 8-inch (203-mm) screwdriver having a blade of the required type and size.*

13.7 Machine screws, rivets, or similar securing means shall be used for fastening a part such as a ballast, a transformer, or a similar component that weighs more than 7-1/2 pounds (3.4 kg).

Exception: Sheet-metal or self-threading screws, or other fastenings are capable of being used for this purpose when the construction is investigated and determined to have the strength required for the intended purpose.

13.8 A letter is capable of being fastened by continuous soldering at joints in place of other fastenings when the construction is such that the letter does not fall outward when the solder releases.

13.9 For the sign body proper, steel surfaces having a length or width less than 10 inches (254 mm), and copper surfaces having a length or width less than 36 inches (914 mm), are capable of being secured solely by being soldered continuously at joints for their entire length and width.

13.10 A sheet-metal channel or other reinforcing member shall not rely solely upon solder for securing it in place.

13.11 Screws and bolts shall be located or protected so that the threads do not damage the insulation on any conductor.

13.12 Screw threads, including those of sheet-metal screws, are capable of being exposed in a wiring compartment for a distance of not more than 3/16 inch (4.8 mm), when not in contact with any wires.

Exception: Screw threads are capable of being exposed for more than 3/16 inch when the wires are held away, or are positioned away, from such screws.

14 Accessibility of Live Parts

14.1 The terminals of a lamp are determined to be a live part when any terminal of that lamp is in contact with an uninsulated live part involving a potential of more than 300 volts.

14.2 No live part of an indoor or a portable outdoor sign shall be accessible while an incandescent or fluorescent lamp, or a fluorescent-lamp starter is being replaced; or while a simple operation, such as the changing of interchangeable advertising material, is being performed.

Exception: The lamp contacts of screw-shell-type lampholders are not prohibited from being accessible while a lamp is being replaced.

14.3 An indoor or a portable outdoor sign using a fluorescent-lamp ballast marked with an output potential greater than 300 volts shall comply with one or more of the following:

a) The sign shall have the primary circuit interlocked so that the circuit is automatically de-energized during the relamping operation and all live parts shall not be accessible when the lamp is removed and the primary circuit is reenergized.

Exception: This requirement does not apply when all uninsulated live parts supplied from the primary circuit and operating at a potential greater than 300 volts are enclosed by a door or cover that is fastened so that it cannot be opened with a flat-blade screwdriver.

b) The sign shall use lampholders of the recessed-contact type having contacts intended for use with lamps having recessed contacts. These types of lampholders are normally for use with high-output lamps rated in the range of 800 to 1500 milliamperes and greater than 40 watts.

c) A sign using a ballast marked "For Use With Circuit Interrupting Lampholders," or an equivalent marking, shall use lampholders of this type only and shall be wired so that when a lamp is removed the potential in that lamp circuit is less than 300 volts.

14.4 An indoor or a portable outdoor sign that is intended to have the lamps replaceable without opening the enclosure shall be constructed so that live parts and live connections are not exposed to unintentional contact while lamps are being replaced.

Exception: Wiring and components connected in a Class 2 circuit that does not alter the circuit to be other than Class 2 is not required to be made inaccessible.

14.4 revised September 3, 1998

14.5 When an uninsulated, current-carrying part involving a potential of greater than 300 volts in an indoor or a portable outdoor sign is accessible when a door is opened or a cover removed, the door or cover shall be fastened so that it cannot be opened with a flat-blade screwdriver; or shall be provided with an interlock that disconnects the primary circuit when the door or cover is opened or removed.

14.6 A door or cover is fastened as required by 14.5 when at least two screws fastening it are soldered to the enclosure, ground off, or similarly treated so that they cannot be removed with tools such as pliers or a screwdriver. Other means are not prohibited from being used when investigated and determined to be capable of being used for the application.

14.7 An outdoor, permanently-installed sign using a fluorescent lamp and involving a potential of more than 300 volts shall have no live part exposed to unintentional contact while a lamp is in place or removed, or while it is being inserted or removed.

14.8 An outdoor permanently installed sign using combinations of neon tubing, fluorescent lamps, HID lamps, or incandescent lamps shall not have live parts involving a potential of more than 300 volts exposed to unintentional contact during relamping of the fluorescent- or incandescent-lamp portions of the sign.

14.8 revised July 2, 2001

14.9 A motor with a brush-holder assembly shall be constructed so that when a brush is worn out (no longer capable of performing its function) the brush, spring, and other parts of the assembly are to be retained to the degree required, to reduce the risk of:

- a) An accessible dead metal part becoming energized and
- b) A live part becoming accessible.

14.10 A fuseholder, flasher, switch, or similar device, or combination of components, when on or within the sign, shall be mounted in one or more accessible enclosures. See 14.11.

Exception: In an indoor sign, a switch is not required to be mounted in a separate compartment when the switch:

- a) Has no exposed operating or current-carrying parts and*
- b) Is located within the sign so that it complies with the requirements in 14.1– 14.8.*

14.11 The enclosure specified in 14.10 shall be of metal not thinner than that required for the sign itself, and is capable of being formed in part by surfaces of the sign body. In an outdoor sign, the components described in 14.10 shall be mounted completely within an accessible enclosure which, in turn, complies with the Exclusion of Water Test, Section 32. See 13.6 and 13.7 for methods of securement.

15 Mechanical Assembly

15.1 Hinges

15.1.1 A sign face that is used to complete an electrical enclosure or an enclosure that is intended to exclude water and complies with the Exclusion of Water Test, Section 32, is not prohibited from being secured to the sign body by means of one or more hinges and one or more other fastenings, when the hinged face is securely attached to the sign body and when the face is in either the open or closed position.

15.1.2 A hinge shall be reliably secured to the sign body and to the sign face. For an outdoor sign, a hinge shall be of metal at least 1/16 inch (1.6 mm) thick.

15.2 Electrical devices

15.2.1 A switch (other than a through-cord switch), a lampholder, an attachment-plug receptacle, a motor-attachment plug, or a similar component shall be mounted securely and shall be prevented from turning.

Exception: A switch is not required to be prevented from turning when:

- a) The switch is normally operated by mechanical means rather than by persons;*
- b) The switch is of a plunger or other type that does not rotate when operated. A toggle switch has been identified as subject to forces that tend to turn the switch during the normal operation of the switch;*
- c) The means for mounting the switch during operation of the switch, does not loosen the switch; and*
- d) The spacings are not reduced below the minimum required values when the switch rotates.*

15.2.2 The means for preventing the turning specified in 15.2.1 is to consist of more than friction between surfaces. For example, a properly applied lockwasher is capable of being used as the means for preventing the turning of a small, stem-mounted switch or other device having a single-hole mounting means.

15.2.3 An electrical device shall not be mounted on a hinged, sliding, or removable door or cover or removable part of a sign when the opening of the door or cover, or the removal of the removable part is required for the replacement of a lamp or lamp starter, or for the performance of other user-servicing operations, such as the changing of advertising material, or when such opening or removal disturbs the internal wiring.

15.3 Signs shipped in sections

15.3.1 A sign is capable of being shipped in sections only when the sections form a complete sign and complete instructions for field-reassembly are provided.

15.3.2 A section shall not be shipped for field installation to an existing sign.

15.3.3 All wire, fittings, bushings, or similar devices, shall be provided for joining the sections.

15.3.4 A section shall be constructed so that when water enters the section or a joint between sections, the water is not capable of contacting components as specified in 32.1. When required, sections shall be joined together and subjected to the test described in 32.2. Field treatment for preventing the entrance of water, such as caulking, is to be disregarded.

15.3.5 Splice compartments shall be provided for all of the conductors to be joined. The compartments shall be accessible for assembly and examination of splices.

15.3.6 A ballast for the control of a fluorescent lamp is not required to be located in the same section as the fluorescent lamp. When the ballast of an individual letter or sign is located outside the sign enclosure, the lamp circuit is not required to be complete before it leaves the factory when all required terminals, bushings, fittings, or similar devices are in place as part of the sign and are arranged so that the connections are capable of being made readily and as required upon installation.

15.3.7 Each ballast lead shall be numbered, and wire connectors or plug and receptacle connections that have been investigated and determined to be as required or are capable of being used, shall be provided. Other arrangements shall be determined by investigation.

16 Supply Connections

16.1 Permanently-connected signs

16.1.1 A sign intended for permanent connection shall have provision for the connection of a permanent wiring system. A field-wiring compartment provided on or within a sign shall be accessible after installation. When a box or fitting is supplied on the outside of the enclosure of an outdoor sign for this purpose, it shall comply with the Exclusion of Water Test, Section 32.

16.1A General

16.1A.1 Signs shall not be connected to a branch circuit exceeding 20 amperes.

Exception: Signs incorporating neon tubing are not prohibited from being connected to a branch circuit not exceeding 30 amperes.

Added 16.1A.1 effective January 2, 2004

16.2 Conduit, electrical tubing, and cable

16.2.1 An outlet box, conduit fitting, cable connector, or similar component is not prohibited from being used as a connecting means when rated for the purpose, or investigated and determined to be capable of being used. A single opening to accommodate a connector or a box is capable of being used when the interior of the sign raceway is accessible at that point.

16.2.2 Leads provided for splice connection to branch-circuit wiring shall:

- a) Not be shorter than 6 inches (152 mm),
- b) Not be smaller than No. 18 AWG (0.82 mm²), and
- c) When leads are of appliance wiring material (AWM), have insulation not less than 1/32 inch (0.8 mm) thick.

16.2.2 revised December 19, 1996

16.2.3 Appliance wiring material is capable of being used in an outdoor sign when the appliance wiring material leads terminate in an accessible, rain-tight compartment within the sign. The leads are to be of such length that they cannot be extended outside the sign.

16.2.4 Insulated wire of the types specified in Line 1 of Table 19.1 is not prohibited from extending outside of an outdoor sign.

16.2.5 A strain-relief shall be provided so that a strain placed on a field-wiring lead is not transmitted to a terminal or splice when tested in accordance with the Strain-Relief Test, Section 34.

Exception: A strain-relief is not required to be provided when the conductor is integral to a ballast, lampholder, or similar component that complies with the applicable requirements for the component, and the component is required to have strain-relief.

16.2.6 A knot in a stranded conductor is not prohibited from serving as a strain-relief when the surface on which the knot is capable of bearing, or with which it is capable of contacting, is free from projections, sharp edges, fins, or similar parts that results in damage to the conductor insulation.

16.3 Cord-connected signs

16.3.1 The power-supply cord shall be:

- a) For an indoor sign, Type S, SJ, SJO, SJT, SJTO, SV, SVO, SVT, SVTO, SP-2, SP-3, SPT-2, SPT-3, SO, ST, or STO or greater;
- b) For an outdoor trailer-mounted sign, Type SW, SOW, STW, STOW or greater; or
- c) For an outdoor sign other than an outdoor trailer-mounted sign, Type SW, SJW, SJOW, SJTW, or SJTOW or greater.

Exception: A cord is not required to be of the types specified when the cord has such properties that it is at least equally serviceable for the application.

16.3.1 effective September 3, 1999

16.3.2 The length of a power supply cord shall be as specified in item (a) or (b):

- a) For an indoor sign, the cord shall be 6 – 15 feet (1.83 – 4.57 m) long.

Exception: A wall-mounted sign is permitted to have a minimum 1-1/2 foot (0.46 m) cord.

- b) For a portable outdoor sign, see Table 16.1.

16.3.2 revised September 3, 1998

Table 16.1
Supply-conductor size for portable outdoor signs

Revised Table 16.1 effective January 2, 2004

Length of cord, feet (m)		Minimum cord-conductor size, AWG No. (mm ²)					
		15-ampere plug		20-ampere plug		30-ampere plug	
6 – 50	1.8 – 15	14	2.1	12	3.3	8	8.4
Over 50	Over 15	12	3.3	10	5.3	6	13.3

16.3.3 The length of a flexible cord is to be measured from the face of the attachment plug to the point where the cord emerges from the sign.

16.3.4 All conductors of a cord shall be of the same size and shall comply with Table 19.2.

16.3.5 Conductors are capable of being routed directly to the terminals or leads of a ballast or transformer when the spacing between the conductors and the ballast or transformer is maintained, as required by Table 19.3, as near to the device as possible.

16.3.6 When provision for grounding is required, the power-supply cord shall also contain an insulated equipment grounding conductor that is green with or without one or more yellow stripes.

16.3.7 Unless otherwise marked, a flexible cord is identified as rated 60°C (140°F).

16.3.8 A through-cord switch or other wiring device shall not be installed in a cord of an outdoor sign.

16.3.9 A braidless parallel cord having integral construction shall not be separated for a distance of more than 3 inches (76 mm) to permit connections to terminals or interior wiring.

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16.3.10 An attachment plug or other fitting determined to be capable of being used for the intended application, shall be provided on the supply end of the cord. For an outdoor-use sign, the plug shall be of a grounding type, of butyl rubber, neoprene, or PVC, and molded to the flexible cord so that it adheres tightly to the jacket where the cord enters the plug. See 16.3.11.

16.3.11 To determine whether the adhesion between the cord and the body of the attachment plug is as intended for the purpose, the cord is to be sharply bent to an angle of 90 degrees from the plane of the cord entrance and visually examined for openings that permit the entry of moisture into the body of the plug.

16.3.12 A means shall be provided to protect the permanently attached supply cord of an outdoor sign from mechanical damage while the sign is in transit or storage. The protection is capable of being a compartment or storage reel. See 40.2.2.

16.3.13 An outdoor, cord-connected sign shall be provided with a Class A ground-fault circuit-interrupter as referenced in 28.5.1 and 28.5.2. Ground-fault protection capability shall not be impaired when:

- a) The grounded and ungrounded conductors are transposed at the attachment plug (the polarity is reversed) or
- b) An open circuit is present in either:
 - 1) The grounding conductor or
 - 2) One of the current-carrying conductors.

16.3.14 An insulating bushing shall be provided where a flexible cord enters the sign enclosure. See 19.4.5 – 19.4.7.

Exception No. 1: A smooth metal bushing, grommet, or a rolled metal edge is capable of being used instead of an insulating bushing when a Type SJ, SJO, SJT, SJTO, S, SO, ST, or STO cord is used.

Exception No. 2: When the cord hole is in insulating material, such as wood, porcelain, or phenolic composition, a smooth, rounded surface is identified as equivalent to a bushing.

16.3.15 A strain-relief shall be provided so that a mechanical stress on the supply cord is not transmitted to a terminal, splice, or internal wiring. The cord shall be prevented from being displaced within the sign enclosure so as to reduce spacings to values less than the minimum rated values.

Exception: A strain-relief is not required to be provided when the conductors of the supply cord are assembled to a wiring device, such as a switch, a lampholder, or similar component, by the manufacturer of the wiring device in such a manner that replacement of the cord requires the disassembly of the wiring device by the removal of a rivet, a drive screw, a drive pin, or by other means determined to be equivalent.

16.3.16 A knot in the cord inside the enclosure at the point of entrance is capable of being used to reduce the risk of stress on the terminal connections. A metal clamp is capable of being used on a Type SJ, SJO, S, or SO cord. A combination bushing and strain-relief device is capable of being used either to provide strain-relief or to reduce the risk of internal displacement of the cord or both.

16.3.17 When a knot in a flexible cord serves as a strain-relief, a surface against which the knot is capable of bearing, or with which it is capable of coming in contact, shall be free from projections, sharp edges, burrs, fins, or similar parts that damage the cord.

16.3.18 A strain-relief shall be provided so that a pull exerted on the flexible cord is not transmitted directly to the binding-screw terminals of the attachment plug.

17 Polarization

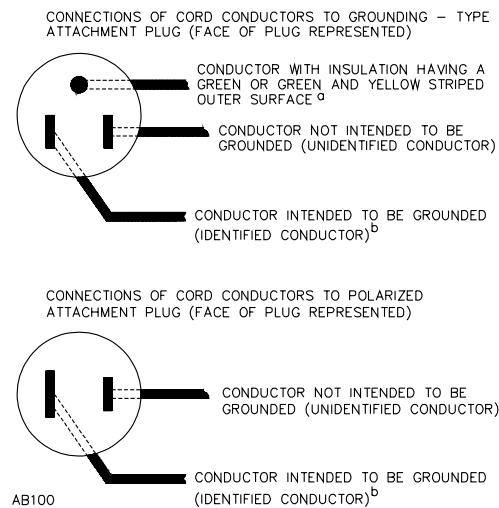
17.1 A cord-connected sign shall be provided with a 3-wire, grounding-type attachment plug or, a 2-wire, polarized attachment plug. The attachment plug shall be configured as shown in Figure 17.1, and the polarity identification of the flexible cord shall be as specified in Table 17.1.

17.2 The conductor that is intended to be connected to the grounded supply conductor shall have the following items connected to it:

- a) The screw shell of an Edison-base lampholder and
- b) The terminal or lead of a receptacle intended to be grounded. Table 17.1 identifies the conductor that is intended to be connected to the grounded supply conductor.

17.3 A single-pole switch or circuit breaker shall not be connected in series with the grounded supply conductor.

Figure 17.1
Connection to attachment plug



^a The blade to which the green conductor is connected is not prohibited from having a U-shaped or circular cross-section.

^b Signifies a conductor identified in accordance with Table 17.1.

Table 17.1
Polarity identification of conductors

Method of identification	Wire combinations, with combinations in compliance with this standard	
	Wire intended to be connected with the grounded power-supply conductor ^a	All other wires ^a
Color of braids on individual conductors	Solid white or natural gray – without tracer	Solid color other than white or natural gray, without tracer
	Color other than white or natural gray, with tracer in braid	Solid color other than white or natural gray, without tracer
Color of insulation on individual conductors	Solid white or natural gray wire ^b	Solid color other than white or natural gray
	Light blue wire ^c	Solid color other than light blue or white
Color of separators	White or natural gray wire ^d	Color other than white or natural gray
Other means	Tin or other white metal on all strands of the conductor ^e	No tin or other white metal on the strands of the conductor
	A stripe, ridge, or groove on the exterior surface of the cord ^d	

^a A wire finished to show a green color with or without one or more yellow stripes or tracers is to be used only as an equipment grounding conductor. See 16.3.6 and 18.18.

^b Only for cords other than Types SP-1 and SPT-1, having no braid on any individual conductor.

^c For jacketed cord.

^d Only for Types SP-1 and SP-2 cords.

^e Only for Types SPT-1 and SPT-2 cords.

18 Grounding and Bonding

18.1 A sign shall have provision for grounding all dead metal parts that are exposed or accessible to contact by persons including parts that are contacted during relamping.

Exception No. 1: Dead metal parts that do not become energized.

Exception No. 2: A cord-connected sign with only user-accessible, dead-metal parts that do not become energized is not required to have provision for grounding when the sign is provided with a two-wire, polarized attachment plug and complies with the requirements for Polarization, Section 17.

18.2 All conductive parts of a sign that are not intended to be electrically live, that are accessible to persons, and that become energized, shall be grounded by being conductively bonded to a common point that incorporates provision for grounding of the sign. The bonding means specified in 18.6, or the provision of a knockout or other opening in the enclosure for the connection of rigid metal conduit, metal raceway, or similar parts that are capable of being used as a means for bonding. The thickness of metal at the point of connection of conduit shall be as specified in Table 5.1.

Exception: Chain links on a cord-connected sign are not required to be conductively bonded.

18.3 Isolated dead metal parts of a sign using neon tubing shall be bonded to the grounded metal of the sign enclosure.

18.3 revised July 2, 2001

18.4 A No. 18 AWG (0.82 mm²) stranded fixture wire or a No. 14 AWG (2.1 mm²) solid wire is capable of being used for the bonding required by the requirements in 18.1 and 18.2.

18.5 A cord-connected sign shall be provided with a three-conductor supply cord. See 16.3.4. The grounding conductor of the supply cord shall be connected to user-accessible metal of the sign and to the fixed grounding member of a grounding attachment plug.

18.6 A bonding means shall be secured to a sign by a machine screw, self-tapping screw, rivet, or similar securing means.

Exception: A sheet metal screw is capable of being used to secure a bonding means when:

- a) It is not removed during the servicing of a component;*
- b) It is not used for connection of an equipment-grounding conductor; and*
- c) The screw and the material into which it is threaded comply with the Exception to 13.6.*

18.7 Liquid-tight flexible metal conduit, flexible metal conduit, and flexible metallic tubing is used as a grounding means when it:

- a) Does not exceed 6 feet (1.83 m) in total length;
- b) Is used in a circuit rated 20 amperes or less; and
- c) Is used with grounding-type fittings rated or determined to be capable of being used for the intended purpose.

18.8 A field-wiring compartment shall use a wire-binding screw, pressure wire connector, grounding lead, or other means determined to be equivalent, for the connection of an equipment-grounding conductor in the field. See 18.9 – 18.11.

18.9 A pressure wire connector provided for connection of an equipment-grounding conductor in the field shall be prevented from rotating by means other than friction between the terminal and mounting surface.

18.10 A terminal intended for the field-connection of an equipment-grounding conductor shall be capable of securing a conductor of the size rated for the application and shall be identified by use of:

- a) A wire-binding screw with a green-colored head that is slotted or hexagonal, or both; or
- b) A threaded stud with a green-colored hexagonal nut; or
- c) A green-colored pressure-terminal connector; or
- d) Being marked "G," "GR," "GND," "Ground," "Grounding," or with a similar marking; or
- e) A marking on a wiring diagram provided on the product.

18.11 A wire-binding screw as described in 18.13 is not prohibited from being used at a wiring terminal intended to accommodate a No. 10 AWG (5.3 mm²) or smaller conductor. Upturned lugs, a cupped washer, or other means determined to be equivalent, shall be provided to hold the wire in position.

18.12 The upturned lugs and cupped washers required in 18.11 shall be capable of retaining a No. 14 AWG (2.1 mm²) or larger supply conductor under the head of the screw or washer.

18.13 A wire-binding screw shall not be smaller than No. 8 (4.2 mm diameter).

Exception: A No. 6 (3.2 mm diameter) machine screw is not prohibited from being used at a terminal intended only for the connection of a No. 14 AWG (2.1 mm²) conductor.

18.14 A terminal plate for a wire binding screw used for field wiring shall be of metal having a thickness as specified in Table 5.1. There shall be at least two full threads in the metal, which is not prohibited from being extruded when required to provide the threads.

18.15 The wire-binding screw, pressure wire connector, lead, or similar connector intended for connection of an equipment-grounding conductor shall be located so that it will not be removed during servicing of the sign.

18.16 An equipment-grounding conductor or bonding wire shall not be terminated by a screw, rivet, or equivalent device that also secures a device, or similar part that is removable during any servicing of the sign.

18.17 An equipment-grounding conductor shall be secured by:

- a) A machine screw and nut;
- b) A machine screw that threads into metal that engages at least two full threads;
- c) A rivet; or
- d) An equivalent means as determined by an investigation.

18.18 The surface of an insulated lead intended for field 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.

18.19 The continuity of the grounding system shall not rely on the dimensional integrity of a polymeric material.

Exception: This requirement does not apply to a polymeric material that has been investigated and determined to comply with 5.1.3, 5.1.4, and 13.7, and the torque requirements in Note (e) of Table 5.1.

18.20 In a sign provided with a dedicated receptacle or receptacles as described in 25.1.1 – 25.1.4, all grounding parts of each receptacle shall be conductively connected to:

- a) The equipment grounding terminal or lead,
- b) The point of attachment of the wiring system, or
- c) The point at which the grounding conductor of the initial sign power supply cord is connected,

so that the resistance between any two points in the conductive path is 0.1 ohm or less.

18.21 The resistance specified in 18.20 is to be measured by an ohmmeter or similar equipment, except that when results not complying with the requirements are observed, an alternating current of 20 amperes or more from a power supply of 12 volts or less is to be passed from the point of connection of the grounding conductor of the sign power supply cord to the grounded metal part being tested, and the resulting drop in potential is to be measured between the two points. The resistance in ohms is to be determined by dividing the drop in potential in volts by the current in amperes passing between the two points.

19 Low-Voltage Wiring

19.1 General

19.1.1 Low-voltage wiring is wiring that does not involve a potential greater than 1000 volts.

19.1.1 revised July 2, 2001

19.1.2 Appliance wiring material of a sign shall have a minimum insulation wall thickness of 1/32 inch (0.8 mm) and be rated for the voltage and temperature involved.

Exception: Exception: Appliance wiring material with less than 1/32 inch (0.8 mm) insulation wall thickness is acceptable when determined to be capable of being used for the particular application.

19.1.2 revised July 2, 2001

19.1.3 Wiring of a sign shall be in accordance with Table 19.1.

19.1.3 revised July 2, 2001

19.1.3.1 Flexible conductors used as wiring of a sign between the pendant and canopy of an indoor permanently-connected chain-supported pendant canopy sign shall:

- a) Be placed through the links of the chain;
- b) Be rated 600 volts and be one of the types enumerated in Table 19.4, or of a type determined to be equivalent; and
- c) Be arranged such that the conductors do not carry any of the weight of the sign. See also Exception No. 5 of 5.1.1.

19.1.3.1 added July 2, 2001

19.1.3.2 Flexible cord shall not be used as wiring for signs.

Exception No. 1: Flexible cord is not prohibited from being used as wiring in an indoor permanently-connected chain-supported pendant canopy sign when:

- a) The flexible cord is used between a pendant and canopy and is placed through the links of the chain;*
- b) The flexible cord has no more than 6 inches (152 mm) at each end of the cord inside the sign;*
- c) The flexible cord is one of the types enumerated in 16.3.1; and*
- d) The flexible cord does not support any of the weight of the sign. See also Exception No. 5 of 5.1.1.*

Exception No. 2: Flexible cord is not prohibited from being used as wiring in an indoor permanently-connected pendant canopy sign, indoor permanently-connected wall-mounted sign provided with a pendant, or an indoor cord-connected freestanding sign provided with a pendant when:

- a) The flexible cord is used between the pendant and canopy or body of the sign;*
- b) The cord has no more than 6 inches (152 mm) at each end of the cord inside the sign;*
- c) The total weight of the sign is 10 pounds (4.5 kg) or less;*
- d) The cord is Type S, SO, ST, STO, SJ, SJO, SJT, SJTO, or another cord determined to be equivalent;*
- e) The cord is installed to comply with 16.3.14 – 16.3.18; and*
- f) All exposed dead metal parts are grounded in accordance with 18.1 – 18.4. See also Exception No. 5 of 5.1.1 and the Exception to 11.4.1.*

With reference to (d), standard types of flexible cord other than those specified are not identified as rated for the support of pendant signs or the pendant portion of a sign. A cord not mentioned above is to be subjected to an investigation to determine whether the cord is capable of being used as the support of a pendant sign or the pendant portion of a sign.

Exception No. 3: Types SO and STO flexible cord are not prohibited from being used as wiring of a sign where essential flexibility is required and when the cord is exposed only during relamping or changing advertising material.

Exception No. 4: Flexible cord is not prohibited from being used as wiring in indoor cord-connected signs.

19.1.3.2 added July 2, 2001

19.1.4 All conductors shall be 18 AWG (0.82 mm²) or larger and shall be sized in accordance with Table 19.2.

Exception No. 1: Conductors connected to the output of a transformer or power supply having a maximum output of 30 volts and 10 amps are not required to be 18 AWG (0.82 mm²) or larger.

Exception No. 2: Integral conductors of components which have been evaluated and determined to be acceptable for this use are not required to be 18 AWG (0.82 mm²) or larger.

Exception No. 3: No. 20 AWG (0.52 mm²) conductors on a synchronous clock-type motor are not prohibited from being used when the conductors are permanently attached and are not more than 6 inches (152 mm) in length.

Exception No. 4: A sign not intended for continuous duty is not prohibited from having conductors sized based on a rating 20 percent greater than the maximum current rating specified in Table 19.2 when the sign is marked in accordance with the requirement in 40.1.14 for a permanently-connected sign or 40.2.5 for a cord-connected sign.

19.1.4 revised July 2, 2001

19.1.5 No. 16 AWG (1.3 mm²) or No. 18 AWG (0.82 mm²) leads as specified in Table 19.2 are not prohibited from being connected:

- a) Together when the combined length of such leads does not exceed 8-1/2 feet (2.59 m) and
- b) To any length of No. 14 AWG (2.1 mm²) conductor.

19.1.6 Wiring shall be positioned away from ballast and transformer enclosures in accordance with Table 19.3.

Exception No. 1: At wiring terminals, when the required spacing is obtained as near the terminal as possible.

Exception No. 2: Within a terminal compartment or splice box that is integral with a ballast.

Exception No. 3: Between a ballast having a splice box or terminal compartment integral with the ballast, and a wire in a raceway, conduit or tubing terminating in the box or compartment.

Exception No. 4: Within a splice box or wiring-terminal compartment that is integral with a ballast, wiring rated for 60°C (140°F) is not prohibited from contacting the ballast enclosure unless the box or compartment is marked to indicate that wire rated for 75°C (167°F) is to be used.

19.1.6 revised July 2, 2001

19.1.7 With reference to the requirements in 19.2, the temperature limits specified in Table 19.4 are applicable for the different types of wire enumerated.

19.1.8 The voltage rating of the secondary-circuit wiring of fluorescent or HID lighting sign shall not be less than the maximum voltage rating marked on the ballast or ballasts to which it is connected.

20.1.7 revised and relocated as 19.1.8 July 2, 2001

19.2 Splices and connections

19.2.1 When a combination or neon tube sign that is built in sections or involves a number of individual letters is supplied with low-voltage lead wires that must be connected after installation, a sheet-metal box or enclosure not thinner than the metal of the sign itself shall be provided in each section or letter to house the splices, unless the arrangement of the conductors is such that there is no reduction of the spacing between high- and low-voltage wires.

19.2.1 revised July 2, 2001

Table 19.1
Wiring

Table 19.1 revised July 2, 2001

Type of wire	Permanently-connected sign		Cord-connected sign	
	Indoor	Outdoor	Indoor	Outdoor
Type MTW, RH, RHW, RHH, T, TW, THW, THWN, THHN, or XHHW wire, or Type UF cable	A ^a	A	A	A
Armored cable	A	A	A	A
Metal-clad cable	A	A	A	A
Fixture wire	A ^a	X	A	X
Appliance-wiring material ^b	A ^a	A	A	A
A – Complies with the requirements				
X – Does not comply with the requirements				
^a See 19.1.3.1.				
^b See 19.1.2.				

Table 19.2
Sign circuits

Table 19.2 revised July 2, 2001

Current ^{a,b} amperes	Minimum conductor size,	
	AWG	(mm ²)
0 – 10	18 or 16	0.82 or 1.3
over 10 – 12	14	2.1
over 12 – 16	12	3.3
over 16 – 24	10	5.3
^a See 19.1.4, Exception No. 3.		
^b See 19.1.4, Exception No. 4.		

Table 19.3
Spacings between internal wiring and components

Table 19.3 revised July 2, 2001

Minimum temperature rating of wire ^a or cord,		Position and spacing ^b of wiring
°C	(°F)	
60	140	Permanently spaced not less than 3 inches (76 mm) from any ballast or transformer.
80 ^c	176	Less than 3 inches from, and not in contact with, any ballast or transformer, other than for permanently attached leads at the point of entry to the ballast or transformer.
90 ^c	194	In contact with any ballast or transformer.
^a A permanently attached neoprene-insulated lead without a braid provided as a part of a ballast or a lampholder for a fluorescent or HID lamp is rated for a temperature of 90°C (194°F). Other permanently attached leads are rated for a temperature of at least 75°C (167°F).		
^b Spacings are not specified for wiring routed through a glass tube as described in 29.2.3.		
^c Wiring rated for a temperature of 75°C (167°F) or more is not prohibited from being used when provided with an outer braid.		

Table 19.4
Temperature and voltage ratings of wires

Table 19.4 revised July 2, 2001

Maximum temperature, ^a		Maximum potential and types of wire		
°C	(°F)	300 volts	600 volts	1000 volts
60	140	—	RH, T, TF, TFF, TW	—
75	167	FFH-1, RFH-1	FFH-2, RFH-2, RH, RHW, THW, THWN	RH ^b , RHW ^b
90	194	—	RHH, THHN, XHHW, MTW	RHH ^b , THW ^c
150	302	SFF-1	SFF-2	—
200	392	SF-1	SF-2	—

^a Certain wires are identified as to temperature by a colored thread under the insulation or braid covering, a colored longitudinal surface stripe, or surface printing of the actual temperature in degrees centigrade. When a colored thread or surface stripe is used, the color coding is as follows:

1) For rubber-insulated wire, green is rated 75°C (167°F),

2) For thermoplastic-insulated wire, red is rated 90°C (194°F), yellow is rated 105°C (221°F), blue is rated 125°C (257°F), brown is rated 150°C (302°F), and black is rated 200°C (392°F).

Although temperature identification is not required on 80°C (176°F) thermoplastic-insulated wire, when a colored thread or stripe is used, it is green in color.

^b Any AWG size, marked either "1000 volts" or with suffix "-10" added to the wire type; for example "RH-10."

^c Applicable only to Nos. 8 – 14 AWG (5.4 – 2.1 mm²) within fluorescent or HID lighting equipment.

19.2.2 A splice shall be mechanically secured and shall provide reliable electrical contact. It shall be soldered unless a splicing device rated or constructed for the intended purpose is used.

19.2.3 A soldered joint and a splice made with an uninsulated wire connector shall be covered with:

- a) Rubber tape held in place by friction tape;
- b) Thermoplastic tape; or
- c) Standard combination friction and rubber tape to a thickness not less than that on the joined conductors. The tape shall be applied so as to exclude moisture.

Exception: Other tapes rated or constructed for the purpose are capable of being used in place of rubber tape in an indoor sign.

19.2.4 A taped joint shall not make contact with any ballast or transformer enclosure.

Exception: A taped joint within a splice box or a wiring-terminal compartment that is integral with a ballast is capable of contacting a ballast or transformer enclosure.

19.2.5 An insulated wire connector shall not contact a transformer or ballast enclosure unless:

- a) The insulation of the wire connector is ceramic material or phenolic composition, or is rated for use at a temperature of 90°C (194°F) or more or

No Text on This Page

- b) The connector is used within a splice box or a terminal compartment that is integral with a ballast.

19.2.6 Insulated pressure wire connectors and fixture-type splicing connectors are not required to be covered with insulating tape.

19.2.7 The voltage rating of an insulated wire connector shall not be less than the voltage of the circuit in which the connector is used.

19.2.8 A wire connector shall be used to join a combination consisting only of the sizes and numbers of wires for which it is rated.

19.2.9 Unless the connector is in a compartment as described in 32.1(b), an insulated wire connector, used in an outdoor sign, shall be supported to clear the bottom of the sign by 1/2 inch (12.7 mm) or more.

19.2.10 A wire shall be fastened to a lampholder terminal so that it is mechanically secure and provides reliable electrical contact.

19.2.11 A connection to a lampholder terminal, other than an insulation-piercing-type terminal, in an outdoor sign shall be soldered. All exposed current-carrying parts of such a soldered terminal shall be covered with an insulating compound (such as asphaltic paint or sealing compound), to reduce the risk of corrosion.

Exception: A connection to a lampholder terminal is not required to be soldered and covered with an insulating compound when the terminal is located in a supplementary enclosure within the overall sign housing that does not permit the entrance of water when subjected to the Exclusion of Water Test, Section 32.

19.2.12 The insulation on a wire at a terminal shall not be removed to such extent that the bare conductor overhangs the edge of the base of the device to which it is wired.

19.2.13 When stranded internal wiring is connected to a wire-binding screw or stud terminal, it shall be connected so that no loose strands result.

19.2.14 Compliance with the requirements in 19.2.13 is capable of being determined by:

- a) Use of a pressure terminal connector, a soldering lug, or a crimped eyelet;
- b) Soldering all strands of the wire together;
- c) Tightly twisting all strands together; or
- d) Another means determined to be equivalent.

19.3 Mechanical security and protection of wiring

19.3.1 Wiring shall be run and fastened so as to be mechanically secure and protected from sharp edges, including screw threads, a burr, a fin, a moving part, and a similar part that abrades the insulation on conductors or otherwise damage the wiring. Openings, cut ends of flexible conduit, and other similar parts are to be deburred or provided with bushings rated or constructed to be used for this purpose, secured in place, to reduce the risk of damage to the conductor insulation during shipment or installation.

19.3.2 Thermoplastic clips are not prohibited from being used to fasten and mechanically secure wires to comply with the requirement in 19.3.1 and 19.3.5.

19.3.3 In a cord-connected sign, internal wiring accessible during user servicing shall be provided with strain-relief such that strain is not transmitted to connections when tested in accordance with the Strain-relief Test, Section 34.

Exception: A strain-relief is not required to be provided when the conductor is integral to a ballast, lampholder, or a similar component that complies with the applicable requirements for the component, and the component is required to have strain-relief.

19.3.4 In a cord-connected outdoor sign, internal wiring shall be positively secured away from sharp edges by wire loops, additional insulation, routing clamps or other means.

19.3.5 In an outdoor sign, wiring shall be supported so as to clear the bottom of the sign by at least 1/2 inch (12.7 mm).

Exception: Wiring is not prohibited from being located less than 1/2 inch from the bottom of the sign when the construction does not result in a risk of fire or electric shock. See 19.2.9.

19.4 Bushings

19.4.1 A wire passing through a sheet-metal partition shall be protected by a bushing, a rolled edge of the metal, a short length of mechanical protection tubing, porcelain tubing, or double-thickness glass tubing or other methods determined to be equivalent. The tubing shall be securely fastened in place. See 19.4.2.

19.4.2 A metal bushing or grommet, or a rolled-metal edge is not prohibited from being used for protection of a wire passing through a sheet-metal partition only when the wire is either:

- a) One of the types specified in the column headed 600 volts in Table 19.4 or
- b) Appliance-wiring material (AWM) having either:
 - 1) Thermoplastic or neoprene insulation at least 1/32 inch (0.8 mm) thick with or without an overlay braid or
 - 2) Rubber insulation at least 1/32 inch thick with a treated fibrous covering.

19.4.3 A bushing shall be firmly fixed in place, and an insulating bushing shall not be less than 1/16 inch (1.6 mm) thick.

19.4.4 An opening in a sheet-metal partition having a thickness of 0.042 inch (1.07 mm) or more that has been treated to remove burrs, fins, and other sharp edges that result in abrasion is capable of being determined to be equivalent to a metal grommet.

19.4.5 A bushing of glass, ceramic material, phenolic composition, or cold-molded composition is not prohibited from being used in either an outdoor or an indoor sign. A fiber bushing shall be used in an indoor sign only, when it is:

- a) Not less than 3/64 inch (1.2 mm) thick and
- b) Formed and secured in place so that it is not affected by moisture.

19.4.6 A bushing or grommet of a material other than those specified in 19.4.5 is capable of being used when investigated and determined to be resistant to deterioration, and when evaluated to be rated or constructed for the operating conditions (such as moisture and temperature) that are to be encountered.

19.4.7 A separate bushing of wood or of hot-molded shellac-and-tar composition shall not be used.

19.5 Class 2 circuits

19.5.1 A sign containing a:

- a) Class 2 transformer having an output of 30 volts or less or
- b) Combination of transformer and fixed impedance that, as a unit has output characteristics that comply with those required for a Class 2 transformer, is determined to comply with the requirements in this standard when:
 - 1) The transformer is enclosed within the sign enclosure, using a means rated or determined to be constructed for its intended use;
 - 2) The Class 2-circuit wiring and components are protected against damage, and have the ampacity rating required so that overheating does not occur under normal conditions of service;
 - 3) The Class 2-circuit wiring is insulated for the maximum voltage involved or is completely and permanently separated from the wiring of other than Class 2 circuits; and
 - 4) The sign, other than for Class 2 components, is otherwise constructed in accordance with the requirements in this standard.

20 High-Voltage Wiring

20.1 General

20.1.1 High-voltage wiring is wiring that involves a potential greater than 1000 volts.

20.1.1 revised July 2, 2001

20.1.2 Deleted July 2, 2001

20.1.3 High-voltage wiring of a sign shall be complete before it leaves the factory.

Exception: When a sign is built in sections, or when the transformers of an individual letter or sign are to be located outside the sign enclosure, the high-voltage wiring is not required to be complete before it leaves the factory when all required terminals, bushings, fittings, or similar devices are in place as part of the sign and are arranged so that the required connections are capable of being made readily and properly upon installation.

20.1.4 The high-voltage wiring of a sign shall use a gas-tube-sign cable, rated for its intended use, or shall be wired completely with uninsulated, solid, nonferrous conductors not smaller than No. 10 AWG (5.3 mm²). Sharp bends in the conductors shall be avoided and the wiring shall be mechanically secured and protected. See 19.3.1.

Exception No. 1: Deleted

Exception No. 2: An uninsulated conductor not more than 6 inches long is not prohibited from being used for connection to an electrode, and between electrode receptacles or lampholders, when the conductor is spaced as intended and supported.

Exception No. 3: Insulated wire, other than Gas-Tube-Sign cable, having solid conductors is capable of being used in place of bare conductors when treated as bare conductors with regard to mounting and spacing. See 20.1.3, 29.1.7, 29.1.8, and Table 29.2.

Exception No. 4: Deleted

20.1.4 revised July 2, 2001

Table 20.1

Table 20.1 deleted July 2, 2001

20.1.5 GTO cable shall have a voltage rating not less than the maximum secondary-voltage rating of the transformer or power supply with which it is used, including a midpoint-return transformer.

20.1.5 effective September 3, 1999

20.1.6 Deleted July 2, 2001

20.1.7 Relocated as 19.1.8 July 2, 2001

20.1.8 Type GTO cable shall have insulation rated for the temperature involved and not less than 105°C (221°F).

Revised 20.1.8 effective January 2, 2004

20.1.9 Deleted effective January 2, 2004

20.1.10 All high voltage conductors shall be as short as possible.

20.1.10 added July 2, 2001

20.1.11 Not more than 20 feet (6.10 m) of high-voltage cable shall be permitted in metallic conduit or tubing from a high-voltage terminal of a neon transformer or neon power supply to the first neon tube. Not more than 50 feet (15.25 m) of high-voltage cable shall be permitted in nonmetallic conduit from a high-voltage terminal of a neon transformer or neon power supply to the first neon tube.

Added 20.1.11 effective January 2, 2004

Figure 20.1 Location of GTO cable

Deleted Figure 20.1 effective January 2, 2004

20.2 Mechanical security and protection of wiring

20.2.1 The insulation and fibrous covering on the conductor of metal-covered gas-tube-sign cable shall extend beyond the end of the metal covering, not less than the distance specified in Table 20.2, wherever connection is made to a transformer, electrode receptacle, or other terminal. The insulation and fibrous covering shall not be damaged where the metal covering is removed or where it terminates. When run in a metal raceway, metal conduit or metallic tubing the metal covering shall extend beyond the end of the metal raceway, metal conduit or metallic tubing.

Exception: A metal covered conductor run in a metal raceway, excluding metal conduit and metallic tubing, that terminates in the metal raceway is not required to have the extension of the conductor insulation beyond the end of the metal raceway.

20.2.1 revised July 2, 2001

Table 20.2
Distance from end of metal to end of insulation

Voltage rating of cable	Minimum distance			
	Outdoor signs,		Indoor signs,	
	inches	(mm)	inches	(mm)
5,000	2	51	1-1/2	38
10,000	3	76	2	51
15,000	4	102	2-1/2	64

20.2.2 At other than an electrode lead, the strands of a stranded conductor shall be:

- a) Soldered together before connection to a terminal,
- b) Provided with a grommet completely enclosing the strands, or
- c) Provided with a wire connector that has been investigated and determined to be capable of being used for this purpose.

20.2.3 The insulation on a conductor at neon tubing termination shall be continuous to within 3-1/2 inches (89 mm) of a terminal, inclusive of the connecting means.

20.2.3 revised July 2, 2001

20.2.4 The wire between neon tubing terminations spaced not over 6 inches (152 mm) apart is not required to be insulated when supported to maintain the required spacing to grounded metal.

20.2.4 revised July 2, 2001

20.2.5 GTO cable shall be mounted on insulators, run in rigid metal conduit, intermediate metal conduit, rigid non-metallic conduit, liquidtight flexible non-metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, electrical metallic tubing, metal enclosure, enclosure investigated for the purpose or metal raceway consisting of completely enclosed metal channels having a thickness not less than that of the sign enclosure. The insulation of a GTO cable shall extend beyond the end of metal raceway, metal conduit or metallic tubing not less than the distance specified in Table 20.2 before the insulation is removed for connections.

Exception No. 1: A GTO cable connected to an output terminal or lead of a neon transformer or neon power supply that is marked "return" is not required to be mounted on insulating supports.

Exception No. 2: The metal covered portion of metal covered GTO cable is capable of being run in contact with the sign enclosure.

20.2.5 revised July 2, 2001

20.2.6 A bare conductor or an insulated high-voltage conductor as specified in Exception No. 3 to 20.1.4 shall be mounted on insulators.

20.2.6 revised July 2, 2001

20.2.7 Not more than one high-voltage conductor shall be routed in raceway, conduit or tubing.

Exception: More than one high-voltage conductor is not prohibited from being routed in a raceway, excluding conduit and tubing, where there is sufficient cross sectional area such that each conductor can be routed to maintain the minimum spacings required in Table 29.2 between the high-voltage conductors and between each high-voltage conductor and any part that is bonded to ground.

20.2.7 revised July 2, 2001

20.2.8 A metal raceway, metal conduit or metallic tubing containing a single conductor from one output terminal or lead of a neon transformer or neon power supply to the first neon tube shall not be longer than 20 feet (6.10 m).

Exception: A metal raceway, excluding metal conduit and metallic tubing, containing a single conductor from one output terminal or lead of a neon transformer or neon power supply to the first neon tube is not prohibited from exceeding 20 feet (6.10 m) where there is sufficient cross sectional area such that the conductor can be routed to maintain the minimum spacings required in Table 29.2 between the high-voltage conductor and any part that is bonded to ground.

20.2.8 revised July 2, 2001

20.2.9 A conductor support shall:

- a) Be made of nonabsorptive, electrically-insulating material such as glass or porcelain;
- b) Have provision for secure attachment to the sign body;
- c) Provide a reliable means for mounting the high-voltage conductor; and
- d) Be such that the conductor complies with the spacing requirement in 29.1.7, 29.1.8, and Table 29.2.

20.2.10 A porcelain conductor support shall be glazed on exposed surfaces.

20.2.11 Conductor supports shall be located not more than 6 inches (152 mm) from the neon tubing termination connections, unless electrode receptacles are used.

20.2.11 revised July 2, 2001

20.2.12 The spacing between conductor supports shall be close enough so that the conductor spacings are not reduced below the minimum spacings specified in Spacings, Section 29. An 18 inch (457 mm) spacing under most conditions, has been determined to be capable of being used between insulators, although this spacing relies to some extent on the strength of the insulators.

20.2.13 Where a conductor mounted on insulators passes through a metal wall or partition, or through the adjoining walls of abutting enclosures, a nonabsorptive, electrically-insulating bushing or tubing shall be used. The bushing or tubing shall be made of glass, porcelain, or a similar flame-retardant material.

20.2.14 The bushing or tubing discussed in 20.2.13 shall provide the full required spacing between the cable and the metal of the sign and shall be securely fastened in place.

20.2.15 Where a conductor passes from one enclosure to another and the two enclosures do not actually meet, a metal raceway, conduit or tubing shall enclose the conductor between the two enclosures.

20.2.15 revised July 2, 2001

20.2.16 A conductor emerging from an outdoor sign shall be arranged so that moisture cannot enter through the opening through which the conductor emerges.

20.3 Splices and connections

20.3.1 Deleted July 2, 2001

20.3.2 A splice shall not be used in a circuit operating at a potential greater than 1000 volts.

Exception: A transformer lead is capable of being spliced to open wiring when the splice complies with the requirements in 19.2.2.

20.3.3 A soldered splice between a transformer lead and an insulated cable in a circuit operating at more than 1000 volts shall be covered to a thickness of not less than that on the joined conductors with:

- a) Rubber tape held in place by friction tape,
- b) Thermoplastic tape, or
- c) Standard combination rubber and friction tape. The tape shall be applied to exclude moisture.

20.3.4 A splice made by using a wire connector, between a transformer lead and an insulated cable, in a circuit operating at more than 1000 volts shall be insulated as described in 19.3.1. The splice shall be capable of being used for this purpose when evaluated with regard to the effect on the insulation and spacings of:

- a) Corona,
- b) Temperature under load, and
- c) Moisture conditions.

20.3.5 A connection between a high-voltage conductor and an electrode lead shall be:

- a) Soldered or
- b) Made with a wire connector capable of being used for this use.

Exception: A GTO lead and electrode lead is not required to be soldered when they are:

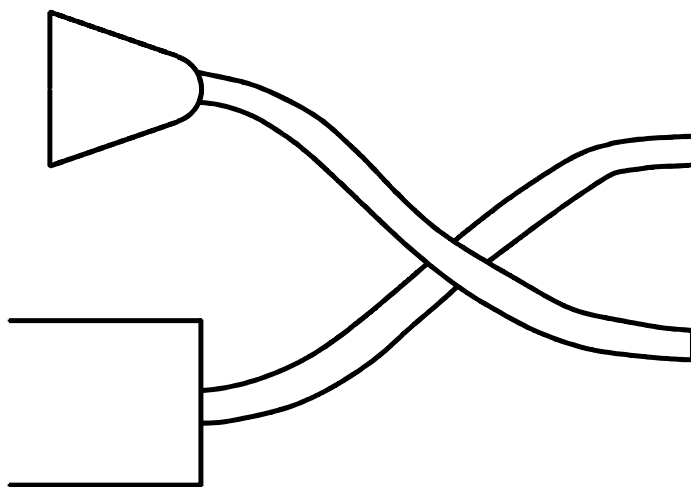
a) *Twisted together by three full twists, with the excess lead length trimmed to a maximum of 1/2 inch (12.7 mm) length and bent back on the twists, as shown in Figure 20.2 or*

b) *Bent over and wrapped around each other at least five times, with the excess lead trimmed off, as shown in Figure 20.3.*

20.3.6 In an indoor sign, the connection between a high-voltage conductor and an electrode lead shall be protected by glass tubing not less than 0.10 inch (2.5 mm) thick or by insulating sleeves that have been investigated and determined to be constructed for the intended use, unless rendered inaccessible as specified in 14.5.

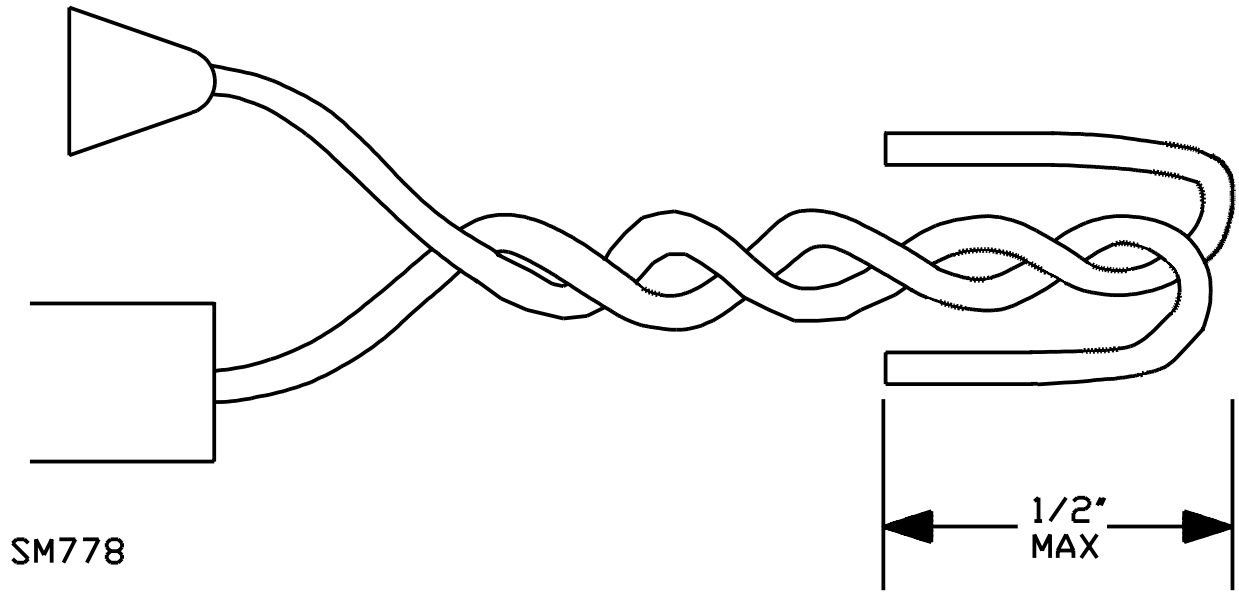
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Figure 20.2
Twisted Leads – Option 1



SM801

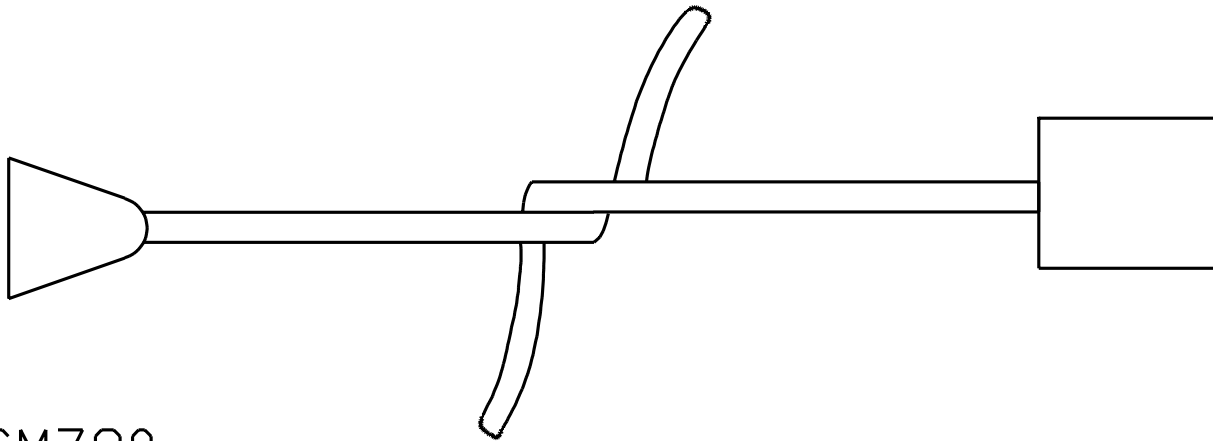
Step 1



Step 2

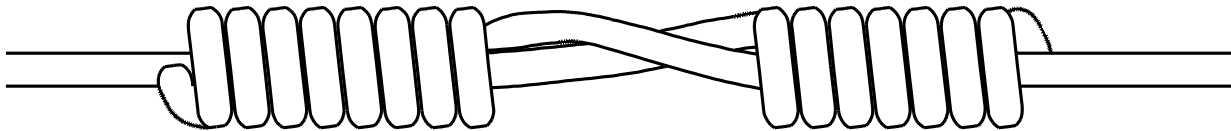
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Figure 20.3
Twisted leads – Option 2



SM780

Step 1



SM800

Step 2

20.3.8 Deleted July 2, 2001

21 Neon Tubing and Electrode Receptacles

21.1 General

21.1.1 Neon tubing connected to a circuit operating at a potential of more than 7500 volts shall be supported on noncombustible, nonabsorptive electrical insulators. The insulators shall provide a separation of 1/4 inch (6.4 mm) or more from grounded metal. This spacing shall be maintained where the neon tubing passes through or is adjacent to metal prior to entering the bushing or receptacle in the sign.

21.1.1 revised July 2, 2001

21.1.2 Other than as noted in Exception No. 4 to 8.2.1, and in 21.1.1, neon tubing shall not be in contact with combustible material.

21.1.2 revised July 2, 2001

21.1.3 Tubing supports shall provide a reliable means for mounting the neon tubing, and shall have provision for secure attachment to the sign face. Supports shall not be mounted on doors or covers of signs.

21.1.3 revised July 2, 2001

21.1.4 When electrode receptacles having openings that reduce spacings to ground are used, the neon tubing shall be mounted on the sign and the spacing between live parts and grounded metal determined. When neon tubing is not made at the plant where the sign is manufactured, other means shall be taken to provide proper spacings.

21.1.4 revised July 2, 2001

21.1.5 A receptacle, a bushing, or other opening for neon tubing in an outdoor sign shall be provided with means to exclude water when located so that the opening faces in a direction above the horizontal plane. An electrode receptacle marked, "Install Where Protected From Rain Or Snow," shall be positioned such that the opening does not face in a direction above the horizontal plane.

21.1.5 revised July 2, 2001

21.1.5.1 Through-wall housing type electrode receptacles located where the opening of the receptacle will be exposed to rain, snow or a direct spray or splashing of water or other liquids shall have the open end, where neon tubing is inserted, covered by an electrode cap that has been evaluated for the purpose. A through-wall housing type electrode receptacle is identified as an electrode receptacle provided with an integral enclosure housing provided with a means for conduit connection.

21.1.5.1 added July 2, 2001

21.1.6 Where neon tubing passes through sheet metal of an outdoor sign, or of an indoor sign that operates at more than 7500 volts, a bushing or receptacle rated or constructed for its intended purpose shall be provided.

Exception: A bushing or a receptacle is not required when:

- a) The neon tubing is supported so that a spacing of not less than 1/4 inch (6.4 mm) is positively maintained between the neon tubing and the sheet metal where the neon tubing passes through the metal and*

b) The wall or partition is of a material intended for a bushing.

21.1.6 revised July 2, 2001

21.2 Electrode receptacles

21.2.1 The voltage rating of an electrode receptacle shall be minimum 7500 volts to ground.

Exception: An electrode receptacle rated less than 7500 volts to ground is not prohibited from being used when the electrode receptacle rating is suitable for the neon transformer or neon power supply rating.

21.2.1 revised July 2, 2001

21.2.2 When an electrode of a neon tube does not enter the sign enclosure, it shall be enclosed in an electrode receptacle of a type that has been investigated and determined to be capable of being used for mounting with only the receptacle opening exposed on the outside of the sign enclosure.

Exception: An electrode is not required to be enclosed in a receptacle when:

a) The electrode connection is provided with the required:

- 1) Spacings,*
- 2) Electrical insulation,*
- 3) Strain-relief, and*
- 4) Mechanical support. Also see 20.2.11, 20.3.3 – 20.3.6, and 21.1.3, and*

b) The electrode connection is within an enclosure that:

- 1) Complies with Frame and Enclosure, Section 5;*
- 2) Provides a level of protection against access by unqualified persons by complying with 14.5; and*
- 3) Otherwise complies with other applicable parts of this standard.*

21.2.2 revised July 2, 2001

21.2.3 A separate sleeve of insulating material is not to be used for the enclosure of an electrode connection on the outside of the sign enclosure.

21.2.4 When the operating voltage of a sign is more than 7500 volts, a bushing used in place of a receptacle shall be of a noncombustible, electrical insulating material and shall provide a spacing of not less than 1/2 inch (12.7 mm) through-air and over the surface of the bushing, between the neon tubing and grounded metal even when the neon tubing is in contact with the bushing.

21.2.4 revised July 2, 2001

21.2.5 A gasket of rubber, cork, or similar material is capable of being used in connection with the mounting of an electrode receptacle to reduce the risk of breakage, and around the neon tube in a receptacle to reduce the risk of entrance of dust, insects, or debris, when the gasket is not depended upon for the insulation of the neon tubing and is not in contact with grounded conducting material.

21.2.5 revised July 2, 2001

21.2.6 An electrode receptacle shall be reliably mounted in a manner such that water does not accumulate in the receptacle.

21.2.7 Each electrode receptacle shall be installed so that the spacings specified in Spacings, Section 29, are maintained.

21.3 Polymeric tube supports

21.3.1 A polymeric support for neon tubing shall be formed of nonabsorptive, electrical insulating material.

21.3.1 revised July 2, 2001

21.3.2 A polymeric material used in a support for neon tubing shall:

a) Be evaluated with regard to mechanical strength, dielectric strength, arc-tracking, ignition from electrical sources, moisture absorption, ultraviolet radiation including water exposure, and resistance to aging and temperatures to which the material is subjected under conditions of normal and abnormal use, when tested in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and

b) Have a minimum flammability rating of V-2 when tested in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

Exception: The polymeric material in a tube support that is only covered as a component for use in an indoor sign that is determined to comply with this standard shall continue to comply with the ultraviolet radiation requirements and is not required to comply with water exposure as part of the ultraviolet radiation resistance rating.

21.3.2 revised May 14, 1999

22 Fluorescent Lamps

22.1 A fluorescent lamp provided with a sign shall be of the type for which the ballast is rated.

22.2 A ballast intended for use with bi-pin lamps is usually marked with the individual lamp wattage, and a ballast intended for use with single-pin or similar lamps is usually marked with a standard lamp designation.

22.3 A U-shaped fluorescent lamp shall be reliably secured in place by a spring clamp or other means determined to be equivalent, at the end opposite the lamp contacts.

23 Lampholders

23.1 General

23.1.1 A lampholder in an incandescent-lamp sign shall be of the unswitched type, and shall have a body of porcelain or molded composition.

23.1.2 The screw shell of each lampholder shall be connected to the same supply lead or terminal. A terminal to which a screw shell is connected shall be of or plated with metal substantially white in color.

23.1.3 A lampholder having insulation-piercing-type wiring terminals shall be used with stranded wire only.

23.1.4 A fluorescent-lamp lampholder shall be intended for use with the ballast and the type of lamp used.

23.1.5 A lampholder shall have a voltage rating not less than the output voltage marked on the ballast with which it is intended to be used.

Exception: The rating of the lampholder is capable of being less than the output voltage marked on the ballast and not less than the marked secondary voltage to ground, when the ballast is also marked with a secondary voltage to ground less than the marked output voltage.

23.1.6 A lampholder shall be installed so that permanent and reliable means to prevent turning are provided. See 13.6 and 13.7.

23.1.7 Other means capable of being used for securement of a lampholder to a sign face to prevent turning relative to the sign face are:

- a) Two screws;
- b) A lug on the lampholder engaging a notch or indentation at the hole in the sign face; or
- c) A notch in the lampholder engaging a tongue or other device determined to be equivalent at the hole in the sign face.

23.1.8 With reference to the requirement in 23.1.6, frictional contact of a screw ring, a gasket, or similar devices, with a sign face is not to be used as a means to prevent turning.

23.2 Outdoor signs

23.2.1 No lampholder in an outdoor sign shall use:

- a) Fiber or similar absorptive material and
- b) An aluminum screw shell.

23.2.2 A porcelain lampholder in an outdoor sign shall be glazed on all surfaces that are exposed to the weather on the outside of the sign enclosure after the lampholder has been installed in the intended manner.

23.2.3 A miniature-base lampholder shall not be used in an outdoor sign.

23.2.4 A fluorescent-lamp lampholder in an outdoor sign shall be rated for use in an outdoor enclosed sign and, unless of the weatherproof type, shall be enclosed in a compartment that complies with the Exclusion of Water Test, Section 32, or is provided with other means that reduces the risk of water entering the lampholder.

23.2.5 A lampholder of the indoor bipin type in an outdoor sign shall be rated for the purpose with regard to materials, spacings, and protection against exposure to moisture.

23.2.6 A lampholder of an outdoor sign shall not be located or mounted so that water accumulates in it.

24 Switches and Controls

24.1 A switch, a flasher, or a similar device that controls a ballast or transformer shall be rated for the application, or shall have a current rating not less than twice the total current rating of the ballasts or transformers that it controls and a voltage rating of not less than the potential of the circuit in which it is used.

Exception: An AC general-use snap switch is capable of being used to control ballast and transformer loads not exceeding the current rating of the switch at rated voltage.

24.2 A snap switch used in an outdoor sign shall use no moisture-absorbing materials, such as fiber, in its construction; and water shall not contact the switch or enter the compartment housing the switch when the sign is subjected to the test described in the Exclusion of Water Test, Section 32.

24.3 A device that controls an incandescent lamp shall be rated for the control of tungsten-filament lamps.

Exception No. 1: A snap switch is capable of being used to control a single intermediate, candelabra, or miniature-base lamp, when the switch is rated not less than 6 amperes, 125 volts for a nominal 120-volt circuit or 3 amperes, 250 volts for a nominal 230-volt circuit.

Exception No. 2: An AC general-use snap switch is capable of being used to control a tungsten-filament lamp load not exceeding the ampere rating of the switch at 120 volts.

24.4 A switch for controlling a tungsten-filament lamp load shall have:

- a) An L or T rating and a current rating at least equal to that of the tungsten-filament lamp load or
- b) An alternating current rating at least six times or a direct current rating at least ten times that of the tungsten-filament lamp load.

24.5 A switch, relay, or similar device that controls a motor, other than a clock-motor, shall have a horsepower rating not less than that of the motor to be controlled.

Exception: An AC general-use snap switch (not an AC-DC general-use snap switch), is capable of being used to control a motor load not exceeding 80 percent of the ampere rating of the switch at its rated voltage.

24.6 A switch or circuit breaker shall not disconnect the grounded conductor of a circuit.

Exception: The switch or circuit breaker is not prohibited from disconnecting the grounded conductor of the circuit when it:

- a) Simultaneously disconnects each ungrounded conductor or*
- b) Is arranged so that the grounded conductor cannot be disconnected until each ungrounded conductor has first been disconnected.*

24.7 A disconnect switch, when provided, shall disconnect all ungrounded conductors of the supply circuit.

24.8 When provided, an externally-operable disconnect switch shall have a designated off position. When the switch is operated vertically rather than horizontally, the up position shall be the on position.

25 Receptacles

25.1 Dedicated type

25.1.1 A sign is capable of being provided with one or more receptacles each of which is dedicated for the connection of a specific product on or within the sign body. The product intended for connection to the dedicated receptacle shall comply with the appropriate requirements for its product class.

25.1.1 revised July 2, 2001

25.1.2 The dedicated receptacle shall be of a type that has the same pin configuration as the attachment plug on the dedicated product.

25.1.3 A sign circuit supplying a dedicated receptacle shall have the circuit protected by supplementary overcurrent protection, consisting of a fuse, circuit breaker, or similar devices, having a current rating not exceeding the applicable value specified in Table 25.1. The total load in amperes imposed on the circuit shall not exceed the current rating of the supplementary overcurrent protective device or the values indicated in Table 19.2. See 18.20, 18.21, and 40.1.17.

Table 25.1
Supplementary overcurrent protective device current rating

Maximum supplementary overcurrent protective device rating, amperes	Minimum cord conductor size, ^a		Minimum internal conductor size, ^b	
	AWG	(mm ²)	AWG	(mm ²)
10	18	0.82	18 ^c	0.82
13	16	1.3	18 ^c	0.82
15	14	2.1	14	2.1
18	14	2.1	12	3.3
20	12	3.3	12	3.3
^a A maximum of two (2) current-carrying conductors in a sign power supply cord, when provided.				
^b Unless otherwise indicated, all internal wiring shall be rated 60°C minimum.				
^c Rated 90°C minimum.				

25.1.4 A marking identifying the product to be used with that receptacle shall be provided adjacent to each dedicated receptacle. See 40.1.17.

25.2 Convenience type

25.2.1 A fixed sign is capable of being provided with one or more convenience receptacles.

25.2.1 revised July 2, 2001

No Text on This Page

25.2.2 A convenience receptacle shall be:

- a) For an indoor sign, a 2-pole, 3-wire grounding-type receptacle, rated 15 or 20 amperes only, 125 volts and compatible with 25.2.2(c);
- b) For an outdoor sign, a 2-pole, 3-wire grounding-type Class A ground-fault circuit interrupter receptacle, rated 15 or 20 amperes only, 125 volts and compatible with 25.2.2(c);
- c) Provided with provisions for connection in the field to a 15- or 20-ampere maximum, 125-volt branch circuit with no conductors common with other sign circuits;
- d) Mounted on, or inside, the sign within an enclosure intended for the purpose;
- e) Mounted in such a way that uninsulated live parts are inaccessible during servicing; and
- f) Marked in accordance with 40.3.6 in a location immediately adjacent to the receptacle.

25.2.3 The circuit conductors for a convenience receptacle shall be sized in accordance with the ampere rating (15 or 20 amperes) of the receptacle and Table 19.2 and not smaller than No. 14 AWG (2.1 mm²).

26 Clocks

26.1 General

26.1.1 A clock mechanism, unless rated for the application, shall comply with the requirements in 26.1.2 – 26.1.5.

26.1.2 Clock windings shall be impregnated to exclude moisture.

Exception: Enameled wire is not required to be additionally treated to exclude moisture absorption when it is used in a clock motor in an indoor sign.

26.1.3 Uninsulated live parts of a clock rated 125 volts or less shall be spaced 1/8 inch (3.2 mm) or more from any other conducting parts, grounded or otherwise. For a clock having a voltage rating of more than 125 volts, this spacing shall be 1/4 inch (6.4 mm) or more.

26.1.4 Terminals shall be constructed so as to reduce the risk of breakage.

26.1.5 Uninsulated live parts shall be mounted on nonabsorptive, electrical insulating material rated for the purpose. Untreated fiber is not to be used for mounting such parts.

26.1.6 A clock shall be mounted securely and, when the movement is secured to a dial made of glass, porcelain, or other fragile material, all uninsulated live parts shall be separately enclosed or shall be located so that they are not in contact with the sign enclosure or other uninsulated parts when the dial breaks and the movement falls.

26.1.7 When the face of a clock is of glass and is the final outer enclosure of the clock movement, the glass shall comply with Glass Panels and Letters, Section 7. Also see General, Section 2.

26.1.8 The outer glass mounted over a sheet-metal dial is not required to be investigated when the dial is placed and fastened so as to be a part of the sign enclosure. The glass shall have such strength and rigidity that it will not break during normal service.

26.1.9 A clock shall be mounted so that uninsulated high-voltage parts of the sign are not exposed to contact by persons working on any part of the clock. A handhole provided to make the clock mechanism accessible shall not be located near any high-voltage part, or an accessibility barrier shall be located so that contact with the part does not occur when servicing is performed on the clock.

26.1.9 revised July 2, 2001

26.1.10 When a clock is operated from a low-voltage circuit of less than 50 volts, or a circuit having current characteristics different from the sign circuit, the clock circuit shall:

a) Enter the sign through a separate fitting and be isolated from the other wiring in the sign by means of accessibility barriers or metal enclosures or

b) Be in a location remote from other wiring to reduce the risk of unintentional contact between the systems.

26.1.10 revised July 2, 2001

26.2 Outdoor signs

26.2.1 A clock installed in a sign intended for outdoor use shall be wired with Type RH rubber-insulated wire or with Type T or TW thermoplastic-insulated wire. The wiring from the clock to the supply-circuit connection shall be completed at the factory.

26.2.2 A clock movement in an outdoor sign shall be housed in a separate accessible enclosure that, when of sheet steel, shall be at least 0.017 inch (0.43 mm) thick and shall be galvanized. The enclosure shall be provided with an opening or openings for drainage.

Exception: A clock movement is not required to be accessible when the entire sign is normally disconnected from the source of supply and dismantled before servicing.

26.2.2 revised July 2, 2001

27 Ballasts and Transformers

27.1 General

27.1.1 All fluorescent and HID open core and coil transformers and ballasts shall have a secondary voltage rating not exceeding 600 volts.

27.1.1 revised July 2, 2001

27.1.2 Deleted July 2, 2001

27.1.3 Deleted July 2, 2001

27.1.4 A transformer or ballast, other than a through-cord ballast, shall be mechanically secured in place.

27.1.4 revised July 2, 2001

27.1.5 A transformer or ballast shall not be mounted on a door.

27.1.6 A transformer or ballast shall not be mounted on a single sheet-metal side, face, or top so that the entire weight is suspended from that surface unless:

- a) The metal is not less than 0.026 inch (0.66 mm) thick when of sheet steel, or not less than 0.030 inch (0.76 mm) thick when of copper, and is reinforced at the mounting points or
- b) One dimension of the side, face, or top is less than 9 inches (229 mm).

27.1.7 The enclosure of a transformer or ballast, other than a through-cord ballast, shall be mounted in electrical connection with the framework and enclosure of the sign.

27.1.8 A ballast or transformer shall be installed so that it is accessible.

Exception: In a small indoor sign that is sealed to prevent access to uninsulated high-voltage parts, or in one that is intended for permanent installation and that is normally removed from its mounting and disconnected from the supply circuit for servicing.

27.1.9 Ballasts and transformers shall be located not less than 1 inch (25.4 mm) apart when arranged end-to-end, and not less than 4 inches (102 mm) apart when arranged otherwise.

Exception: Ballasts and transformers are capable of being located closer together when it has been determined that excessive temperatures do not occur on wiring or other electrical components and when the construction complies with Spacings, Section 29.

27.2 Ballasts

27.2.1 A fluorescent ballast shall comply with the requirements in the Standard for Fluorescent-Lamp Ballasts, UL 935.

27.2.1 revised September 3, 1998

27.2.2 A ballast used in an outdoor sign shall be of the weatherproof or outdoor type.

27.2.3 A fluorescent ballast shall be of the Class P, thermally-protected type.

Exception: A simple reactance ballast connected only to straight tubular lamps is not required to be thermally protected.

27.2.3 effective September 3, 1999

27.2.4 The number and type of lamps connected to a ballast shall be the number and type for which the ballast is rated.

Exception No. 1: A ballast intended for use with standard cold-cathode lamps is capable of being used with 25-mm, neon tubing when the length of the neon tubing is within 6 inches (152 mm) of the length of the lamp as marked on the ballast.

Exception No. 2: Neon Tubing of sizes and lengths other than those specified in Exception No. 1 are capable of being used when it has been determined that a risk of fire or electric shock, such as overheating or abnormal voltage, does not result.

27.2.4 revised July 2, 2001

27.2.5 A rated through-cord ballast is capable of being used with an indoor cord-connected sign.

27.2.6 In an outdoor sign, a ballast of other than the weatherproof type shall be secured 1/2 inch (12.7 mm) or more above the bottom of the sign.

27.2.7 A ballast shall be wired in accordance with the wiring diagram or the instructions on the ballast.

Exception: A ballast is capable of being wired in a different manner when it has been determined that a risk of fire or electric shock (such as overheating or abnormal voltage) does not occur.

27.2.8 Deleted September 3, 1998.

27.3 Transformers and power supplies

27.3.1 A transformer or power supply in a neon tube sign shall comply with the Standard for Neon Transformers and Power Supplies, UL 2161.

27.3.1 revised July 2, 2001

27.3.2 A transformer or power supply shall be installed in accordance with the transformer or power supply manufacturer's installation instructions for its Type designation as specified in Table 27.2.

27.3.2 effective September 3, 1999

27.3.3 Deleted September 3, 1998.

Table 27.1
Transformer output maximum ratings for outline lighting signs only

Table 27.1 deleted September 3, 1998

27.3.4 When the transformer secondary-current rating exceeds 30 milliamperes, electrode receptacles rated for the voltage and current shall be used at the point of neon tubing connection.

27.3.4 revised July 2, 2001

27.3.5 The high-voltage windings of two or more transformers or power supplies shall not be connected in parallel or series.

27.3.5 effective September 3, 1999

27.3.6 A transformer is capable of being supported between two sheet-metal faces of a sign by a strap-iron bracket or sheet-metal channel having a thickness of not less than 0.021 inch (0.53 mm) when of steel, and 0.030 inch (0.76 mm) when made of copper, when the bracket or channel is secured by at least two rivets or bolts to each face of the sign.

Table 27.2
Construction type designation

Table 27.2 added September 3, 1998

Core and/or circuitry	Primary connections			Secondary connections			Type designations
Completely enclosed ^a	Wiring terminals or leads		Power supply cord	Wiring terminals or leads		Integral receptacles	Type designation number – see numbered footnotes for definition
	Exposed – not in wiring compartment or through conduit fitting	Unexposed – in wiring compartment or through conduit fitting		Exposed – not in wiring compartment or through conduit fitting	Unexposed – in wiring compartment or through conduit fitting		
no	yes	no	no	yes	no	no	1
yes	yes	no	no	yes	no	no	2
yes	no	yes	no	yes	no	no	3
yes	no	yes	no	no	yes	no	4
yes	no	yes	no	no	no	yes	5
yes	no	no	yes	no	no	yes	6
yes	no	no	yes	yes	no	no	7
yes	no	no	yes	no	yes	no	8

^a Enclosed is the containment of all electrical parts other than input and output leads or terminals in an enclosure.

Type 1 – Open core-and-coil transformer or open power supply that requires a complete enclosure in the end product.

Type 2 – Neon supply with the input and output terminals, leads, and connections enclosed in the end product.

Type 3 – Neon supply with input leads or terminals enclosed and intended for connection to a permanent wiring system, and with secondary leads or terminals required to be enclosed in the end product.

Type 4 – Neon supply that is fully enclosed including the output and is intended for connection to a permanent wiring system.

Type 5 – Neon supply that is fully enclosed and intended for connection to a permanent wiring system, and is provided with integral output receptacles.

Type 6 – Cord-connected neon supply provided with integral output receptacles.

Type 7 – Cord-connected neon supply with secondary output leads or terminals required to be enclosed in the end product.

Type 8 – Cord-connected neon supply with enclosed output leads or terminals.

28 Other Electrical Components

28.1 General

28.1.1 There shall be no capacitor or current-interrupting device in a high-voltage circuit.

No Text on This Page

28.2 Fuses

28.2.1 A plug fuseholder shall be Type S or shall have an Edison-base with a factory-installed, nonremovable Type S adapter.

28.3 Motors

28.3.1 An electric motor that is used in a clock mechanism shall comply with Clocks, Section 26. Any other motor used in a sign shall be investigated to determine that it is rated or constructed for the intended use.

28.4 Starters

28.4.1 A starter holder shall be base- or front-mounted when an accessibility barrier is provided over the terminals. When no accessibility barrier is provided, the holder shall be front-mounted only.

28.4.1 revised July 2, 2001

28.5 Ground-fault circuit-interrupter

28.5.1 The ground-fault circuit-interrupter required by 16.3.13 shall comply with the applicable requirements in the Standard for Ground-Fault Circuit-Interrupters, UL 943, and be:

- a) Integral with the attachment plug of the power supply cord or
- b) Located in a separate compartment that:
 - 1) Encloses only the interrupter and the wiring required for the connection of the interrupter;
 - 2) Complies with the Exclusion of Water Test, Section 32; and
 - 3) Is located within 12 inches (305 mm) of the attachment plug.

28.5.2 A ground-fault circuit-interrupter shall not be provided with a power receptacle, and shall be located so that the test and reset operators (control levers, knobs, and similar parts) are accessible to the user.

29 Spacings

29.1 General

29.1.1 Primary and secondary electrical spacings shall not be less than those specified in Tables 29.1 and 29.2, except as noted in 29.1.2 – 29.1.14.

29.1.2 In a circuit involving not more than 50 volts, spacings at field-wiring terminals shall be minimum 1/8 inch (3.2 mm) through-air and 1/4 inch (6.4 mm) over-surface, and spacings elsewhere shall be minimum 1/16 inch (1.6 mm) through-air or over-surface, when the insulation and clearances between the circuit operating at less than 50 volts, and any high potential circuit are in accordance with the requirements applicable to the circuit of the higher potential.

29.1.3 Spacings are not specified for a circuit involving a potential of not more than 30 volts that is supplied by a primary battery, a Class 2 transformer, or by a combination of transformer and fixed impedance having output characteristics complying with the requirements for Class 2 transformers.

Table 29.1
Minimum spacings (51 – 1000 volts)

Parts involved and location	Nature of spacing	51 – 150 V,		151 – 300 V,		301 – 600 V,		601 – 1000 V,	
		inch	(mm)	inch	(mm)	inch	(mm)	inch	(mm)
Between any uninsulated live part and an uninsulated live part of opposite polarity, uninsulated grounded part other than the enclosure, or exposed metal part	Through- air or oil	1/8 ^a	3.2 ^b	1/4	6.4	3/8	9.5	3/4	19.0
	Over- surface	1/4	6.4	3/8	9.5	1/2	12.7	3/4	19.0
Between any uninsulated live part and the walls of a metal enclosure including fittings for conduit or armored cable ^b	Shortest distance	1/2	12.7	1/2	12.7	1/2	12.7	3/4	19.0
^a The spacing between wiring terminals of opposite polarity and the spacing between a wiring terminal and a grounded dead metal part shall not be less than 1/4 inch (6.4 mm) when short circuiting or grounding of such terminals results from projecting strands of wire. ^b For the purpose of this requirement, a metal piece attached to the enclosure is determined to be a part of the enclosure when deformation of the enclosure reduces spacings between the metal piece and an uninsulated live part.									

29.1.4 The spacings specified in Tables 29.1 and 29.2 do not apply between uninsulated live parts of a wiring device such as a lampholder or starter holder, and dead metal that is part of the wiring device, including mounting screws, rivets, yoke, clamp, or similar device, or between such live parts and that part of the dead metal surface of the sign on which the device is mounted in the intended manner. See Figure 29.1.

29.1.5 Spacings at or within a component or device are evaluated based on the requirements for the component or device and are not evaluated under these requirements.

29.1.6 Enameled and similar film-coated wire is regarded as an uninsulated live part in determining compliance with spacings requirements in this section.

29.1.7 The spacings through-air or over-surface for parts operating at 1,001 – 15,000 volts shall not be less than those specified in the appropriate column in Table 29.2 for the voltage corresponding to the open-circuit potential rating of the transformer, power supply or ballast used. The spacings are to be measured from the nearest outer surface of an insulated conductor.

Exception No. 1: In confined, tight-fitting raceways, spacings between high-voltage insulated conductors of opposite polarity, and between a conductor and a raceway, are not required to comply with the requirements in Table 29.2. This exception does not apply to the use of a short length of conduit over conductors where they pass through a barrier or partition within a sign enclosure, or a sign body as an alternative to the spacings required in Table 29.2.

Exception No. 2: When GTO cable is located within metal conduit or metallic tubing as specified in 5.3.2, no spacings are required between the GTO cable and the metal conduit or metallic tubing.

29.1.7 revised July 2, 2001

29.1.8 Deleted effective September 3, 1999.

29.1.8 effective September 3, 1999

Table 29.2
Minimum high-voltage spacings

Table 29.2 revised July 2, 2001

Location	Parts involved	Minimum spacings – over-surface or through-air					
		Maximum voltage rating of transformer or ballast					
		1001 – 5000 volts,		5001 – 10000 volts,		10001 – 15000 volts,	
		inch	(mm)	inches	(mm)	inches	(mm)
Between uninsulated high-voltage parts and	– Uninsulated high-voltage parts of opposite polarity – Uninsulated parts of other high-voltage circuits – Uninsulated parts of low-voltage circuits – Ground (insulated-secondary transformers)	1	25.4	1-1/2	38.1	2	50.8
	– Insulated conductors of low-voltage circuits – Insulated high-voltage conductors of opposite polarity (of the same or different circuits) – Ground (midpoint-grounded transformers)	3/4	19.0	1-1/8	28.8	1-1/2	38.1

Table 29.2 Continued on Next Page

Table 29.2 Continued

Location	Parts involved	Minimum spacings – over-surface or through-air					
		Maximum voltage rating of transformer or ballast					
		1001 – 5000 volts, inch (mm)		5001 – 10000 volts, inches (mm)		10001 – 15000 volts, inches (mm)	
Between insulated high-voltage conductors and	– Insulated conductors of opposite polarity ^a – Insulated conductors of other high-voltage circuits ^a – Insulated conductors of low-voltage circuits – Ground ^a – Uninsulated parts of low-voltage circuits	1/2	12.7	3/4	19.0	1	25.4
^a No spacing is required where the insulated conductors are within a raceway, conduit or tubing in accordance with the Exceptions to 29.1.7.							

29.1.9 Deleted July 2, 2001

29.1.10 The spacing between the enclosure of any ballast or transformer and any conductor of the supply cord other than a grounding conductor shall not be less than 3 inches (76 mm).

Exception No. 1: A supply cord rated for 90°C (194°F) or 105°C (221°F).

Exception No. 2: The conductors of a supply cord are capable of being run directly to the terminals of a ballast or transformer, and the 3-inch (76-mm) spacing between the conductor and the ballast or transformer enclosure is to be maintained as near to the terminals as possible.

29.1.11 In a neon tubing circuit, parts that are not connected by a metal conductor are to be identified as parts of opposite polarity.

29.1.11 revised July 2, 2001

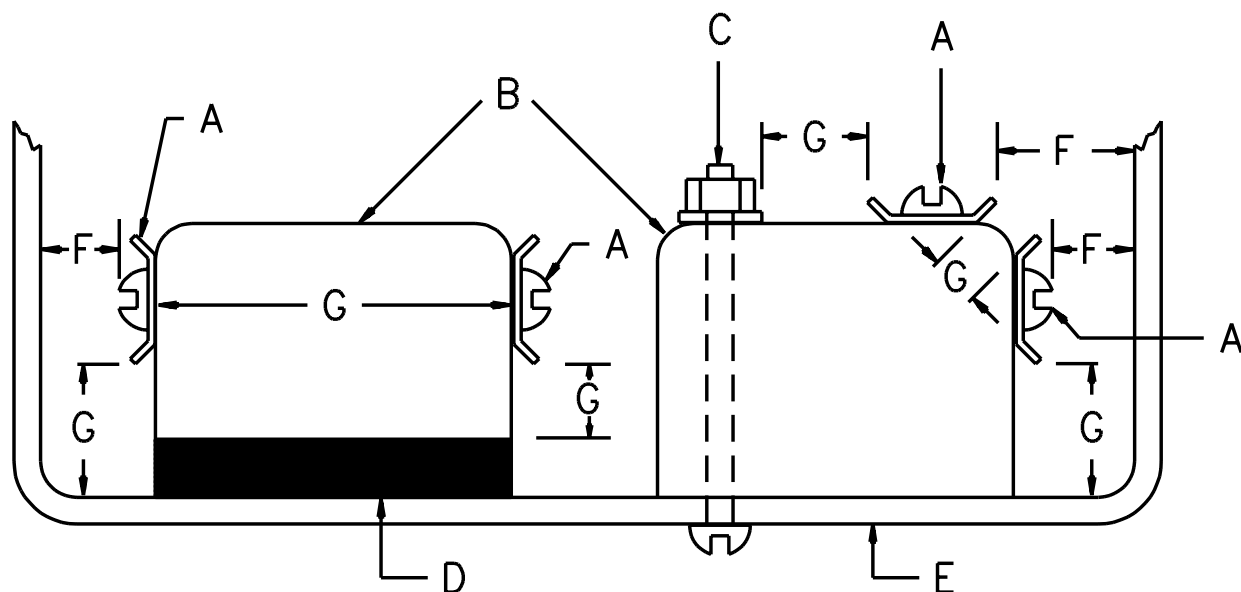
29.1.12 The spacing at a neon tubing electrode directly connected to a terminal or lead of a neon transformer or neon power supply marked "RETURN" shall be as specified for uninsulated live parts connected to the ungrounded terminal of the neon transformer or neon power supply.

29.1.12 revised July 2, 2001

29.1.13 The spacing between the windings of an open transformer or ballast (core and coils only) and the sign enclosure shall not be less than 1/2 inch (12.7 mm) unless protective metal guards at least 0.026 inch (0.66 mm) thick are provided as part of the transformer or ballast.

29.1.14 The leads of an open transformer not provided with Type GTO cables are determined to be the same as bare conductors with regard to spacings.

Figure 29.1
Spacings in components



SM100

A – Uninsulated live metal parts of wiring device.

B – Insulated material of wiring device.

C – Mounting screw of wiring device.

D – Dead-metal parts of wiring device.

E – Dead-metal parts of sign.

F – Spacings to which 29.1.1 applies.

G – Spacings to which 29.1.1 does not apply.

29.2 Insulating Barriers

29.2.1 An insulating barrier that is provided in place of a required electrical spacing shall be of a nonabsorptive, electrically-insulating material such as porcelain, glass, or other material evaluated for the purpose and shall be effectively secured in place. See Table 29.3.

29.2.1 revised July 2, 2001

Table 29.3
Barriers involving insulation

Material	Minimum thickness, inch (mm)		Outdoor sign		Indoor sign	
			Lamp Type	Tube Type	Lamp Type	Tube Type
Fiber	1/32	0.8	X	X	A	X ^a
Cold-molded composition	3/32	2.4	A	X	A	A ^a
Glass	1/8	3.2	A	A	A	A
Phenolic composition	1/32	0.8	A	X	A	A ^a
Porcelain, glazed	1/8	3.2	A	A	A	A
Porcelain, unglazed	1/8	3.2	X	X ^b	A	A ^a
Mica	1/32	0.8	A	A	A	A

A – Complies with requirements, X – Does not comply with the requirements.

^a Complies with requirements only when not in contact with live parts.

^b Unglazed porcelain tubes are capable of being used on insulated wires.

29.2.2 An insulating cap provided on an electrode receptacle shall be secured in place. Spacings are to be measured through the joint between the cap and the receptacle.

29.2.3 Glass tubing used in place of air spacing shall be double-thickness glass, 0.1 inch (2.54 mm) thick, and shall be taped in place at both ends or otherwise reliably secured.

30 Form-1 Signs

30.1 Deleted July 2, 2001

30.2 Deleted July 2, 2001

30.3 Deleted July 2, 2001

30.4 Deleted July 2, 2001

30.5 Deleted July 2, 2001

30.6 Deleted July 2, 2001

30A Awning Signs

30A.1 An awning sign, including retractable awning signs, shall be provided with a means to be permanently connected to a source of supply and mounting means for permanent securement to a building or structure.

30A.1 added July 2, 2001

30A.2 Where lighting fixtures are provided as part of an awning sign, the lighting fixtures shall comply with the requirements in the Standard for Fluorescent Lighting Fixtures, UL 1570, the Standard for Incandescent Lighting Fixtures UL 1571, or the Standard for High Intensity Discharge Lighting Fixtures , UL 1572, as applicable. Lighting fixtures shall be suitable for use in wet locations.

Exception: A lighting fixture suitable for damp locations is not prohibited from being used when all of the following conditions are met:

- a) The awning material, flexible or rigid, has been evaluated and identified as suitable for wet locations,*
- b) The awning is not retractable, and*
- c) The lighting fixtures are not mounted where they are exposed to precipitation. See 30A.6.*

Added 30A.2 effective January 2, 2004

30A.3 Awning material shall be spaced from heat producing components in accordance with 8.2.

30A.3 added July 2, 2001

30A.4 All awning material shall be mechanically secured to the awning framework. Flexible awning material, when provided, shall be taut over the framework.

30A.4 added July 2, 2001

30A.5 Fixtures previously evaluated as appropriate for wet or damp locations shall not be modified, such as by adding drain openings.

30A.5 added July 2, 2001

30A.6 Awning signs which rely on the mounting surface to prevent water from contacting damp location fixtures, or other non-weatherproof type enclosures, shall be shipped with outdoor, non-hardening caulking, and instructions for proper location and application of the caulking during installation. See 41.3.1.

30A.6 added July 2, 2001

30A.7 Awning signs shall be designed to prevent the accumulation of water on any portion of the material.

30A.7 added July 2, 2001

30A.8 Awning signs shall be provided with a means for attachment to a building, support or hanging rig, and the installation shall be described in the installation instructions provided with each sign. See 41.3.1.

30A.8 added July 2, 2001

PERFORMANCE

31 Mechanical Tests

31.1 Stability test

31.1.1 A freestanding sign is to be tipped as described in 31.1.2. As a result of this test, the sign shall not overturn, collapse, or show other indication of instability or visible damage to the supporting structure.

31.1.2 To determine whether a sign complies with the requirement in 31.1.1, a sample of the sign is to be completely assembled (including any accessories intended to be provided on or in the sign), located on a flat, horizontal surface, and then tipped through an angle of 10 degrees from the normal rest position without any additional restraint. The sign is to remain in this position for a period of 1 minute, after which it is to return by gravity to its normal upright position and is to be visually examined.

31.2 Mounting test

31.2.1 A wall-mounted sign that uses openings or keyhole slots in a polymeric material or a polymeric frame, or similar parts for mounting is to be tested as described in 31.2.2. As a result of this test, the plastic support, frame, or similar parts shall remain mounted as intended and show no visible cracking or distortion of the supporting part which affects the overall integrity of the sign mounting or enclosure.

31.2.2 A sample of the sign is to be mounted and operated as intended. While the sign is in a well-heated condition, a weight of three times the total weight of the sign, and not less than 5 pounds (2.3 kg), is to be suspended from it for a period of 1 minute. The weight is to be applied so as to act through the center of gravity of the sign. The sign is then to be visually examined.

32 Exclusion of Water Test

32.1 A sign or a component required to exclude water shall be tested as described in 32.2. As a result of the test:

a) Water shall not contact:

- 1) A fluorescent-lamp lampholder,
- 2) A fluorescent lamp mounted in other than a horizontal position,
- 3) A snap switch,
- 4) Flexible metal conduit,

- 5) Armored cable, and
 - 6) Other electrical components, unless they are of the weatherproof type; and
- b) Water shall not enter:
- 1) A splice enclosure provided as part of an outdoor ballast,
 - 2) A separate enclosure housing an outdoor ballast,
 - 3) An enclosure housing appliance-wiring-material conductors,
 - 4) An enclosure housing a snap switch, or similar device, or
 - 5) A drain opening provided on the back surface of a sign.

32.2 To determine whether a sign complies with the requirement in 32.1, the sign shall be positioned as intended in service and 1 gallon (3.8 L) of water is to be poured in a continuous stream on or over each part of the sign that permits the entrance of water, such as openings at the back of the sign for drainage, openings for ventilation, mounting straps, seams, or hinge joints. The water is to be poured slowly from a pail of any convenient size, with the lip of the pail held 6 inches (150 mm) above the point under test, in a manner that results in water entering the opening. At the conclusion of the test, the exterior of the sign is to be wiped dry and the interior examined for compliance with 32.1(a) and (b).

32.3 An outdoor sign intended to be mounted on a post or mast that extends through the sign, is to be subjected to the test described in 32.2 with short sections of the post or sheet-metal replicas that extend a distance to simulate the intended installation.

33 Aging of Gaskets Test

33.1 A gasket of neoprene, rubber, solid elastomer material, or open and closed flexible cellular materials used to block the entrance of water into a sign body, is identified as resistant to aging when the material, after testing:

- a) Shows no significant reduction in tensile strength or elongation characteristics (60 percent minimum of original), following the oven aging test (conducted for 70 hours at 100°C for a 60°C maximum service temperature) in the Standard for Gaskets and Seals, UL 157; or
- b) Shows no visible evidence of deterioration such as cracking after flexing, softening, or hardening after exposure for 70 hours in an air oven at a temperature of 100 ±2°C.

33.1 revised September 3, 1998

34 Strain-Relief Test

34.1 General

34.1.1 Each supply lead or cord of a sign shall be tested as described in 34.2.1 and 34.2.2, or 34.5.1, as applicable. There shall not be any strain transmitted to a terminal or splice.

34.2 Power supply cord

34.2.1 The conductors of a power-supply cord are to be severed immediately adjacent to the terminals or splices, unless they are assembled to a lampholder, switch, or similar devices as described in the Exception to 16.3.15.

34.2.2 For cord-connected signs, a 35-pound (16-kg) weight is to be applied to the cord for 1 minute and in any direction that the construction permits, including the direction that results in the displacement of the cord or the strain-relief.

34.3 Attachment plug

34.3.1 The attachment plug and supply cord shall be tested as described in 34.3.2 to determine whether the strain-relief is capable of being used as a strain-relief. Either conductor of the cord shall not detach from a terminal of the plug.

34.3.2 To determine whether a strain-relief complies with the requirement in 34.3.1, the attachment plug is to be securely supported by the blades, a pull of 30 pounds (133 N) is to be applied for 1 minute to the flexible cord by means of a weight, in a direction perpendicular to the plane of the cord-entry hole.

34.4 Internal wiring

34.4.1 For a cord-connected sign with wiring accessible during user servicing of the sign, a 20-pound (89-N) force is to be applied to the wiring as described in 34.2.2.

34.5 Supply leads

34.5.1 For a field-wiring lead, a 20-pound (89-N) force is to be applied to the lead as described in 34.2.2.

35 Security of Blades Test

35.1 When a blade or pin of an attachment plug is connected to a conductor of the cord prior to being affixed to the plug, each blade and pin, and the parallel blades shall be tested as described in 35.2. After removal of the weight, there shall not be any loosening of the blades or pin. Either blade of a plug of nonrigid construction (for example, a plug of soft, molded material) shall not be displaced more than 3/32 inch (2.4 mm) measured 2 minutes after removal of the weight.

35.2 To determine whether an attachment plug complies with the requirements in 35.1, the plug is to be wired in the intended manner and then supported on a horizontal steel plate with the blades or pin projecting downward through a hole having a diameter sized only to permit the blades and the pin to pass through it. A 20-pound (9-kg) weight is to be supported for 2 minutes by each blade or pin in succession and then by the two blades tested together.

36 Temperature Test

36.1 A sign requiring a temperature test as specified in 4.4 and 9.1, shall be tested in accordance with this section. When tested under the conditions that result in maximum heat, a sign shall not attain a temperature at any point that results in risk of fire, to affect adversely any material used, or to exhibit rises in temperature above an ambient of 25°C (77°F) at specific points greater than as indicated in Table 36.1.

Table 36.1
Maximum temperature rise

Component or location	°C	(°F)
1. Coil of open-type device using:		
a) Class 105 insulation system		
1) Thermocouple method ^a	65	117
2) Change of resistance method	75	135
b) Class 130 insulation system		
1) Thermocouple method ^b	85	153
2) Change of resistance method	95	171
c) Class 155 insulation system		
1) Thermocouple method	110	198
2) Change of resistance method	115	207
d) Class 180 insulation system		
1) Thermocouple method	125	225
2) Change of resistance method	140	252
2. Capacitors: ^{c,d}		
a) Electrolytic	40	72
b) Other types	65	117
3. Resistor-type ballast	125	225
4. Varnished-cloth insulation ^d	60	108
5. Fiber used as electrical insulation	65	117
6. Wood and other cellulosic material	65	117
7. Insulated wires and cords:		
a) GTO cable ^{e,f}	35	63
b) RH-10 cable	50	90
c) Other	f	f
8. Thermoplastic	g	g
9. Points of sign support	65	117
10. Gaskets ^d	35	83

Table 36.1 Continued on Next Page

Table 36.1 Continued

Component or location	°C	(°F)
<p>^a At a point on the surface of a coil where the temperature is affected by an external heat source, the temperature rise measured by means of a thermocouple is capable of exceeding 65°C (117°F), but not exceeding 80°C (144°F), when the temperature rise indicated by the change of resistance method is not greater than 75°C (135°F).</p> <p>^b At a point on the surface of a coil where the temperature is affected by an external heat source, the temperature rise measured by means of a thermocouple is capable of exceeding 85°C (153°F), but not exceeding 105°C (189°F), when the temperature rise indicated by the change of resistance method is not greater than 95°C (171°F).</p> <p>^c For capacitors not integral with, and enclosed by, items (1), (2), and (5).</p> <p>^d These limitations do not apply to compounds or components that are rated for higher temperature.</p> <p>^e GTO cable having a temperature rating of 60°C (140°F) is capable of being exposed to a temperature greater than 60°C (such as at terminals) when supplementary insulation having the required voltage and temperature ratings, such as glass or other rated material, is used over the insulation on each conductor and fixed in location.</p> <p>^f A wire or cord shall have a temperature rating of at least the maximum measured temperature rise plus 25°C (77°F). See 36.2.</p> <p>^g Thermoplastic shall have a temperature rating of at least the maximum measured temperature rise plus 25°C (77°F). See 36.2.</p>		

36.2 All values for temperature rises in Table 36.1 are based on an assumed ambient temperature of 25°C (77°F). Tests are to be conducted at any room ambient temperature within the range of 10 – 40°C (50 – 104°F), and corrections made as required to compensate for the temperature above or below the normal (assumed) ambient.

36.3 For the temperature test, the voltage of the test circuit is to be 120 volts when the sign is rated between 110 and 120 volts (inclusive), or 240 volts when the sign is rated between 220 and 240 volts (inclusive). At any other voltage rating, the sign is to be tested at its marked rating. A sign that is rated for use at more than one voltage, or for a range of voltages and contains a tapped transformer or other means of being adapted to different sources of supply, is to be tested at the most unfavorable combination of supply voltage and internal adjustment.

Exception: The test for a sign that is rated for use at more than one voltage, or for a range of voltages, is not prohibited from being conducted with the sign connected to the intended supply voltage in accordance with the manufacturer's instructions, when all of the following conditions are present:

- a) A clear, permanent marking adjacent to the cord or supply compartment warning the user that internal adjustments for supply voltage are required when the equipment is installed or moved;*
- b) Detailed instructions clearly show the adjustments that must be made for various voltages. These instructions are permanently affixed to the sign, either on the outside or inside where visible at the point where adjustments are made; and*
- c) The means provided for adjustment of the sign for different voltages comply with the requirements for wiring terminals.*

36.4 The temperature test is to be continued until thermal equilibrium is attained. Thermal equilibrium is determined to exist when three successive readings, taken at intervals of 10 percent of the previously elapsed total test duration (with no interval between readings shorter than 5 minutes) indicate no change.

36.5 Temperatures are to be measured by means of thermocouples; however, coil temperatures are not prohibited from being determined by the resistance method when the coil is inaccessible for mounting a thermocouple.

36.6 When thermocouples are used in the determination of temperatures, it is common practice to use thermocouples consisting of No. 30 AWG (0.05 mm²) iron and constantan wires and a potentiometer-type indicating instrument. Such equipment is to be used for all referee temperature measurement by a thermocouple. Thermocouples are to consist of wires not larger than No. 24 AWG (0.21 mm²).

36.7 Rubber and other material subject to deterioration is to be removed from feet and other supports of the unit when absence of the material results in the unit attaining higher temperatures.

37 Dielectric Voltage-Withstand Test

37.1 While at its maximum normal operating temperature, a sign shall withstand for 1 minute, without breakdown, the application of a 60-hertz, sinusoidal potential between line parts and dead metal parts; between circuits of different potentials and not electrically connected (this includes the primary and secondary circuits of isolating transformers); and between terminals of opposite polarity on capacitors that are across-the-line.

37.2 The test potential is to be 1000 volts plus twice the rated voltage of the unit.

37.3 The test potential shall be obtained from any convenient source of a capacity (at least 500 volt amperes) to maintain the potential indicated except during breakdown. The voltage source is to be continuously variable. A direct-current source is to be used for a direct-current circuit.

37.4 In all tests, the potential is to be gradually increased from zero at a substantially uniform rate until the specified test potential is reached. This specified potential is then to be maintained for 1 minute.

38 Production-Line Grounding Continuity Check

38.1 Each piece of a sign that has a power supply cord having provision for a grounding conductor shall be checked to determine that grounding continuity exists between the grounding blade of the attachment plug and the accessible dead-metal parts of the sign that become energized.

38.2 Only a single check is required when the accessible metal specified is conductively connected by design to all other accessible metal.

38.3 Any indicating device that is determined to comply with the requirements for testing, such as a battery-and-buzzer combination, an ohmmeter, or similar equipment, is capable of being used to determine whether a product complies with the requirement in 38.1.

RATING

39 General

39.1 A portable, cord-connected sign for outdoor use shall not be rated more than 125 volts.

MARKING

40 Details

40.1 General

40.1.1 A sign shall be marked, in a location where the marking is plainly visible after the sign has been installed, with the manufacturer's name, trade name, or trademark, and the date or other dating period of manufacture not exceeding any three consecutive months.

Exception No. 1: The manufacturer's identification is capable of being in a traceable code when the sign is identified by the brand or trademark owned by a private labeler.

Exception No. 2: The date of manufacture is capable of being abbreviated or in an established code, or in another code determined to comply with the requirements.

Exception No. 3: A recessed sign is capable of having the marking applied to the inside of the lamp compartment where visible during user servicing.

40.1.2 A marking that is painted, die-stamped, indelibly stamped, or applied on a decalcomania transfer or pressure-sensitive label is capable of being used.

40.1.3 A form of marking other than those specified in 40.1.2 is capable of being used, when upon investigation, it is determined to comply with the requirements.

40.1.4 When a manufacturer produces or assembles signs at more than one factory, each finished sign shall have a distinctive marking by which it is identified as the product of a particular factory.

40.1.5 An incandescent-lamp sign shall be marked with its electrical rating in volts and either watts or amperes, and with the number of lampholders used in the sign. In addition, the sign shall be marked "Replace with ____ watt lamp, maximum."

40.1.6 A sign using fluorescent lamps, HID lamps, or neon tubing shall be marked with the input amperes at full load and the input voltage.

40.1.6 revised July 2, 2001

40.1.7 A high-intensity-discharge lamp sign shall be marked "USE ONLY LAMP TYPE(S) _____ FOR REPLACEMENT." The appropriate manufacturer's lamp code designation shall be inserted in the blank space. This marking shall be clearly legible with letters not less than 1/8 inch (3.2 mm) high and located adjacent to each lamp assembly where visible during user servicing.

40.1.8 A sign using an incandescent lamp and a fluorescent lamp, HID lamp, or neon tubing shall be marked as required by 40.1.5 – 40.1.7.

40.1.8 revised July 2, 2001

40.1.9 A sign intended for trailer mounting shall be marked "Trailer on which sign may be mounted has not been investigated."

40.1.10 Unless the mounting position is fixed by the construction or message, an outdoor-use electric sign shall be marked to indicate the proper mounting position.

40.1.11 A sign intended for operation at a frequency of other than 60 hertz shall be marked with its rated frequency expressed in one of the following terms: hertz, hz, cycles per second, cps, or cycles/second.

40.1.12 A sign having blank faces that are intended to have advertising applied prior to the installation of the sign shall be marked with the following or equivalent statement: "This sign is intended to have advertising applied to the face (or faces) prior to installation."

40.1.13 A sign shipped without a face shall be marked with the following or equivalent statement: "This sign is intended to be installed with a rigid sign face, with advertising, having dimensions of _____," or "This sign is intended to be installed with a flexible sign face, with advertising, designated _____, using a tensioning system designated _____ and manufactured by _____." The appropriate dimensions, designations, and identifications shall be inserted in the blanks. This marking shall be located in the open lamp area where readily visible prior to installation of the sign. Instructions for installation of the sign face shall also be provided.

40.1.14 A sign as described in Exception No. 4 to 19.1.4 shall be marked "Not for continuous duty" in a location that is readily visible after the sign is installed as intended.

40.1.14 revised July 2, 2001

40.1.15 A wall-mounted sign that is provided with drain openings at the bottom edge of the back surface as described in 10.2.2, and that is capable of being mounted so the drain openings are spaced less than 1/2 inch (12.7 mm) from the mounting surface, shall be marked in a location visible during installation with the following or equivalent statement: "Maintain 1/2 inch clearance between all drain openings and the mounting surface."

40.1.16 A renewable overcurrent protective device, such as a fuse, provided to comply with the requirement in 25.1.3 shall have the following or equivalent marking located adjacent to the device that reads: "Replace with same type and rating of protective device only."

40.1.17 Each dedicated receptacle as described in Receptacles, Section 25, shall have a marking immediately adjacent to the receptacle identifying its use. The marking shall include the statement: "Not a convenience receptacle – For use with _____ only." A description of the product to be connected to the receptacle, including the model number, catalog number, or other identification determined to be equivalent, shall be inserted in the blank space.

40.1.18 A sign or outline lighting marked "The neon supply(ies) complies(y) with the secondary ground-fault protection requirements of UL 2161" shall be provided with neon transformers or neon power supplies all of which comply with the Standard for Neon Transformers and Power Supplies, UL 2161.

40.1.18 added September 3, 1998

40.2 Cord-connected signs

40.2.1 An outdoor-use, cord-connected sign shall be marked with the following or equivalent statement: "Portable outdoor sign."

40.2.2 An outdoor-use, cord-connected sign shall be marked to specify that the user protect the power-supply cord from excessive abuse such as by vehicle traffic. The sign shall be marked to instruct the user to completely unreel the cord before use.

40.2.3 A cord-connected sign for outdoor use shall be marked at a location near the supply cord with the following or equivalent wording: "Replace with a hard-service cord Type SW, SOW, STW or STOW."

40.2.3 revised May 14, 1999

40.2.4 A sign using a ground-fault circuit-interrupter shall be marked with instructions for testing the interrupter. The marking shall be located adjacent to the interrupter so that the user is aware of the instructions. The instructions shall include any required cautionary statements provided with the interrupter instructions, and enough information to enable to user to conduct the required tests on the interrupter. The instructions shall also specify the frequency of such testing, for example: "Test operation of ground-fault circuit-interrupter each time sign is plugged in."

40.2.5 A cord-connected sign not intended for continuous duty and imposing a load greater than 80 percent of the branch-circuit rating on the branch circuit shall be marked "Use on single-outlet circuit only," in a location that is readily visible after the sign is installed as intended.

40.3 Permanently-connected signs

40.3.1 A permanently-connected sign using a motor rated more than 1/20 horsepower (38 watt output) shall also be marked with the motor rating in volts and amperes.

40.3.2 A permanently-connected sign having a motor, other than a clock motor, and motor-overload protection shall be marked to indicate the presence of such protection.

40.3.3 A sign as described in 40.3.2 that does not incorporate motor-overload protection, shall be marked to indicate that remote motor-overload protection is to be provided; to identify the leads to which the power-supply circuit to the motor shall be connected; and to provide motor-rating data, such as voltage, frequency, horsepower, and full-load current per phase, so that proper motor-overload protection shall be determined.

40.3.4 The marking required by 40.3.2 or 40.3.3 shall be located so that it is readily visible after the sign has been installed as intended. This marking is not required to be on the exterior of the sign enclosure when it is readily visible after opening a door or removing a cover at the point where the power-supply leads to the sign are to be connected.

40.3.5 An indoor sign intended for permanent connection shall be marked with the following or equivalent statement: "For indoor use only."

40.3.6 A sign using a convenience receptacle shall be marked with the word "CAUTION" and the following or equivalent statement: "Risk of electric shock. Sign disconnect does not de-energize this receptacle. To reduce the risk of electric shock, disconnect all branch circuit-breakers or fuses before servicing this circuit." See 40.3.7.

40.3.7 A marking that begins with the word "CAUTION" shall be as specified in 40.1.2 or 40.1.3. The word "CAUTION" or "DANGER" shall be in letters not less than 1/8 inch (3.2 mm) in height.

40.4 Signs for outline lighting

40.4.1 A sign for outline lighting shall be marked "Outdoor sign for outline lighting" or "Indoor sign for outline lighting."

40.4.2 Each enclosure of a sign for outline lighting that houses high-voltage secondary circuits in excess of 1000 volts and 30 mA, shall be marked in letters not less than 1/4 inch (6.35 mm) high with the following or equivalent statement: "Caution: ____ Volts." The voltage indicated shall be the maximum rated open circuit transformer voltage.

40.5 Signs shipped in sections

40.5.1 A sign shipped in sections shall be marked to identify:

- a) The splice compartment,
- b) The conductors to be spliced, and
- c) The voltage rating of the splice insulation determined by the maximum voltage between any two conductors and between any conductor and ground.

40.5.2 The marking described in 40.5.1 shall be located on or adjacent to the splice compartment or cover where it is readily visible during installation.

INSTRUCTIONS

41 Details

41.1 Signs shipped in sections

41.1.1 Instructions for the installation of a section sign shall be provided, attached to a sign (where readily visible during installation) or shipped with a sign (for example, as a stuffer sheet), and shall contain the information specified in 41.1.2 and 41.1.3. These instructions are not prohibited from including details of operator or user servicing features.

41.1.2 The location of the field-wiring compartment and wiring connections for a section sign shall be identified in the instructions. The voltage rating of splice insulation to be provided by the installer shall be specified. The value specified is determined by the maximum voltage between any two conductors or any conductor and ground.

Exception No. 1: When an instruction is provided as part of a marking required in Marking, Section 40, an additional instruction is not required to be provided.

Exception No. 2: An external outlet box is not required to be so identified.

41.1.3 Instructions for a section sign for field installation of a flexible sign face system, electrode receptacles, signs with dedicated receptacles, or other constructions permitted by this standard shall be provided where appropriate.

41.2 Signs for outline lighting

41.2.1 A sign for outline lighting having a transformer with a secondary-current rating in excess of 30 mA shall be provided with installation instructions that specify:

- a) Transformers shall be accessible after installation;
- b) Transformers shall be located so that adjacent combustible materials are not subjected to temperatures in excess of 90°C (194°F); and
- c) Neon tubing shall not be located where normally exposed to physical damage.

41.2.1 revised July 2, 2001

41.3 Awning signs

41.3.1 Instructions for the installation of an awning sign shall be provided either attached to a sign where readily visible during installation, or shipped with a sign (i.e. a stuffer sheet). Instructions shall contain the information specified in 30A.6 and 30A.8. These instructions are to include details of operator or user servicing features.

41.3.1 added July 2, 2001

APPENDIX A

Standards for Components

Standards under which components of the products covered by this standard are evaluated include the following:

Title of Standard – UL Standard Designation

Armored Cable – UL 4
Attachment Plugs and Receptacles – UL 498
Ballasts, Fluorescent-Lamp – UL 935
Circuit Breakers, Molded-Case, Molded-Case Switches, and Circuit-Breaker Enclosures – UL 489
Control Centers for Changing Message Type Electric Signs – UL 1433
Cord Reels – UL 355
Cord Sets and Power-Supply Cords – UL 817
Electrical Metallic Tubing – UL 797
Electrode Receptacles for Gas-Tube Signs – UL 879
Enclosures for Electrical Equipment – UL 50
Fittings for Cable and Conduit – UL 514B
Flexible Cord and Fixture Wire – UL 62
Flexible Metal Conduit – UL 1
Fuseholders – UL 512
Ground-Fault Circuit-Interrupters – UL 943
Intermediate Metal Conduit – UL 1242
Lampholders, Edison-Base – UL 496
Lampholders, Starters, and Starter Holders for Fluorescent Lamps – UL 542
Liquid-Tight Flexible Steel Conduit – UL 360
Motor-Operated Appliances – UL 73
Outlet Boxes, Metallic – UL 514A
Polymeric Materials – Fabricated Parts – UL 746D
Polymeric Materials – Long Term Property Evaluations– UL 746B
Polymeric Materials – Short Term Property Evaluations – UL 746A
Polymeric Materials – Use in Electrical Equipment Evaluations – UL 746C
Power Units Other Than Class 2 – UL 1012
Printed-Wiring Boards – UL 796
Motors, Overheating Protection for – UL 2111
Rigid Metal Conduit – UL 6
Schedule 40 and 80 Rigid PVC Conduit – UL 651
Switches, Clock-Operated – UL 917
Transformers, Class 2 and Class 3 – UL 1585
Transformers, Specialty – UL 506

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**Superseded requirements for
the Standard for
Electric Signs**

UL 48, Fourteenth Edition

The requirements shown are the current requirements that have been superseded by requirements in revisions issued for this Standard. To retain the current requirements, do not discard the following requirements until the future effective dates are reached.

5.3.3 Rigid conduit or rigid tubing smaller than 1/2 inch (12.7 mm) diameter trade size, and flexible conduit or flexible tubing smaller than 3/8 inch (9.5 mm) diameter trade size, shall not be used.

10.2.1 An outdoor sign shall be provided with two or more openings for water drainage. A drain opening shall be free from burrs so that the risk of clogging is reduced. When circular, a drain opening shall have a diameter of 1/4 – 1/2 inch (6.4 – 12.7 mm). When not circular in shape, a drain opening shall have a minimum dimension of not less than 1/4 inch and an area of 0.05 – 0.20 square inch (32.3 – 129.0 mm)².

Exception: Although they are not required, drain openings are capable of being used in a supplementary enclosure located within a sign body, when the sign complies with the Exclusion of Water Test, Section 32.

10.2.2 Drain openings shall be located in the bottom of the sign body, or at the bottom edge of the back surface of a sign body, so that the sign complies with the Exclusion of Water Test, Section 32. When the openings are located at the bottom of the back surface of a wall-mounted sign, the construction shall be such that the openings are located at least 1/2 inch (12.7 mm) from the mounting surface or the sign shall be provided with instructions as specified in Instructions, Section 41, and marked as specified in 40.1.15.

10.3.1 A horizontal trough for supporting panels or letters in an outdoor sign shall be provided with one or more drain holes when the trough is arranged, formed, or located so that water pockets are capable of forming.

Table 16.1
Supply-conductor size for portable outdoor signs

Length of cord, feet (m)		Minimum cord-conductor size, AWG No. ^a (mm ²)									
		15-ampere plug		20-ampere plug		30-ampere plug		50-ampere plug		60-ampere plug	
6 – 50	1.8 – 15	14	2.1	12	3.3	8	8.4	4	21.2	4	21.2
Over 50	Over 15	12	3.3	10	5.3	6	13.3	2	33.6	2	33.6

^aFor maximum internal-circuit ampere ratings see Note (c) of Table 19.2.

20.1.8 Type GTO cable is rated for a maximum service temperature of 60°C (140°F) unless it is marked otherwise. Type RH-10 wire is rated for a maximum service temperature of 75°C (167°F).

20.1.9 All high-voltage wiring shall be permanently positioned not less than 3 inches (76 mm) away from a transformer or ballast case, see Figure 20.1.

Exception No. 1: High-voltage wiring is capable of being positioned less than 3 inches from any transformer or ballast case when it complies with the Temperature Test, Section 36. See 29.1.7 and Table 29.2 for the minimum spacing requirements.

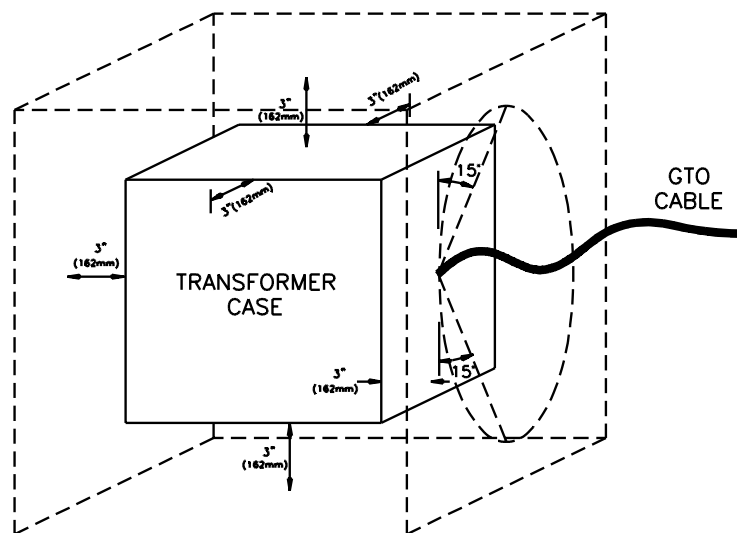
Exception No. 2: High-voltage wiring is capable of being positioned less than 3 inches from any transformer or ballast case when it is routed through glass tubing constructed of double-thick glass, 0.1 inch (2.54 mm) thick, that is taped in place at both ends or otherwise reliably secured. See 29.1.7 and Table 29.2 for the minimum spacing requirements.

Exception No. 3: High-voltage wiring is capable of being positioned less than 3 inches from any transformer case at the point of entry, and 3 inches beyond when:

- a) It is routed and secured away from the transformer case and*
- b) The wiring does not enter the transformer case at an angle less than 15 degrees from the plane of the case at the point of entry.*

Exception No. 4: GTO cable is capable of being positioned less than 3 inches from a gas tube sign transformer case when the GTO cable is rated for a 90°C or greater temperature. See 29.1.7 and Table 29.2 for the minimum spacing requirements.

Figure 20.1
Location of GTO cable



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NOTE – A GTO Cable is capable of being located anywhere outside the three dimensional envelope formed by the dotted lines.