CHAPTER 6

Special Equipment

ARTICLE 600

Electric Signs and Outline Lighting

Part I. General

600.1 Scope. This article covers the installation of conductors, equipment, and field wiring for electric signs, retrofit kits, and outline lighting, regardless of voltage. All installations and equipment using neon tubing, such as signs, decorative elements, skeleton tubing, or art forms, are covered by this article.

Informational Note: Sign and outline lighting illumination systems include, but are not limited to, cold cathode neon tubing, high-intensity discharge lamps (HID), fluorescent or incandescent lamps, light-emitting diodes (LEDs), and electroluminescent and inductance lighting.

Covered under the requirements of this article are signs of the fixed, stationary, and portable self-contained types. Electric signs and outline lighting frequently include sources of illumination identical to those of luminaires; however, the structure and electrical operation of many electric signs are far more complex than simply a set of fluorescent lamps within an enclosure. The terms *electric sign* and *outline lighting* as defined in Article 100 distinguish the function and use of equipment covered by these requirements from the equipment covered by the requirements of Article 410.

Neon tubing is used extensively in the sign industry, and its uses go far beyond the typical electric sign or outline lighting applications. Neon tubing is used in decorative and artistic applications to enhance the indoor and outdoor appearance of buildings and structures. Neon art forms are mounted on enclosures, sign bodies, and other support structures, or they are field-installed skeleton tubing. Depending on how neon art forms are constructed and installed, they are subject to the requirements of either Part I or Parts I and II of Article 600.

600.3 Listing. Fixed, mobile, or portable electric signs, section signs, outline lighting, photovoltaic (PV) powered signs, and retrofit kits, regardless of voltage, shall be listed and labeled, provided with installation instructions, and installed in conformance with that listing, unless otherwise approved by special permission.

Electric signs and outline lighting are occasionally designed for a very specific purpose and may be a one-time construction for which the manufacturer might not obtain listing. Listing or approval by special permission helps ensure that electrical equipment does not pose a shock or fire hazard.

(A) Field-Installed Skeleton Tubing. Field-installed skeleton tubing shall not be required to be listed where installed in conformance with this *Code*.

(B) Outline Lighting. Outline lighting shall not be required to be listed as a system when it consists of listed luminaires wired in accordance with Chapter 3.

600.4 Markings.

(A) Signs and Outline Lighting Systems. Signs and outline lighting systems shall be listed and labeled; marked with the manufacturer's name, trademark, or other means of identification; and input voltage and current rating.

(B) Signs with a Retrofitted Illumination System. Signs with a retrofitted illumination system shall contain the following:

(1) The sign shall be marked that the illumination system has been replaced.
(2) The marking shall include the kit providers and installer's name, logo, or unique identifier.
(3) Signs equipped with tubular light-emitting diode lamps powered by the existing sign sockets shall include a label alerting the service personnel that the sign has been modified. The label shall meet the requirements of 110.21(B). The label shall also include a warning not to install fluorescent lamps and shall also be visible during relamping.

Retrofit kits for electric signs must be listed in accordance with 600.3. As part of the listing, installation instructions are required to be provided. The installation instructions specify the

manufacturer and the type of sign in which the kit is intended to be installed. The marking required by this section will assist the AHJ in verifying that the kit is installed in accordance with the manufacturer's installation instructions.

The label required by item (3) addresses installations in which tubular light-emitting diode (LED) lamps are used with the existing sign sockets. The label is important because installing a fluorescent lamp into retrofitted sockets with unregulated line voltage can be a potential hazard for service personnel.

(C) Signs with Lampholders for Incandescent Lamps. Signs and outline lighting systems with lampholders for incandescent lamps shall be marked to indicate the maximum allowable lamp wattage per lampholder. The markings shall be permanently installed, in letters at least 6 mm (¼ in.) high, and shall be located where visible during relamping.

The required markings are only required to be visible during relamping of the sign. The markings can be placed within the interior of a sign body or sign equipment enclosure.

(D) Visibility. The markings required in 600.4(A) and listing labels shall be visible after installation and shall be permanently applied in a location visible prior to servicing. The marking shall be permitted to be installed in a location not viewed by the public.

(E) Installation Instructions. All signs, outline lighting, skeleton tubing systems, and retrofit kits shall be marked to indicate that field wiring and installation instructions are required.

Exception: Portable, cord-connected signs are not required to be marked.

600.5 Branch Circuits.

Δ **(A) Required Branch Circuit.** Each commercial building and each commercial occupancy accessible to pedestrians shall be provided with at least one outlet in an accessible location at each entrance to each tenant space for sign or outline lighting system use. The outlet(s) shall be supplied by a branch circuit rated at least 20 amperes that supplies no other load.

Exception No. 1: A sign or outline lighting outlet shall not be required at entrances for deliveries, service corridors, or service hallways that are intended to be used only by service personnel or employees.

Exception No. 2: The required branch circuit shall be permitted to supply loads directly related to the control of the sign such as electronic or electromechanical controllers.

This requirement is not contingent on whether an electric sign will be installed at the time an occupant moves in, since it is common to install an electric sign after the space is occupied or when a new occupant moves into an existing space.

(B) Marking. A disconnecting means for a sign, outline lighting system, or controller shall be marked to identify the sign, outline lighting system, or controller it controls.

Exception: An external disconnecting means that is mounted on the sign body, sign enclosure, sign pole, or controller shall not be required to identify the sign or outline lighting system it controls.

(C) Rating. Branch circuits that supply signs shall be rated in accordance with 600.5(C)(1) or (C)(2) and shall be considered to be continuous loads for the purposes of calculations.

(1) Neon Signs. Branch circuits that supply neon tubing installations shall not be rated in excess of 30 amperes.

(2) All Other Signs. Branch circuits that supply all other signs and outline lighting systems shall be rated not to exceed 20 amperes.

Large signs often have load requirements that exceed the maximum rating specified by 600.5(C). These signs typically are supplied by a feeder that in turn supplies branch circuits, which must be rated as specified by this requirement. In some cases, particularly for signs installed along highways or large free-standing signs, a utility service dedicated to the sign is provided. The rating of the feeder or service is not limited by this requirement. Because sign loads are continuous, the conductors and overcurrent protective devices (OCPDs) for circuits supplying sign loads have to be sized in accordance with the requirements for continuous loads contained in Articles 210, 215, and 230.

(D) Wiring Methods. Wiring methods used to supply signs shall comply with 600.5(D)(1), (D)(2), and (D)(3).

(1) Supply. The wiring method used to supply signs and outline lighting systems shall terminate within a sign, an outline lighting system enclosure, a suitable box, a conduit body, or panelboard.

Δ **(2) Enclosures as Pull Boxes.**

(a) Listed and labeled electrical enclosures integral to the sign shall be permitted to be used for voltages up to 600 volts as pull or junction boxes for conductors supplying the following:

(1) Other adjacent signs
(2) Outline lighting systems
(3) Floodlights that are part of a sign

(b) The enclosures in 600.5(D)(2)(a) shall be permitted to contain both branch and secondary circuit conductors.

(c) Listed and labeled neon transformer boxes shall be permitted to contain multiple voltages over 1000 volts. A disconnecting means shall be provided to de-energize all ungrounded conductors in the enclosures.

Δ **(3) Metal or Nonmetallic Poles.** Metal or nonmetallic poles used to support signs shall be permitted to enclose supply conductors.

Δ **600.6 Disconnects.** Each sign and outline lighting system, feeder conductors, or branch circuits supplying a sign, outline lighting system, or skeleton tubing shall be controlled by an externally operable switch or circuit breaker that opens all

ungrounded conductors and controls no other load. Signs and outline lighting systems located within fountains shall have the disconnect located in accordance with 680.13.

Exception No. 1: A disconnecting means shall not be required for an exit directional sign located within a building.

Exception No. 2: A disconnecting means shall not be required for cord-connected signs with an attachment plug.

Informational Note: The location of the disconnect is intended to allow service or maintenance personnel and first responders complete and local control of the disconnecting means.

Δ **(A) Location.** The disconnecting means shall be accessible and located in accordance with 600.6(A)(1), 600.6(A)(2), or 600.6(A)(3). If the disconnecting means is remote from the sign it controls, it shall comply with 600.6(A)(4).

Δ **(1) At Point of Entry to a Sign.** The disconnect shall be located at the point the feeder circuit or branch circuits supplying a sign or outline lighting system enters a sign enclosure, a sign body, or a pole in accordance with 600.5(D)(3). The disconnect shall open all ungrounded conductors where it enters the enclosure of the sign or pole.

Exception No. 1: A disconnect shall not be required for branch circuits or feeder conductors passing through the sign where not accessible and enclosed in a Chapter 3 listed raceway or metal-jacketed cable identified for the location.

Exception No. 2: A disconnect shall not be required at the point of entry to a sign enclosure or sign body for branch circuits or feeder conductors that supply an internal panelboards in a sign enclosure or sign body. The conductors shall be enclosed where not accessible in a Chapter 3 listed raceway or metal-jacketed cable identified for the location. A field-applied permanent hazard label that is visible during servicing shall be applied to the raceway at or near the point of entry into the sign enclosure or sign body. The danger label shall state the following: "Danger. This raceway contains energized conductors." The marking shall include the location of the disconnecting means for the energized conductors. The disconnecting means shall be capable of being locked in the open position.

Δ **(2) Within Sight of the Sign.** The disconnecting means shall be within sight of the sign or outline lighting system that it controls. Where the disconnecting means is out of the line of sight from any section that is able to be energized, the disconnecting means shall be lockable in accordance with 110.25. A permanent field-applied marking identifying the location of the disconnecting means shall be applied to the sign in a location visible during servicing.

Δ **(3) Within Sight of the Controller.** The following shall apply for signs or outline lighting systems operated by electronic or electromechanical controllers located external to the sign or outline lighting system:

(1) The disconnecting means shall be located within sight of the controller or in the same enclosure with the controller.
(2) The disconnecting means shall disconnect the sign or outline lighting system and the controller from all ungrounded supply conductors.
(3) The disconnecting means shall be designed such that no pole can be operated independently and shall be lockable in accordance with 110.25.

Exception: Where the disconnecting means is not located within sight of the controller, a permanent field-applied marking identifying the location of the disconnecting means shall be applied to the controller in a location visible during servicing.

Δ **(4) Remote Location.** The disconnecting means, if located remote from the sign, sign body, or pole, shall be mounted at an accessible location available to first responders and service personnel. The location of the disconnect shall be marked with a label at the sign location and marked as the disconnect for the sign or outline lighting system.

A disconnecting means that is not within sight of the sign that it controls is required to be installed where it can be operated by maintenance personnel and by emergency first responders. In accordance with 600.6(A)(2), a remote disconnecting means must be constructed or equipped to be locked in the open position in accordance with 110.25. Additionally, the sign controlled by the remote disconnecting means must have a permanent and durable label that denotes the location of the disconnecting means. The disconnecting means is required to be marked in accordance with 110.22(A).

(B) Control Switch Rating. Switches, flashers, and similar devices controlling transformers and electronic power supplies shall be rated for controlling inductive loads or have a current rating not less than twice the current rating of the transformer or the electronic power supply.

A switching device that controls the primary circuit of a transformer supplying a luminous gas tube is subject to a highly inductive load that causes severe arcing of its contacts. Therefore, the switch or flasher is required to be rated for the inductive load, or it must have a current rating that is at least twice the current rating of the transformer it controls.

600.7 Grounding and Bonding.

(A) Grounding.

(1) Equipment Grounding Conductor. Metal equipment of signs, outline lighting, and skeleton tubing systems shall be grounded by connection to the equipment grounding conductor of the supply branch circuit(s) or feeder using the types of equipment grounding conductors specified in 250.118.

Exception: Portable cord-connected signs shall not be required to be connected to the equipment grounding conductor where protected by a system of double insulation or its equivalent. Double insulated equipment shall be distinctively marked.

(2) Size of Equipment Grounding Conductor. The equipment grounding conductor size shall be in accordance with 250.122.

(3) Connections of Equipment Grounding Conductor. Equipment grounding conductor connections shall be made in accordance with 250.130 and in a method specified in 250.8.

(4) Auxiliary Grounding Electrode. Auxiliary grounding electrode(s) shall be permitted for electric signs and outline lighting systems covered by this article and shall meet the requirements of 250.54.

(5) Metal Building Parts. Metal parts of a building shall not be permitted as a secondary return conductor or an equipment grounding conductor.

(B) Bonding.

(1) Bonding of Metal Parts. Metal parts and equipment of signs and outline lighting systems shall be bonded together and to the associated transformer or power-supply equipment grounding conductor of the branch circuit or feeder supplying the sign or outline lighting system and shall meet the requirements of 250.90.

Exception: Remote metal parts of a section sign or outline lighting system only supplied by a remote Class 2 power supply shall not be required to be bonded to an equipment grounding conductor.

(2) Bonding Connections. Bonding connections shall be made in accordance with 250.8.

Δ **(3) Metal Building Parts.** Metal parts of a building shall not be used as a means for bonding metal parts and equipment of signs or outline lighting systems together or to the transformer or power-supply equipment grounding conductor of the supply circuit.

(4) Flexible Metal Conduit Length. Listed flexible metal conduit or listed liquidtight flexible metal conduit that encloses the secondary circuit conductor from a transformer or power supply for use with neon tubing shall be permitted as a bonding means if the total accumulative length of the conduit in the secondary circuit does not exceed 30 m (100 ft).

Listed flexible metal conduit (FMC) and listed liquidtight flexible metal conduit (LFMC) are suitable as a bonding means in lengths up to 100 feet because the purpose of the bonding specified by 600.7(B)(1) is not to operate an OCPD on the primary side of the transformer or power supply but to minimize differences of potential between the metal parts of signs or outline lighting systems.

(5) Small Metal Parts. Small metal parts not exceeding 50 mm (2 in.) in any dimension, not likely to be energized, and spaced at least 19 mm (¾ in.) from neon tubing shall not require bonding.

(6) Nonmetallic Conduit. Where listed nonmetallic conduit is used to enclose the secondary circuit conductor from a transformer or power supply and a bonding conductor is required, the bonding conductor shall be installed separate and remote from the nonmetallic conduit and be spaced at least 38 mm (1½ in.) from the conduit when the circuit is operated at 100 Hz or less or 45 mm (1¾ in.) when the circuit is operated at over 100 Hz.

Secondary circuit raceways normally contain only one conductor, which is connected to one side of the neon tube. Where nonmetallic conduit is used and any sign parts are required to be bonded, the bonding conductor(s) must be run outside of and be separated from the nonmetallic conduit. Installing bonding conductors inside the nonmetallic conduit with secondary power-supply conductors is prohibited because doing so could increase the chance of failure of the conductor or nonmetallic tubing.

Δ **(7) Bonding Conductors.** Bonding conductors installed outside of a sign or raceway shall be protected from physical damage. Bonding conductors shall comply with 250.120 and 250.122. Bonding conductor size shall also comply with one of the following:

(1) Bonding conductors shall be copper and not smaller than 14 AWG.
(2) Bonding conductors shall be copper-clad aluminum and not smaller than 12 AWG.

Δ **(8) Signs in Fountains.** Signs or outline lighting installed inside a fountain shall have all metal parts bonded to the equipment grounding conductor of the branch circuit for the fountain recirculating system. The bonding connection shall be as near as practicable to the fountain and shall be permitted to be made to metal piping systems that are bonded in accordance with 680.54(B).

Informational Note: See 600.32(J) for restrictions on length of high-voltage secondary conductors.

600.8 Enclosures. Live parts, other than lamps, and neon tubing shall be enclosed. Transformers and power supplies provided with an integral enclosure, including a primary and secondary circuit splice enclosure, shall not require an additional enclosure.

(A) Strength. Enclosures shall have ample structural strength and rigidity.

(B) Material. Sign and outline lighting system enclosures shall be constructed of metal or shall be listed.

(C) Minimum Thickness of Enclosure Metal. Sheet copper or aluminum shall be at least 0.51 mm (0.020 in.) thick. Sheet steel shall be at least 0.41 mm (0.016 in.) thick.

(D) Protection of Metal. Metal parts of equipment shall be protected from corrosion.

600.9 Location.

(A) Vehicles. Sign or outline lighting system equipment shall be at least 4.3 m (14 ft) above areas accessible to vehicles unless protected from physical damage.

(B) Pedestrians. Neon tubing, other than listed, dry-location, portable signs, readily accessible to pedestrians shall be protected from physical damage.

Informational Note: See 600.41(D) for additional requirements.

(C) Adjacent to Combustible Materials. Signs and outline lighting systems shall be installed so that adjacent combustible materials are not subjected to temperatures in excess of 90°C (194°F).

The spacing between wood or other combustible materials and an incandescent or HID lamp or lampholder shall not be less than 50 mm (2 in.).

(D) Wet Location. Signs and outline lighting system equipment for wet location use, other than listed watertight type, shall be weatherproof and have drain holes, as necessary, in accordance with the following:

(1) Drain holes shall not be larger than 13 mm (½ in.) or smaller than 6 mm (¼ in.).
(2) Every low point or isolated section of the equipment shall have at least one drain hole.
(3) Drain holes shall be positioned such that there will be no external obstructions.

600.10 Portable or Mobile Signs.

(A) Support. Portable or mobile signs shall be adequately supported and readily movable without the use of tools.

(B) Attachment Plug. An attachment plug shall be provided for each portable or mobile sign.

(C) Wet or Damp Location. Portable or mobile signs in wet or damp locations shall comply with 600.10(C)(1) and (C)(2).

(1) Cords. All cords shall be junior hard-service or hard-service types as designated in Table 400.4 and have an equipment grounding conductor.

(2) Ground-Fault Circuit Interrupter. In addition to the requirements in 210.8, the manufacturer of portable or mobile signs shall provide listed ground-fault circuit-interrupter protection for personnel. The ground-fault circuit interrupter shall be an integral part of the attachment plug or shall be located in the power-supply cord within 300 mm (12 in.) of the attachment plug.

The type of GFCI required for portable electric signs provides integral open-neutral protection in accordance with UL 48, *Standard for Electric Signs*. An interruption of the neutral conductor on the supply side of the GFCI disables the protection circuitry. Open-neutral protection ensures that if damage to the supply cord causes a break in the grounded conductor, both conductors on the load-side circuit to the portable sign will be opened and no voltage will be present at the sign. These protective devices are required to be original equipment installed by the manufacturer as an integrated GFCI device in the attachment plug or as part of the cord as shown in Exhibit 600.1.

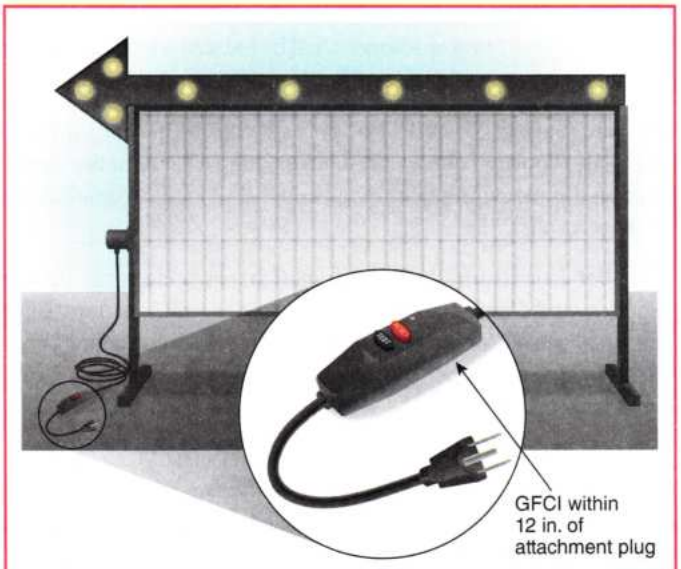

EXHIBIT 600.1 A factory-installed GFCI device located in the power-supply cord within 12 inches of the attachment plug.

(D) Dry Location. Portable or mobile signs in dry locations shall meet the following:

(1) Cords shall be SP-2, SPE-2, SPT-2, or heavier, as designated in Table 400.4.
(2) The cord shall not exceed 4.5 m (15 ft) in length.

600.12 Field-Installed Secondary Wiring. Field-installed secondary circuit wiring for electric signs, retrofit kits, outline lighting systems, skeleton tubing, and photovoltaic (PV) powered sign systems shall be in accordance with their installation instructions and 600.12(A), (B), or (C).

(A) 1000 Volts or Less. Neon and secondary circuit wiring of 1000 volts or less shall comply with 600.31.

(B) Over 1000 Volts. Neon secondary circuit wiring of over 1000 volts shall comply with 600.32.

(C) Class 2. Where the installation complies with 600.33 and the power source provides a Class 2 output that complies with 600.24, either of the following wiring methods shall be permitted as determined by the installation instructions and conditions.

(1) Wiring methods identified in Chapter 3
(2) Class 2 cables complying with Table 600.33(A)(1) and Table 600.33(A)(2)

600.21 Ballasts, Transformers, Electronic Power Supplies, and Class 2 Power Sources. Ballasts, transformers, electronic power supplies, and Class 2 power sources shall be of the self-contained type or be enclosed by placement in a listed sign body or listed separate enclosure.

(A) Accessibility. Ballasts, transformers, electronic power supplies, and Class 2 power sources shall be located where accessible and shall be securely fastened in place.

(B) Location. Ballasts, transformers, electronic power supplies, and Class 2 power sources shall be installed as near to the lamps or neon tubing as practicable to keep the secondary conductors as short as possible.

(C) Wet Location. Ballasts, transformers, electronic power supplies, and Class 2 power sources used in wet locations shall be of the weatherproof type or be of the outdoor type and protected from the weather by placement in a sign body or separate enclosure.

(D) Working Space. A working space at least 900 mm (3 ft) high × 900 mm (3 ft) wide × 900 mm (3 ft) deep shall be provided at each ballast, transformer, electronic power supply, and Class 2 power source or at its enclosure where not installed in a sign.

(E) Attic and Soffit Locations. Ballasts, transformers, electronic power supplies, and Class 2 power sources shall be permitted to be located in attics and soffits, provided there is an access door at least 900 mm × 562.5 mm (36 in. × 22½ in.) and a passageway of at least 900 mm (3 ft) high × 600 mm (2 ft) wide with a suitable permanent walkway at least 300 mm (12 in.) wide extending from the point of entry to each component. At least one lighting outlet containing a switch or controlled by a wall switch shall be installed in such spaces. At least one point of control shall be at the usual point of entry to these spaces. The lighting outlet shall be provided at or near the equipment requiring servicing.

(F) Suspended Ceilings. Ballasts, transformers, electronic power supplies, and Class 2 power sources shall be permitted to be located above suspended ceilings, provided that their enclosures are securely fastened in place and not dependent on the suspended-ceiling grid for support. Ballasts, transformers, and electronic power supplies installed in suspended ceilings shall not be connected to the branch circuit by flexible cord.

600.22 Ballasts.

(A) Type. Ballasts shall be identified for the use and shall be listed.

(B) Thermal Protection. Ballasts shall be thermally protected.

600.23 Transformers and Electronic Power Supplies.

(A) Type. Transformers and electronic power supplies shall be identified for the use and shall be listed.

(B) Secondary-Circuit Ground-Fault Protection. Transformers and electronic power supplies other than the following shall have secondary-circuit ground-fault protection:

(1) Transformers with isolated ungrounded secondaries and with a maximum open circuit voltage of 7500 volts or less

(2) Transformers with integral porcelain or glass secondary housing for the neon tubing and requiring no field wiring of the secondary circuit

(C) Voltage. Secondary-circuit voltage shall not exceed 15,000 volts, nominal, under any load condition. The voltage to ground of any output terminals of the secondary circuit shall not exceed 7500 volts, under any load condition.

(D) Rating. Transformers and electronic power supplies shall have a secondary-circuit current rating of not more than 300 mA.

(E) Secondary Connections. Secondary circuit outputs shall not be connected in parallel or in series.

(F) Marking. Transformers and electronic power supplies that are equipped with secondary-circuit ground-fault protection shall be so marked.

600.24 Class 2 Power Sources. Class 2 transformers, power supplies, and power sources shall comply with the requirements of Class 2 circuits and 600.24(A), (B), (C), and (D).

(A) Listing. Class 2 power supplies and power sources shall be listed for use with electric signs and outline lighting systems or shall be a component in a listed electric sign.

(B) Equipment Grounding Conductor. Metal parts of Class 2 power supplies and power sources shall be connected to the equipment grounding conductor.

(C) Wiring Methods on the Supply Side of the Class 2 Power Supply. Conductors and equipment on the supply side of the power source shall be installed in accordance with the appropriate requirements of Chapter 3.

(D) Secondary Wiring. Secondary wiring on the load side of a Class 2 power source shall comply with 600.12(C) and 600.33.

Part II. Field-Installed Skeleton Tubing, Outline Lighting, and Secondary Wiring

600.30 Applicability. Part II of this article shall apply to all of the following:

(1) Field-installed skeleton tubing
(2) Field-installed secondary circuits
(3) Outline lighting
(4) Field-installed retrofit kits

These requirements shall be in addition to the requirements of Part I.

600.31 Neon Secondary-Circuit Wiring, 1000 Volts or Less, Nominal.

(A) Wiring Method. Conductors shall be installed using any wiring method included in Chapter 3 suitable for the conditions.

(B) Insulation and Size. Conductors shall be listed, insulated, and not smaller than 18 AWG.

(C) Number of Conductors in Raceway. The number of conductors in a raceway shall be in accordance with Table 1 of Chapter 9.

(D) Installation. Conductors shall be installed so they are not subject to physical damage.

(E) Protection of Leads. Bushings shall be used to protect wires passing through an opening in metal.

600.32 Neon Secondary-Circuit Wiring, over 1000 Volts, Nominal.

(A) Wiring Methods.

(1) Installation. Conductors shall be installed in rigid metal conduit, intermediate metal conduit, liquidtight flexible nonmetallic conduit, flexible metal conduit, liquidtight flexible metal conduit, electrical metallic tubing, metal enclosures; on insulators in metal raceways; or in other equipment listed for use with neon secondary circuits over 1000 volts.

(2) Number of Conductors. Conduit or tubing shall contain only one conductor.

(3) Size. Conduit or tubing shall be a minimum of metric designator 16 (trade size ½).

Δ **(4) Spacing from Grounded Parts.** Other than at the location of connection to a metal enclosure or sign body, nonmetallic conduit or flexible nonmetallic conduit shall comply with the following:

(1) Be spaced not less than 38 mm (1½ in.) from grounded or bonded parts when the conduit contains a conductor operating at 100 Hz or less, or
(2) Be spaced not less than 45 mm (1¾ in.) from grounded or bonded parts when the conduit contains a conductor operating at more than 100 Hz

Where installed in nonmetallic conduit, GTO (gas tube and oil burner ignition) cable located in close proximity to a grounded surface could result in damaging stress to the cable insulation due to capacitive coupling and the resulting production of ozone.

(5) Metal Building Parts. Metal parts of a building shall not be permitted as a secondary return conductor or an equipment grounding conductor.

(B) Insulation and Size. Conductors shall be insulated, listed as gas tube sign and ignition cable type GTO, rated for 5, 10, or 15 kV, not smaller than 18 AWG, and have a minimum temperature rating of 105°C (221°F).

(C) Installation. Conductors shall be so installed that they are not subject to physical damage.

(D) Bends in Conductors. Sharp bends in insulated conductors shall be avoided.

(E) Spacing. Secondary conductors shall be separated from each other and from all objects other than insulators or neon tubing by a spacing of not less than 38 mm (1½ in.). GTO cable installed in metal conduit or tubing shall not require spacing between the cable insulation and the conduit or tubing.

(F) Insulators and Bushings. Insulators and bushings for conductors shall be listed for use with neon secondary circuits over 1000 volts.

(G) Conductors in Raceways. The insulation on all conductors shall extend not less than 65 mm (2½ in.) beyond the metal conduit or tubing.

(H) Between Neon Tubing and Midpoint Return. Conductors shall be permitted to run between the ends of neon tubing or to the secondary circuit midpoint return of listed transformers or listed electronic power supplies and provided with terminals or leads at the midpoint.

(I) Dwelling Occupancies. Equipment having an open circuit voltage exceeding 1000 volts shall not be installed in or on dwelling occupancies.

(J) Length of Secondary Circuit Conductors.

(1) Secondary Conductor to the First Electrode. The length of secondary circuit conductors from a high-voltage terminal or lead of a transformer or electronic power supply to the first neon tube electrode shall not exceed the following:

(1) 6 m (20 ft) where installed in metal conduit or tubing
(2) 15 m (50 ft) where installed in nonmetallic conduit

(2) Other Secondary Circuit Conductors. All other sections of secondary circuit conductor in a neon tube circuit shall be as short as practicable.

(K) Splices. Splices in high-voltage secondary circuit conductors shall be made in listed enclosures rated over 1000 volts. Splice enclosures shall be accessible after installation and listed for the location where they are installed.

600.33 Class 2 Sign Illumination Systems, Secondary Wiring.

The wiring methods and materials used shall be in accordance with the sign manufacturer's installation instructions using any applicable wiring methods from Chapter 3, Wiring Methods, or the requirements for Class 2 circuits contained in 600.12(C), 600.24, and 600.33(A), (B), (C), and (D).

(A) Insulation and Sizing of Class 2 Conductors. Class 2 cable listed for the application that complies with Table 600.33(A)(1) or Table 600.33(A)(2) for substitutions shall be installed on the load side of the Class 2 power source. The conductors shall have an ampacity not less than the load to be supplied and shall not be sized smaller than 18 AWG.

TABLE 600.33(A)(1) *Applications of Power Limited Cable in Signs and Outline Lighting*

Location	CL2	CL3	CL2R	CL3R	CL2P	CL3P	PLTC
Nonconcealed spaces inside buildings	Y	Y	Y	Y	Y	Y	Y
Concealed spaces inside buildings that are not used as plenums or risers	Y	Y	Y	Y	Y	Y	Y
Environmental air spaces plenums	N	N	N	N	Y	Y	N
Environmental air spaces risers	N	N	Y	Y	Y	Y	N
Wet locations	N	N	N	N	N	N	Y

Y = Permitted. N = Not Permitted.

TABLE 600.33(A)(2) *Class 2 Cable Substitutions*

Cable Type	Permitted Substitutions
CL3P	CMP
CL2P	CMP, CL3P
CL3R	CMP, CL3P, CMR
CL2R	CMP, CL3P, CL2P, CMR, CL3R
CL3	CMP, CL3P, CMR, CL3R, CMG, CM, PLTC
CL2	CMP, CL3P, CL2P, CMR, CL3R, CL2R, CMG, CM, PLTC, CL3
CL3X	CMP, CL3P, CMR, CL3R, CMG, CM, PLTC, CL3, CMX
CL2X	CMP, CL3P, CL2P, CMR, CL3R, CL2R, CMG, CM, PLTC, CL3, CL2, CMX,CL3X
PLTC	None

(1) General Use. CL2 or CL3, PLTC, or any listed applicable cable for general use shall be installed within and on buildings or structures.

(2) Other Building Locations. In other locations, any listed applicable cable permitted in 600.33(A)(1), (A)(2), (A)(3), and (A)(4) and Table 600.33(A)(1) and Table 600.33(A)(2) shall be permitted to be used as follows:

(1) CL2P or CL3P — Ducts, plenums, or other spaces used for environmental air
(2) CL2R or CL3R — Vertical shafts and risers
(3) Substitutions from Table 600.33(A)(2)

(3) Wet Locations. Class 2 cable used in a wet location shall be listed and marked suitable for use in a wet location.

(4) Other Locations. Class 2 cable exposed to sunlight shall be listed and marked "sunlight resistant — suitable for outdoor use."

Exception: Listed PLTC not marked as sunlight resistant shall be permitted.

Informational Note: PLTC is tested for exposure to sunlight but might not be so marked.

(B) Installation. Secondary wiring shall be installed in accordance with 600.33(B)(1) and (B)(2).

(1) Wiring shall be installed and supported in a neat and workmanlike manner. Cables and conductors installed exposed on the surface of ceilings and sidewalls shall be supported by the building structure in such a manner that the cable is not damaged by normal building use. The cable shall be supported and secured at intervals not exceeding 1.8 m (6 ft). Such cables shall be supported by straps, staples, hangers, cable ties, or similar fittings designed and installed so as not to damage the cable. The installation shall also comply with 300.4(D).
(2) Connections in cable and conductors shall be made with listed insulating devices and be accessible after installation. Where made in a wall, connections shall be enclosed in a listed box.

(C) Protection Against Physical Damage. If subject to physical damage, the conductors shall be protected and installed in accordance with 300.4. All through-wall penetrations shall be protected by a listed bushing or raceway.

(D) Grounding and Bonding. Grounding and bonding shall be in accordance with 600.7.

600.34 Photovoltaic (PV) Powered Sign. All field wiring of components and subassemblies for an off-grid stand-alone, on-grid interactive, or non-grid interactive PV installation shall be installed in accordance with Article 690, as applicable, 600.34, and the PV powered sign installation instructions.

(A) Equipment. Inverters, motor generators, PV modules, PV panels, ac PV modules, dc combiners, dc-ac converters, and charge controllers intended for use in PV powered sign systems shall be listed for PV application.