

SECTION 659 LIGHTING

659.1 Description

- (1) This section describes furnishing and installing highway, walkway, and other outdoor lighting.

659.2 Materials

659.2.1 General

- (1) The department prequalifies lighting components for some applications on the department's approved products list. The department also provides a list of approved manufacturers on the department's approved products list. Furnish components consistent with the IES type, wattage, and voltage the plans show as follows:
 - If a listed component meets the contract requirements, furnish a prequalified component from the list.
 - If no listed components meet the contract requirements, furnish a component made by a manufacturer from the list.
 - If a required component is not listed and is not available from a listed manufacturer, furnish a component conforming to the requirements specified here in 659.2.
- (2) The requirements specified here in 659.2.1 are generally applicable to lighting components unless superseded by more specific requirements under 659.2.2 through 659.2.6.

659.2.1.1 Luminaires

- (1) Assure that luminaire housings are cast or drawn from a nonferrous alloy, are free of cracks and excessive porosity, and, unless the plans show otherwise, are painted utility gray. Use housing fasteners and attachment hardware fabricated from highly corrosion resistant alloys. Cadmium plating is not acceptable. Do not use housings with caps, sockets, or openings that are not required.
- (2) Furnish clear high-pressure sodium vapor lamps from a department-approved manufacturer and rated for a life of 24,000 hours or more. Use encapsulated plug-in igniters. Furnish sockets attached to high-grade porcelain bases that completely encase the metal shell. Secure the socket shell with 2 or more fasteners. Incorporate a means to lock the lamp into the socket shell that ensures positive lamp contact.
- (3) Furnish a closed type optic assembly with permanently resilient gaskets, constructed to maintain an effective seal against moisture and other contaminants. Provide suitable screens at slipfitter openings to deter insect nesting.

659.2.1.2 Ballasts

- (1) Furnish ballasts with a high power factor (HPF), a magnetic regulator (MAG-REG), copper windings, and suited for operation at temperatures as low as minus 40 F (- 40 C). Use ballasts compatible with the voltage and wattage the plans show as follows:

APPLICATION	LAMP TYPE	AC VOLTAGE
Utility, Under Deck, High Mast, Walkways	High Pressure Sodium (HPS)	120/208/240/277
Utility, Under Deck, High Mast, Walkways	High Pressure Sodium (HPS)	480
Sign Lighting	Mercury Vapor (MV)	120/208/240/277
Sign Lighting	Mercury Vapor (MV)	480

- (2) If a (MAG-REG) is not available in the specified wattage, use an constant wattage autotransformer (HPF-CWA) lead-type. If neither a MAG-REG nor an HPF-CWA lead-type is available in the specified wattage, use a ballast with an autoregulator (AUTO-REG).

659.2.2 Utility Luminaires

- (1) Furnish un-fused luminaires conforming to ANSI C136.15 that perform well within the defined limits of IES distribution the plans show. Assure that luminaires have a photometric distribution type medium, cutoff, IES type 3 created by means of a multifaceted reflector. Provide flat, clear, tempered glass lenses with full cutoff. Assure that the supplied luminaire displays the ANSI designation.
- (2) Furnish luminaires without photocells except where the plan specifies a single photocell for a fixture. Provide a single photocell actuating a contactor in a lighting control cabinet for central switching of lighting branch circuits. Also assure that luminaires are designed to accept supply wires rated at 90 degrees C or lower. Provide a 3-place terminal block or board assembly for connecting supply wires. Assure that the center terminal is factory connected to the chassis with a green wire.

- (3) Mount the ballast with quick-disconnect wiring on an interchangeable door assembly. Internal trays are not acceptable. The quick-disconnect connections shall include an equipment grounding conductor. Ballast door grounding shall not depend on metal-to-metal contact.
- (4) Furnish variable socket settings to accommodate various IES output settings. IES types 2 and 3 are minimal required settings.
- (5) Furnish luminaire housings for 250 watt and 400 watt fixtures sized to the manufacturer's full roadway size, ovate in shape, and electrocoated gray. The contractor may furnish smaller luminaire housings for 150 watt fixtures. Luminaire weight shall not exceed 50 lb. Effective projected area (EPA) shall not exceed 1.5 square feet.
- (6) Provide a slipfitter system that consists of a single-clamp, 4-bolt system.
- (7) Equip each luminaire with a leveling device that is visible from the roadway. Use a leveling device that indicates both longitudinally and transversely if the optical assembly is level and functions in temperatures as low as -30 F (-34 C).

659.2.3 Underdeck Luminaires

- (1) Furnish luminaires with glass refractors and provisions in the sides and top for direct conduit entry. Locate and size luminaire fuses as the plans show.

659.2.4 Sign Lighting Luminaires

- (1) Furnish individually fused, mercury vapor, sign luminaires with a photometric performance suitable for spacing of up to 23 feet (7 m) for sign panels. Use deluxe mercury vapor lamps.
- (2) The engineer will evaluate photometric performance over a 20 foot (6.1 m) (horizontal) by 10 foot (3 m) (vertical) sign panel with a single luminaire centered on the sign, 4 feet (1.2 m) out and one foot (300 mm) down. On this panel, provide a maximum initial illuminance at any point of 45 foot-candles (480 lx); a ratio of illuminance, maximum to minimum, of 12:1 or less; and a ratio of illuminance, average to minimum, of 4:1 or less.
- (3) Use stainless steel perforated channels to support the luminaires for sign lighting. Use stainless steel fasteners and hardware to attach the sign lighting fixtures and their supports.

659.2.5 High Mast Lighting Luminaires

- (1) Furnish individually fused high mast luminaires with IES type 3 distribution unless the plans show otherwise. Use sharp cutoff type luminaires without prismatic refractors.
- (2) Furnish slipfitter mounted luminaires with optical assemblies capable of rotating 360 degrees against the fixed position of the slipfitter. Assure that lamps are supported near the end of the lamp envelope to relieve strain on the lamp and socket and to resist vibration.

659.2.6 Lighting Units for Walkways

- (1) Furnish IES Type 5 distribution luminaires unless plans show otherwise. Locate and size luminaire fuses as the plans show. Furnish one-piece prismatic, injection-molded polycarbonate refractors, with a symmetric light pattern unless the plans show otherwise.
- (2) Use a modular design ballast assembly containing all electrical components including ballast, terminal block, socket, starter, and bracket. Use a fully encapsulated quick disconnect type starter.
- (3) Provide self-leveling slipfitters to fit pedestal base standard tops or mounting tenons.

659.3 Construction

659.3.1 General

- (1) Keep the luminaire lamps in their shipping cartons and protect against contamination until use. Wear clean gloves when installing luminaire lamps. Furnish and install circuit identification plaques and luminaire sequence decals suitable for outdoor construction on the support poles as the plans show.

659.3.2 Wiring and Fusing

- (1) Use 12 AWG, stranded copper, XLP insulated, single conductor, USE rated, 600 volt AC wire from the lighting branch circuit to luminaires, unless sized otherwise on the plans.

- (2) For fusing in hand-holes or junction boxes, use approved in-line 600 volt AC fuse assemblies from an approved manufacturer, with type FNQ fuses. If luminaires are double-fused in 240 volt AC 2-wire systems, or 480 volt AC 3-phase delta systems, furnish and install 2-pole fuse holders.
- (3) Individually fuse the luminaires at 5 amp, or as the plans show otherwise. Locate fusing at the pole hand-hole. Fuse walkway lighting units at 5 amp, in the hand-hole of the pole. Fuse underdeck lighting at 5 amp per each luminaire, located as the plans show. Fuse sign lighting at 20 amp per each ungrounded conductor, in the lower column hand-hole, in addition to the required fuses, sized as the plans show, in the luminaires.
- (4) For sign lighting and underdeck lighting, provide a separate equipment grounding conductor, equal in size to the ungrounded conductors, in all runs.
- (5) For hand-hole or junction box splices and fuse assemblies, provide a neatly trained loop of each conductor to facilitate removing each splice and each fuse assembly from the hand-hole or the junction box for servicing. Ground each hand-hole or junction box as the plans show.
- (6) If the plans show grounded neutral lighting systems, ground the neutral only as far as the hand-hole or the junction box. From the hand-hole or junction box to the luminaires, isolate the neutral, and separately bond metal parts to ground.
- (7) Connect the equipment grounding conductor to the grounding lug in each metal lighting pole and sign bridge column. If transformer bases are required, make the grounding connection to the transformer base.
- (8) Make the splices of lighting conductors in breakaway bases or in hand-holes electrically secure. Protect the splices with an approved vinyl plastic tape and insulate the splice equal to that of the rest of the conductor. If making connections, taps, and splices with irregularly shaped connectors (split bolts), first build them up with approved insulating putty or approved rubber insulating tape to eliminate sharp corners and voids. Then use vinyl electrical tape to cover the splice. The engineer will only accept splices that are taped with at least 3 layers, 1/2 lapped, or covered with the equivalent amount of putty. Then cover the tape with a liberal coating of an approved electrical varnish or approved sealant providing flexible protection from oil, moisture, and corrosion.

659.3.3 Luminaires

- (1) Under the Luminaires Utility bid item, furnish and install high-pressure sodium luminaires together with hardware and fittings as the plans show. Install luminaires on luminaire arms with an initial rake of plus 3 degrees, this measurement includes the rake of the arm. Install luminaires on luminaire arms level in the longitudinal direction of the highway. Except on segments where the profile is sloped greater than 3 degrees, then the engineer will determine the longitudinal level of the luminaires.
- (2) Under the Luminaires Underdeck bid item, furnish and install High Pressure Sodium underdeck luminaires together with hardware and fittings as the plans show.
- (3) Under the Luminaires Sign Lighting bid item, furnish and install mercury vapor luminaires together with hardware and fittings as the plans show.
- (4) Under the Luminaires High Mast Lighting bid item, furnish and install high-pressure sodium luminaires together with hardware and fittings as the plans show.

659.3.4 Sign, Underdeck, and Walkway Lighting

- (1) Under the Underdeck Lighting bid item, furnish and install lighting systems under highway bridges together with hardware and fittings as the plans show.
- (2) Under the Sign Lighting bid item shall consist of furnishing and installing lighting systems on highway sign bridges together with hardware and fittings as the plans show.
- (3) Under the Lighting Units Walkway bid item, furnish and install standards and post-top high-pressure sodium luminaires, together with hardware and fittings as the plans show.
- (4) Make wires continuous without splices from the fuses to the first luminaire and from luminaire to luminaire.
- (5) For underdeck lighting, use one inch (27 mm) rigid metal conduit conforming to section 652. For condulets and covers conform to the requirements for loop detector conduit in 652.2.4; except that for short lengths of conduit between a pull point and a luminaire the contractor will use 3/4 inch (21 mm) or one inch (27 mm) liquid tight metal conduit, depending on the number of conductors.

- (6) Install junction boxes for underdeck lighting as the plans show and as specified in section 653. For underdeck luminaire mounting boxes, if necessary to mount the luminaire, use boxes made of highly corrosion resistant metal and listed for outdoor use.
- (7) For sign lighting, use 3/4 inch (21 mm) rigid metal conduit conforming to section 652. For condulets and covers conform to the requirements for loop detector conduit in 652.2.4; except that for short lengths of conduit between a pull point and a luminaire the contractor will use 3/4 inch (21 mm) or one inch (27 mm) liquid tight metal conduit depending on the number of conductors. Do not paint the rigid steel conduit conforming to section 652.

659.4 Measurement

- (1) The department will measure the Luminaires Utility bid items, the Luminaires Underdeck bid items, Luminaires Sign Lighting, and Luminaires High Mast Lighting as each individual luminaire acceptably completed.
- (2) The department will measure the Underdeck Lighting bid items as a single lump sum unit for each structure acceptably completed.
- (3) The department will measure the Sign Lighting bid items as a single lump sum unit for each structure acceptably completed.
- (4) The department will measure Lighting Units Walkway as each individual unit acceptably completed. The department will measure the concrete base under a separate bid item.
- (5) The department will measure Plaques Sequence Identification as each individual plaque acceptably completed.

659.5 Payment

- (1) The department will pay for measured quantities at the contract unit price under the following bid items:

<u>ITEM NUMBER</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
659.0100 - 0199	Luminaires Utility (material) (watts)	EACH
659.0200 - 0299	Luminaires Underdeck (watts)	EACH
659.0300	Luminaires Sign Lighting	EACH
659.0400	Luminaires High Mast Lighting	EACH
659.0500	Sign Lighting (location)	LS
659.0600	Underdeck Lighting (location)	LS
659.0700	Lighting Units Walkway	EACH
659.0802	Plaques Sequence Identification	EACH

- (2) Payment for the Luminaires bid items is full compensation for providing all materials including luminaires, ballasts, lamps, fittings, brackets, hardware and attachments; and for luminaire fusing if required. Payment for Luminaires High Mast Lighting also includes the anchor rods, templates, nuts, and washers required under the High Mast Foundation bid item as specified in section 660.
- (3) Payment for the Underdeck Lighting bid items is full compensation for grounding; for junction boxes; for luminaire mounting boxes as required; for conduit, condulets, and junction box fusing; and for hardware and fittings.
- (4) Payment for the Sign Lighting bid items is full compensation for providing conduit, condulets, luminaire supports, fuses, fuse holders, junction boxes if required, hardware and fittings; and for grounding and hand-hole fusing.
- (5) Payment for Lighting Units Walkway is full compensation for providing all materials, including pedestal base standards, luminaires, lamps, fuses, fuse holders, and all hardware and fittings needed to integrate the components into units connected to lighting branch circuit. The department will pay for the concrete base under a separate bid item.
- (6) The department will pay for wiring from the lighting underground feeder systems to any luminaires under the separate contract bid item.
- (7) Payment for Plaques Sequence Identification is full compensation for providing plaques including all installation and attachment hardware.