

## SPECIAL EQUIPMENT

### Chapter E 600

#### ELECTRIC SIGNS AND OUTLINE LIGHTING

E 600.01	Scope	E 600.22	Lampholders
E 600.02	Disconnect required	E 600.31	Installation of conductors
E 600.05	Grounding	E 600.32	Transformers
E 600.06	Load of branch circuit	E 600.33	Electric discharge tubing
E 600.07	Marking	E 600.34	Terminals and electrode receptacles for electric discharge tubing
E 600.08	Enclosures	E 600.35	Switches on doors
E 600.09	Portable gas tube signs		
E 600.11	Tube terminals		
E 600.21	Installation of conductors		

#### A. GENERAL

**E 600.01 Scope.** The provisions of this chapter shall apply to the installation of conductors and equipment for electric signs and outline lighting as defined in chapter E 100. ✓

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 600.02 Disconnect required.** Each outline lighting installation, and each sign of other than the portable type, shall be controlled by an externally-operable switch or breaker which will open all ungrounded conductors and shall be suitable for conditions of installation, such as exposure to the weather.

(1) **IN SIGHT OF SIGN.** The switch or breaker required by section E 600.02 shall be within sight of the sign or outline lighting which it controls or may be located elsewhere when capable of being locked in the open position.

(2) **CONTROL SWITCH RATING.** Switches, flashers, and similar devices controlling transformers shall be either of a type approved for the purpose, or have a current rating not less than twice the current rating of the transformers. On alternating-current circuits, general use alternating-current snap switches may be used to control inductive loads other than motors, not exceeding the ampere rating of switch. See section E 380.14. ✓

**Note:** The intent of this rule is to prohibit one sign enclosure being used as a pull box or raceway for conductors supplying other signs or equipment.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 600.05 Grounding.** (1) Signs, troughs, tube terminal boxes and other metal frames shall be grounded in the manner specified in chapter E 250 of this code, unless they are insulated from ground and from other conducting surfaces and are inaccessible to unauthorized persons.

(2) Isolated non-current-carrying metal parts of outline lighting may be bonded by No. 14 conductors and grounded in accordance with chapter E 250. ✓

(3) Signs of the portable incandescent or fluorescent-lamp type in which the open circuit voltage does not exceed 150 volts to ground are not required to be grounded.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 600.06 Load of branch circuit.** (1) Circuits shall be so arranged that the load imposed by outlets, lamps, and transformers connected to them, shall in no case exceed the rating of the branch circuit.

(2) Circuits which supply lamps, ballasts, and transformers or combinations thereof may be rated not to exceed 20 amperes.

(3) Circuits containing electric discharge lighting transformers exclusively shall not be rated in excess of 30 amperes.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 600.07 Marking.** (1) Signs shall be marked with the maker's name, and for incandescent-lamp signs with the number of lamp-holders, and for electric discharge signs with input amperes at full load and input voltage. The marking of the sign shall be visible for inspection after installation.

(2) Transformers shall be marked with the maker's name, and transformers for electric discharge signs shall be marked with the input rating in amperes or volt-amperes, the input voltage and the open-circuit high-tension voltage.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 600.08 Enclosures.** Enclosures for signs and outline lighting shall conform to the following:

(1) **CONDUCTORS AND TERMINALS.** Conductors and terminals in sign boxes, cabinets, and outline troughs shall be enclosed, except the supply leads.

(2) **CUTOUTS, FLASHERS, ETC.** Cutouts, flashers, and similar devices shall be enclosed in metal boxes the doors of which shall be arranged so that they can be opened without removing obstructions or finished parts of the enclosure.

(3) **STRENGTH.** Enclosures shall have ample strength and rigidity.

(4) **MATERIAL.** Except for portable signs of the indoor type, signs and outline lighting shall be constructed of metal or other noncombustible material. Wood may be used for external decoration if placed not less than 2 inches from the nearest lampholder or current-carrying part.

(5) **MINIMUM THICKNESS; ENCLOSURE METAL.** Sheet copper shall be at least 20 ounce (0.028 inch). Sheet steel may be of No. 28 MS (USS Revised) gauge except that for outline lighting and for electric discharge signs sheet steel shall be of No. 24 MS (USS Revised) gauge, unless ribbed, corrugated or embossed over its entire surface, when it may be of No. 26 MS (USS Revised) gauge.

(6) **PROTECTION OF METAL.** All steel parts of enclosures shall be galvanized or otherwise protected from corrosion.

(7) **ENCLOSURES EXPOSED TO THE WEATHER.** Enclosures for outside use shall be weatherproof and shall have an ample number of drain holes, each not larger than ½ inch or smaller than ¼ inch. Wiring connections shall not be made through the bottoms of enclosures exposed to the weather unless the enclosures are of the raintight type,

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 600.09 Portable gas tube signs.** All gas tube signs not coming within the definition of portable shall be wired in accordance with the code rule. Satisfactory portable signs may be installed by connection with portable cord.

*Note:* As applied to Neon or gas tube signs, portable means less than 75 pounds in weight and 10 square feet over the largest surface, with all high tension wires and tube terminals within the sign enclosure proper, and the tubes or lamps fastened only to and not extending beyond the sign surface or background. All portable gas tube signs shall have the metal enclosure grounded by a 3-wire cord connected to a 3-point receptacle and the portable cord shall be limited to 6 feet in length.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 600.11 Tube terminals.** The terminals shall be so designed that the tubing can be replaced without the necessity of exposing uninsulated live parts. If the spring contact type of receptacle is used, it shall be so designed that, even with the tube removed, the live spring will be recessed a distance equal to 3 times the diameter of the receptacle opening. It is recommended that the primary circuit be controlled by a relay that will open the circuit when a tube in the secondary circuit is broken or removed. Live parts shall be protected by barriers which require other than ordinary tools such as pliers and screw-drivers for removal unless access to the parts requires the disconnection of the primary circuits. (See section E 410.80).

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

## B. SIGNS AND OUTLINE LIGHTING—600 VOLTS OR LESS

**E 600.21 Installation of conductors.** Conductors shall be installed as follows:

(1) **WIRING METHOD.** Conductors shall be installed as open conductors on insulators, in rigid metal conduit, flexible metal conduit, electrical metallic tubing, metal-clad cable, metal troughing, type ALS cable or type MI cable.

(2) **INSULATION AND SIZE.** Conductors shall be of a type approved for general use and shall be no smaller than No. 14.

(a) *Exception:* Conductors in portable signs and leads in wiring channels which are permanently attached to electric discharge lamp-holders or electric discharge ballasts and which are not longer than 8 feet may be smaller than No. 14 but shall not be smaller than No. 18 and shall be of a type approved for the purpose.

(3) **EXPOSED TO THE WEATHER.** Conductors in raceways, armored cable or enclosures exposed to the weather, shall be of the lead-covered type or other type specially approved for the conditions, except where rigid conduit, electrical metallic tubing or enclosures are made raintight and arranged to drain.

(4) **NUMBER OF CONDUCTORS IN RACEWAY.** Number of conductors in raceway for sign flashers may be in accordance with table 1 of chapter E 900.

(5) **OPEN CONDUCTORS.** Open conductors on insulators shall comply with the provisions of sections E 300.02 to E 300.22 inclusive, and, if outdoors, chapter E 730 except that the separation between conductors need be only 2 inches.

(a) *Exception*: Open conductors may be supported by lampholders located not more than 1 foot apart.

(6) **CONDUCTORS SOLDERED TO TERMINALS.** Where the conductors are fastened to lampholders other than of the pin type, they shall be soldered to the terminals and the exposed parts of conductors and terminals shall be treated to prevent corrosion. Where the conductors are fastened to pin-type lampholders which protect the terminals from the entrance of water, and which have been found acceptable for sign use, the conductors shall be of the stranded type but need not be soldered to the terminals.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 600.22 Lampholders.** Lampholders shall be of the unswitched type having bodies of suitable insulating material and shall be so constructed and installed as to prevent turning. Miniature lampholders shall not be employed for outdoor signs and outline lighting.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

### C. SIGNS AND OUTLINE LIGHTING—EXCEEDING 600 VOLTS

**E 600.31 Installation of conductors.** Conductors shall be installed as follows:

(1) **WIRING METHOD.** Conductors shall be installed as open work, as concealed conductors on insulators, in rigid or flexible metal conduit, or in electrical metallic tubing.

(2) **INSULATION AND SIZE.** Conductors shall be of a type approved for the purpose and for the voltage of the circuit and shall be not smaller than No. 14.

(a) *Exception*: Leads in wiring channels which are permanently attached to electric discharge lampholders or electric discharge ballasts and which are not longer than 8 feet may be smaller than No. 14 but shall not be smaller than No. 18 and shall be of a type approved for the purpose.

(3) **BENDS IN CONDUCTORS.** Sharp bends in the conductors shall be avoided.

(4) **OPEN CONDUCTORS; INDOORS.** Open conductors indoors shall be mounted on noncombustible, nonabsorptive insulators. Insulators of porcelain shall be glazed on all exposed surfaces. A separation of at least 1½ inches shall be maintained between conductors and between conductors and other objects. Conductors shall not be located where subject to physical damage.

(5) **CONCEALED CONDUCTORS ON INSULATORS; INDOORS.** Concealed conductors on insulators shall be separated from each other and from all objects other than the insulators on which they are mounted by a spacing of not less than 1½ inches for voltages above 10,000 volts, and not less than 1 inch for voltages of 10,000 or less. They shall be installed in channels lined with noncombustible material and used for no other purpose, except that the primary circuit conductors may be in the same channel. The insulators shall be of noncombustible, non-absorptive material.

(6) **CONDUCTORS IN RACEWAYS.** Where the conductors are covered with lead or other metal sheathing, the covering shall extend beyond the end of the raceway, and the surface of the cable shall not be injured where the covering terminates.

(a) In damp or wet locations, the insulation on all conductors shall extend beyond the metal covering or raceway at least 4 inches for voltages over 10,000, 3 inches for voltages over 5,000 but not exceeding 10,000, and 2 inches for voltages of 5,000 or less.

(b) In dry locations the insulation shall extend beyond the end of the metal covering or raceways not less than 2½ inches for voltages over 10,000, 2 inches for voltages over 5,000 but not exceeding 10,000, and 1½ inches for voltages of 5,000 or less.

(c) For conductors at grounded midpoint terminals, no spacing is required.

(d) Not more than 20 feet of cable from a single transformer shall be run in metal raceway where the potential between the cable and the raceway is more than 5,000 volts.

(7) **OPEN CONDUCTORS; OUTDOORS.** (a) Open conductors outdoors shall be mounted on noncombustible, nonabsorptive insulators. Insulators of porcelain shall be glazed on all exposed surfaces. A separation of at least 2 inches shall be maintained between conductors, and between conductors and other objects.

(b) Where subject to physical damage, or where within reach from ground, roof, or window, conductors shall be enclosed in raceways or suitably guarded. Where guarded, a spacing of not less than 1½ inches shall be maintained between conductors and the enclosure unless the enclosure is nonconducting and noncombustible.

(8) **SHOW-WINDOWS AND SIMILAR LOCATIONS.** Conductors that hang freely in the air, away from combustible material, and where not subject to physical damage, as in some show-window displays, need not be otherwise protected.

(9) **CONDUCTORS TO TRANSFORMERS MIDPOINT.** Conductors may be run from the ends of tubing to the grounded midpoint of transformers specifically designed for the purpose and provided with terminals at the midpoint. Where such connections are made to the transformer grounded midpoint, the connections between the high-voltage terminals of the transformer and the line ends of the tubing shall be as short as possible.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 600.32 Transformers.** Transformers shall comply with the following:

(1) **VOLTAGE.** The transformer secondary open-circuit voltage shall not exceed 15,000 volts with an allowance on test of 1,000 volts additional. In end-grounded transformers the secondary, open-circuit voltage shall not exceed 7,500 volts with an allowance on test of 500 volts additional.

(2) **TYPE.** (a) Transformers shall be of a type approved for the purpose and shall be limited in rating to a maximum of 4,500 volt-amperes.

(b) Open core-and-coil type transformers shall be limited to 5,000 volts with an allowance on test of 500 volts, and to indoor applications in small portable signs.

(c) Transformers for outline lighting installations shall have secondary current ratings not in excess of 30 milliamperes except where they and all wiring connected to them are installed in accordance with the provisions of chapter E 410<sup>4</sup> for electric discharge lighting of the same voltage.

(3) **EXPOSED TO WEATHER.** Transformers used outdoors shall be of the weather-proof type or shall be protected from the weather by enclosure in the sign body or in a separate metal box.

(4) **TRANSFORMER SECONDARY CONNECTIONS.** The high-voltage windings of transformers shall not be connected in parallel; and shall not be connected in series, except that 2 transformers each having one end of its high-voltage winding connected to the metal enclosure may have their high-voltage windings connected in series to form the equivalent of a midpoint grounded transformer. The grounded ends shall be connected by insulated conductors not smaller than No. 14.

(5) **ACCESSIBILITY.** Transformers shall be accessible.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 600.33 Electric discharge tubing.** Electric discharge tubing shall conform to the following:

(1) **DESIGN.** The tubing shall be of such length and design as not to cause a continuous over-voltage on the transformer.

(2) **SUPPORT.** Tubing shall be adequately supported on noncombustible, nonabsorptive supports. Tubing supports should, where practicable, be adjustable.

(3) **CONTACT WITH FLAMMABLE MATERIAL AND OTHER SURFACES.** The tubing shall be free from contact with flammable material and shall be located where not normally exposed to physical damage. Where operating in excess of 7,500 volts, the tubing shall be supported on noncombustible, nonabsorptive, insulating supports which maintain a spacing of not less than  $\frac{1}{4}$  inch between the tubing and the nearest surface.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 600.34 Terminals and electrode receptacles for electric discharge tubing.** Terminals and electrode receptacles for electric discharge tubing shall comply with the following:

(1) **TERMINALS.** Terminals of the tubing shall be inaccessible to unqualified persons and isolated from combustible material and grounded metal or shall be enclosed. Where enclosed they shall be separated from grounded metal and combustible material by noncombustible, nonabsorptive insulating material approved for the purpose or by  $1\frac{1}{2}$  inches of air. Terminals shall be relieved from stress by the independent support of the tubing.

(2) **TUBE CONNECTIONS OTHER THAN WITH RECEPTACLES.** Where tubes do not terminate in receptacles designed for the purpose, all live parts of tube terminals and conductors shall be so supported as to maintain a separation of at least  $1\frac{1}{2}$  inches between conductors or between conductors and any grounded metal.

(3) **RECEPTACLES.** Electrode receptacles for the tubing shall be of noncombustible, nonabsorptive insulating material approved for the purpose.

(4) **BUSHINGS.** Where electrodes enter the enclosure of outdoor signs or of an indoor sign operating at a voltage in excess of 7,500 volts, bushings shall be used unless receptacles are provided or the sign is wired with bare wire mounted on approved supports which maintain the tubing in proper position. Bushings shall be of noncombustible, nonabsorptive material. Where bare wiring is used, the conductor shall be not less than No. 14 solid copper, shall be supported so as to prevent sagging and lessening of the spacing required elsewhere in this chapter, and electrode terminal assemblies shall be of an approved type and supported not more than 6 inches from the electrode terminals.

(5) **SHOW-WINDOWS.** In the exposed type of show-window signs, terminals shall be (a) enclosed by receptacles approved for the purpose or (b) where hanging in air, free from grounded surfaces, enclosed in sleeves of vulcanized fiber, phenolic composition, or other suitable material which overlaps all live parts by at least  $\frac{1}{2}$  inch.

(6) **RECEPTACLES AND BUSHING SEALS.** A flexible, non-conducting seal may be used to close the opening between the tubing and the receptacle or bushing against the entrance of dust or moisture. This seal shall not be in contact with grounded conductive material and shall not be depended upon for the insulation of the tubing.

(7) **ENCLOSURES OF METAL.** Enclosures of metal for electrodes shall be of not less than No. 24 MS (USS Revised) gauge sheet metal.

(8) **ENCLOSURES OF INSULATING MATERIAL.** Enclosures of insulating material shall be noncombustible, nonabsorptive and approved for the voltage of the circuit.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 600.35 Switches on doors.** Doors or covers giving access to uninsulated parts of indoor signs or outline lighting exceeding 600 volts and accessible to the general public, shall either be provided with interlock switches which on the opening of the doors or covers disconnect the primary circuit, or shall be so fastened that the use of other than ordinary tools will be necessary to open them.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.