

Section 637—Illuminated Sign System

637.1 General Description

This Specification describes the complete sign illumination system. Complete a secure installation according to the recommendations of the American Association of State Highway and Transportation Officials (AASHTO), the Illuminating Engineering Society, the standards of the National Electrical Code, and the applicable local ordinances.

For temporary overhead guide sign structures, except wire-supported signs, light the signs as soon as they are erected. Keep them lit during darkness until the temporary sign is no longer required.

The cost of temporary signs and electrical energy are included in the price bid for Section 150 when shown in the Proposal as a Pay Item. Otherwise, payment is as shown in Section 150. Ensure that illumination complies with Subsection 637.3.05.H, “Externally Illuminated Signs.”

637.1.01 Definitions

The terms “cable” and “wire” are used synonymously in this Specification.

637.1.02 Related References

A. Standard Specifications

Section 150—Traffic Control

Section 500—Concrete Structures

Section 636—Highway Signs

Section 638—Structural Supports for Overhead Signs

Section 863—Preservative Treatment of Timber Products

Section 911—Sign Posts

Section 923—Electrical Conduit

B. Referenced Documents

NEC Section 370-18(c) in conjunction with NEC Section 250-42

ANSI C 80.1

EI/NEMA publications

637.1.03 Submittals

Before purchasing materials or equipment, submit to the Engineer for approval a complete list of the products proposed for use. On the list, show the manufacturer’s name and catalog number of each item to ensure compliance with the requirements of these Specifications. Include in this submittal the calculations or computer printouts for sign illumination and uniformity values.

Submit voltage drop calculations for each circuit to verify that proper voltage is furnished to the sign luminaires. Provide alternate equipment or a sample board to be activated for in-service evaluation, when the Engineer requires.

637.2 Materials

A. General Requirements

Have electrical material approved by the Underwriter’s Laboratory or other acceptable testing agency. Provide the fittings, devices, materials, and Work to install the complete functional system. Use methods that comply with local ordinances, rules, and regulations. See Section 636 and Section 638.

B. Power Supply and Wiring

Use cable and wire of sufficient size to safely carry the capacity intended and to prevent the voltage from dropping more than 5 percent from the service point to the farthest light.

1. Determine Cable and Wire Sizes

If the cable size is not specified on the Plans, determine the safe size after studying the Plans and Specifications.

Wire and cable sizes as indicated below are for copper. Do not use aluminum wire unless otherwise noted on the Plans.

Acceptable copper cable and wire sizes (commercial) are as follows:

No. 2/0 AWG	19 strand
No. 1/0 AWG	19 strand
No. 2 AWG	7 strand
No. 4 AWG	7 strand
No. 6 AWG	7 strand

Use smaller wire sizes (No. 10 AWG minimum) on the sign structure only if it is adequately protected with fuses inside the handhole of the structural support. Ensure that the fuse rating is the same as the ampere rating of the wire, such as 30 A for No. 10 AWG wire.

Do not reduce the wire size to a size that carries more than 80 percent of its rated amperage. If the number of luminaires on the sign structure is too many for No. 10 AWG wire, run two separate circuits from the base of the structural support to the luminaires. Fuse each of these separate circuits at the handhole of the sign structure.

2. Insulate Wire and Cable

The neutral/ground wire shall have white insulation or mark it with strips of white tape at each access point.

On the cable installed underground, use 600 V, type RHH/RHW/USE, 75 °C insulation. On the cable installed on the sign structure and connected to the luminaires, use 600 V, type RHH, XHHW, or THHN, 90 °C insulation.

Install a waterproof boot, furnished by the fuseholder manufacturer, over each end of the fuseholder.

C. Power Control

When noted on the Plans, furnish and install a lighting contactor and a photoelectric control, complete with receptacle and accessories. Mount the photoelectric control near the top of the service pole so that it is exposed to the north sky. The control shall provide ON operation as shown in Subsection 637.2.I, "Photoelectric Controls."

D. Grounding Rods

Use ground rods 5/8 in (16 mm) in diameter ($\pm 1/16$ in [± 1.6 mm]) and 8 ft (2.4 m) long unless otherwise specified on the Plans. Use ground rods that are galvanized steel. Ensure that the galvanization coating is at least 2 ounces/ft² (610 g/m²) according to the requirements of ASTM A 153/A 153 M.

E. Conduit

Use conduit approved by the Underwriters' Laboratories, Inc.

1. Rigid Steel Conduit

Use rigid steel conduit, including elbows and couplings, that conforms to American National Standards Institute Specification C 80.1.

- Protect rigid steel conduit by a uniform metallic zinc coating on the exterior and interior surfaces.
- Ensure that the conduit and coupling are galvanized at least 1.24 ounces/ft² (380 g/m²) (total of both surfaces).
- Determine the weight of the zinc coating according to ASTM A 90. If the Engineer elects, determine the thickness of the zinc coating by using a magnetic or electromagnetic thickness gage.

2. Nonmetallic Conduit

Unless otherwise noted, use Type II, schedule 40 (heavy wall) polyvinyl chloride (unplasticized) nonmetallic conduit that conforms to Subsection 923.2.02.

3. Flexible Conduit

Ensure that the flexible conduit consists of a galvanized steel core and a polyvinyl chloride cover. Ensure that it contains a continuous copper ground and is liquid tight.

F. Circuit Breakers

Use quick-make and quick-break circuit breakers with a thermal magnetic molded case.

Use circuit breakers with the following characteristics:

- Over-the-center, toggle operating type with the handle positioned between ON and OFF to indicate automatic tripping

- Single handle and common trip multi-pole breakers
- Multi-pole breakers with a voltage rating 240 V or more from line to ground
- Bolt-on type with industrial rating and a minimum interrupting capacity of 10,000 RMS symmetrical amperes
- Lugs large enough to accommodate the cable used
- Lockable, weatherproof enclosure

G. Fuses and Fuseholders

Use fuses with the appropriate ampere rating and voltage rating for the operating voltage.

Use in-the-line and waterproof fuseholders.

H. Lightning Arresters

Use metal oxide varistor lightning arresters rated 650 V with the number of required poles unless otherwise specified. Provide a pole for each ungrounded leg of the service voltage.

I. Photoelectric Controls

Ensure that the photoelectric controls have a factory setting for turn-on at 1.5 foot-candles (16.1 lx) ambient light level.

Provide controls with a differential between turn-on and turn-off levels to prevent cycling at critical levels.

Use controls that meet these requirements:

- Operates on a supply voltage of 105 V to 130 V, 50/60 Hz, AC with an inrush rating of 120 A at 120 V and a lamp load rating of 1,000 W for incandescent and 1,800 V amperes for mercury vapor and fluorescent
- Contains built-in surge and lightning protection
- Has a rated life at full load of at least 5,000 on-off operations
- Withstands an ambient temperature range of -65°F to 158°F (-54°C to 70°C) and is moisture proof

Provide single-pole, single-throw (SPST), normally closed (NC) relay contacts. Ensure that the dielectric strength is at least 5,000 V between a current carrying part and the metal mounting surface.

The housing shall be approximately 2.25 in (57 mm) high with a base diameter of no more than 3.25 in. (83 mm).

The chassis shall be molded phenolic with three locking type blades and a neoprene gasket that conforms to EEI/NEMA publications. Mount the photoelectric control on an approved receptacle.

J. Lighting Control

Use lighting contactors specifically designed for use on tungsten and ballast (fluorescent and high-intensity discharge) lamp loads without derating. Use a contactor with these characteristics:

- The number of poles required to open each ungrounded conductor
- Lugs large enough to accommodate the cable used
- Lockable, weatherproof enclosure

K. Luminaires and Lamps

Use 400 W mercury luminaires with H 33-GL-400/DX lamps and a box-type configuration, unless otherwise specified. Mount on horizontal luminaire support channels.

Ensure that the luminaire contains:

- Integral regulator ballast and a prewired terminal board to connect the supply voltage
- Conduit openings on each side for through wiring
- Rain-tight housing made of aluminum with baked-on enamel finish
- Noncorrosive hardware
- Seals or gaskets at critical points to form a weathertight, breathing seal.
- Porcelain enclosed mogul socket, with spring loaded center contact and lamp grips, attached to ensure proper lamp positioning
- Lamp support on the end opposite from the socket to prevent the lamp from breaking from vibration

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- Highly polished anodic-surfaced aluminum reflector and a removable, stippled, heat and shock tempered glass refractor
- Integral hinge system for the door that must be in a specified position to remove the door
- Detachable locking brace to hold the door open during maintenance
- Heavy-duty spring loaded latch on the front of the luminaire that produces a watertight seal between the door and housing when closed

Ensure that the luminaire support framework is designed to withstand wind and 1 in (25 mm) of ice accumulated on the entire framework as shown on the Plans.

Ensure that lamps are 400 W deluxe white mercury vapor and have 24,000 hours rated life at 10 hours per start.

L. Ballasts

Use regulator-type ballast that provides rated lamp watts to the lamp through a range in primary voltage of plus or minus 10 percent.

Use high-power ballasts with a power factor of at least 0.90 and enough open circuit voltage to start lamps at a temperature as low as -20 °F (-29 °C). Enclose ballasts for external or cabinet mounting in an epoxy-encapsulated covering.

637.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

637.3 Construction Requirements

637.3.01 Personnel

A. Contractor Requirements

The person performing this work must be on the Department list of approved electrical contractors or electrical subcontractors.

B. Qualified Electrician

A qualified electrician has a Class II license issued by the Georgia State Construction Industry Licensing Board, has completed an approved four-year apprenticeship training program, and is classified as a Journeyman Electrician. The qualified electrician shall show evidence of this classification to the Department Engineer in charge of the Construction. For further definition, see Subsection 755.1.01.

Always have a qualified electrician on the job site when pulling electrical wiring or making electrical connections.

637.3.02 Equipment

General Provisions 101 through 150.

637.3.03 Preparation

General Provisions 101 through 150.

637.3.04 Fabrication

A. Pull and Junction Boxes

Construct pull and junction boxes installed in the ground according to the design and dimensions, and at the locations shown on the Plans. Use a type approved by the Engineer.

1. Construct concrete boxes of Class A concrete meeting the requirements of Section 500, including precast concrete boxes.
Manufactured units are permitted when the Engineer determines that they are equal in design, quality, and structural strength.
2. Provide cast iron, steel, or reinforced concrete covers as shown on the Plans for each pull or junction box.
3. Provide a drainage system for each ground-mounted box to keep water from accumulating inside the box.
4. Ground cast iron or steel covers used on electrical junction boxes or pull boxes as required by NEC Section 370-18(c) in conjunction with NEC Section 250-42.
5. Ensure that the pull and junction boxes mounted on bridges and the sign structure are waterproof, galvanized steel, stainless steel, or cast aluminum and conform to NEC requirements.

6. Seal conduit entrance holes in pull or junction boxes around the conduit to the Engineer's satisfaction.
7. Blank off unused entrance holes and openings for conduit to be extended by other Contractors with suitable plugs of plastic, bituminous fiber, or other approved material to prevent foreign matter from entering.

637.3.05 Construction

A. Fees and Permits

Pay the fees and permits required by power companies or governmental agencies.

Notify the power company at least 30 days before the power source connection is needed.

B. Power Supply and Wiring

Use a power supply of 120/240 V, 3-wire, single phase, with a supply point where the Department and the serving electric utility determine, unless otherwise noted. The supply point is usually near the right-of-way line near the sign location.

The sign lighting pay Unit includes setting a wooden service pole that meets the requirements of Section 863 near the edge of the right-of-way to receive the service from the utility company, unless otherwise indicated. Use at least a 30 ft (9 m) Class 5 pole or as shown on the Plans.

1. Install the metallic service riser with a weatherhead on the service pole and a weatherproof housing containing circuit breakers of the appropriate voltage and ampere rating.
2. When specified on the Plans, install a photoelectric control with the mounting hardware near the top of the service pole and a lighting contactor in a weatherproof housing on the service pole.
3. Ensure that the circuit breaker and lighting contactor have the number of poles required to open each ungrounded conductor.
Ensure that the circuit breakers and lighting contactors have proper lugs, sized for the cable to be used. Do not cut the cable strands to attach to the circuit breakers or lighting contactors.
4. Install an approved meter base in the service riser when required by the power company or indicated on the Plans.
5. Furnish and install an approved 650 V lightning arrester at the weatherproof enclosure and connect the arrester to the grounding system.
6. Furnish an approved padlock with two keys each for locking the weatherproof housings. Key the padlocks alike if more than one padlock is required on a Project.
7. Enclose the wiring on the sign framework in rigid galvanized steel conduit. Use liquid-tight flexible conduit in transition areas between rigid members. Do not splice cable or wire except in junction boxes.
8. Splice the conductors according to the National Electric Code and the splice manufacturer's recommendations. Splicing is subject to the Engineer's approval.
 - a. Make splices only in junction boxes and pole bases unless otherwise shown on the Plans.
 - b. Make the straight or line splices of conductors the same size with tin-plated copper compression tubular splices.
 - c. Splice conductors of different sizes or different terminating directions by using tin-plated copper compression ring tongue terminals on each conductor. Bolt the terminals together with stainless steel or high-strength silicone bronze hardware.
9. Use lock nuts, pal nuts, or lock washers to keep the connection tight. Do not use split bolt connectors.
10. After splicing the conductor, insulate the splice with heat shrinkable tubing coated with adhesive on the inner wall supplied by the manufacturer.
Select the shrink tube so that when it is applied over the connector it has an insulation thickness equal to or greater than the insulation thickness of the conductor used.
Ensure that the heat shrinkable tubing is UL listed and meets ANSI C 119.1 (latest edition) requirements for submersible and direct buried splices.
11. When bolting connectors together:
 - a. Wrap the bolted connection with cloth tape before applying the heat shrinkable tubing.
 - b. Pad the sharp points and edges on splices to prevent the heat shrinkable tubing from splitting during shrinking.
 - c. Position the shrink tubing so that at least 3 in (75 mm) of seal length \pm 0.05 in (\pm 13 mm) is established on each side of the splice after the tube is fully recovered.
 - d. Ensure that the spliced joints are watertight.

12. Include an approved 650 V lightning arrester inside the handhole of each structural support for illuminated signs.
13. Install in-the-line fuses in each ungrounded conductor inside the handhole of each structural support for illuminated signs.
14. Notify the power company at least 30 days before the connection to the power source is needed.

C. Power Control

The photoelectric control operates the lighting contactor that supplies power to the lighting circuit. If the supply voltage is other than 120/240 V, furnish and install a transformer in a weatherproof enclosure to provide 120 V control voltage.

1. Mount the circuit breaker, lighting contactor, and transformer, if required, in NEMA-3R lockable weatherproof cabinet(s) located on the service pole accessible from the ground.
2. Enclose the wiring to and from the photoelectric control in rigid galvanized conduit.

D. Grounding Rods

Install the grounding rods adjacent to each structural support foundation where the supply voltage enters and adjacent to the service pole.

1. Solidly connect to the grounding conductor the sign framework and metallic, noncurrent carrying materials in the lighting system.
2. Ensure that the neutral/grounding conductor is continuous and is connected to the luminaire housing, the ground rod at each structural support, and the ground rod at the service pole.
3. Drive the single ground rods vertically until the top of the rod is at least 12 in (300 mm) below the finished ground.
4. Use round rod clamps to attach a length of No. 6 AWG, bare solid, soft drawn or medium hard drawn copper ground wire to the ground rod. Connect it to the grounding point on the structural support.

If penetration cannot be obtained in the above manner:

- a. Place a ground rod system consisting of 3 parallel ground rods at least 6 ft (1.8 m) center to center in a horizontal pattern and at least 12 in (300 mm) below the finished ground.
- b. Join these rods and connect them to the grounding point on the structural support with No. 6 AWG, bare solid, soft drawn, or medium-hard drawn copper ground wire and ground rod clamps.

E. Conduit, Boxes, Fittings, Circuit Breakers, Fuses, Wiring, and Supports

Furnish and install the conduit, boxes, fittings, circuit breakers, fuses, wiring supports, and accessories to complete the work for each circuit as required by the National Electrical Code.

F. Fuses and Fuseholders

Construct and install the fuseholder to retain the fuse on the load side if disconnected or broken apart. Install a waterproof boot, furnished by the fuseholder manufacturer, over each end of the fuseholder.

G. Lightning Arresters

House the lightning arrester in a watertight housing. Encapsulate or seal the lead entrance into the housing.

For units that are not factory sealed, apply silicone caulk to the lead entrance and install heat shrinkable tubing with precoated sealant on the interior surface over the lead entrance.

H. Externally Illuminated Signs

Ensure that the lighting system provides on the face of the signs at least 30 foot-candles (320 lx), average maintained, at 60 °F (15 °C) ambient temperature with a uniformity ratio (average/minimum) of no more than 3.5:1. Tilt the sign 3 degrees off perpendicular toward the pavement.

1. Luminaires and Lamps
 - a. Mount luminaires so that the top of the luminaire is at least 18 in (450 mm) below the bottom edge of the sign and at a horizontal distance to provide uniform illumination.
 - b. Extend the luminaires within 2 ft (600 mm) of the outside edge of the sign in each direction. The luminaire design will direct the longitudinal separation of luminaires.
 - c. Support the luminaires and conduit runs with a framework of aluminum or hot dip galvanized steel channel solidly fastened to the structural support with galvanized steel or aluminum clamps. Do not drive holes into the structure.
 - d. Ensure that luminaires are accessible from the maintenance walkway for maintenance and lamp replacement.

2. Ballasts

Ensure that the ballasts for high intensity discharge (HID) or fluorescent lamps are integral with the luminaire housing or are in a separate weatherproof housing attached to the luminaire housing, unless otherwise specified. Use ballasts when using multiple circuits, unless otherwise specified, and when operating at voltages shown on the Plans.

3. Light Shield

Provide a light shield plate made of 0.10 in (2.54 mm) thick, B-209 alloy 6061-T6 aluminum sheet 12 in (300 mm) wide and the combined length of the signs.

Erect the shield below the signs at an elevation that will eliminate glare from the luminaires to motorists traveling in the opposite direction from the face of the sign. Mount the shield to the catwalk supports with U-clamps according to Section 911.

637.3.06 Quality Acceptance

The Department will accept luminous intensity using a color and cosine corrected lux meter. The Department will measure at random points by placing the meter flat against the surface of the sign with the light cell parallel to the face of the sign.

The maintained luxfoot-candle values will be calculated using depreciation factors of 0.75 for the luminaire and 0.70 for the lamp (combined value = 0.525) to provide a minimum of 30 foot-candles (320 lx) average maintained during the service life of the system.

A. Before Testing Period

Complete and energize each lighting circuit as early as possible. Before beginning the testing period, have an electrician with a megger, voltmeter, and ammeter perform the following tests in the presence of the Department Inspectors for each lighting circuit.

1. Before connecting the phase conductors to the source breaker, the sign structure, or the lighting standard wiring and lightning arresters, megger the circuit conductors to ensure that the phase conductors are free of grounds.
2. Test systems of 480 V at 1,000 V dc. Test systems less than 480 V at 500 V dc. The minimum acceptable reading is one megohm after the test voltage has been applied for 10 minutes. Test the system as follows:
 - a. Before turning the circuit breaker on at the service point, measure the service voltage between the phase conductors and between each phase conductor and the neutral or ground.
 - b. If the proper voltage is observed, turn the circuit breaker on. Wait 10 minutes for the luminaires to warm up and repeat the above voltage measurements.
 - c. After energizing the circuit for at least 10 minutes, measure the load current in each phase conductor and the neutral at the service point. Ensure that the current in the phase conductors is balanced and no current is in the neutral.
 - d. Record the test data in the Project records.

Final acceptance of the lighting system will be withheld for a 30-day testing period of continuous nightly automatic operation after the lighting work is complete or until other items in the Contract (except grassing) have been accepted, whichever occurs later. If a portion of this testing period occurs after Final Acceptance, other Work will not be charged against the Contract Time.

Correct defects in material or workmanship that occur during this 30-day period of continuous nightly automatic operation and until the Project is accepted, whichever occurs later. If defects are found during the 30-day test, continue testing it until achieving 30 days of continuous nightly automatic operation.

Assume the energy cost of each circuit or part of the circuit during this test period. Others will assume the energy costs after the successful 30-day test period.

B. After Testing Period

After the testing period and at the time of Final Acceptance, have an electrician with a voltmeter and ammeter perform the following tests in the presence of the Department Inspector for each lighting circuit.

1. Energize the circuit for at least 10 minutes and measure the service voltage between the phase conductors and between each phase conductor and the neutral or ground at the service point.
2. If the proper voltage is observed, measure the load current in each phase conductor and the neutral. Ensure that the current in the phase conductors is balanced and there is no current in the neutral.
3. Record this test data in the Project records.

637.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

637.4 Measurement

Each illuminated sign system completed and accepted at the location specified is measured for payment per Lump Sum.

637.4.01 Limits

General Provisions 101 through 150.

637.5 Payment

Each illuminated sign system measured for payment will be paid for at the Lump Sum price bid for each system. Price and payment is full compensation for furnishing and installing each complete and functional system, including designs when furnished by the Contractor, drawings, electrical apparatus and wiring specified, required excavation, backfill, concrete for conduits, and other materials, labor, equipment, and incidentals to complete the Item.

Structural supports for overhead highway signs will be erected and paid for separately according to Section 638. Signs will be paid for according to Section 636.

Payment will be made under:

Item No. 637	Illuminated sign system—sta. ____	Per lump sum
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637.5.01 Adjustments

General Provisions 101 through 150.

Section 638—Structural Supports for Overhead Signs**638.1 General Description**

This item includes the materials, design requirements, fabrication, and erection of structural supports for overhead signs, including excavation, foundations, anchor bolt assemblies, backfill, redressing, and regrassing but exclusive of signs.

638.1.01 Definitions

Structural supports for overhead signs are defined generally as follows:

Type	Description
I	A SIGN BRIDGE type structure that spans the roadway with more than two horizontal chords supported by two columns, one at each end. Each column shall have at least two braced vertical members. A walkway is required.
II	A CANTILEVER type structure with two or more horizontal chords supported by a single column at one end. A walkway is required.
III	A BUTTERFLY type structure with two or more horizontal chords extending an equal distance in opposite directions from a single column. Walkways are required.
IV	A COMBINATION (Bridge-Cantilever) type structure with more than two horizontal chords supported by two columns, only one at one end and one at an intermediate point. Each column shall have at least two braced vertical members. Walkways are required.
V	A CANTILEVER type structure with a maximum of two horizontal chords supported by a single column at one end. A walkway is not required.
VI	A SIGN BRIDGE type structure that spans the roadway with a maximum of two horizontal chords supported by two columns, one at each end. A walkway is not required.
VII	A BRIDGE MOUNTED (attached to a highway bridge) structural frame with a walkway.
VIII	A BUTTERFLY type structure with a maximum of two horizontal chords extending an equal distance in opposite directions from a single column. Walkways are not required.

Type II and V structures' maximum horizontal dimension shall be 32 ft (9.75 m). The horizontal dimension is measured from the column's centerline to the furthest point of the structure or sign.