

SECTION 26 56 00
EXTERIOR LIGHTING

SPEC WRITER NOTE: Delete between // _____
// if not applicable to project. Also,
delete any other item or paragraph not
applicable in the section and renumber
the paragraphs.

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of exterior fixtures, poles, and supports. The terms "lighting fixtures", "fixture" and "luminaire" are used interchangeably.

1.2 RELATED WORK

- A. Section 03 30 00, CAST-IN-PLACE CONCRETE.
- B. Section 09 06 00, SCHEDULE FOR FINISHES: Finishes for exterior light poles and luminaires.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- D. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- F. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings, and boxes for raceway systems.
- G. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground handholes and conduits.
- H. Section 26 09 23, LIGHTING CONTROLS: Controls for exterior lighting.

1.3 QUALITY ASSURANCE

- A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:

- a. Submit the following information for each type of lighting fixture designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of lighting fixture designation.
 - b. Material and construction details, include information on housing and optics system.
 - c. Physical dimensions and description.
 - d. Wiring schematic and connection diagram.
 - e. Installation details.
 - f. Energy efficiency data.
 - g. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.
 - h. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours), and color temperature (degrees Kelvin).
 - i. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts, and total harmonic distortion (THD).
 - j. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.
 - k. Submit site plan showing all exterior lighting fixtures with fixture tags consistent with Lighting Fixture Schedule as shown on drawings. Site plan shall show computer generated point-by-point illumination calculations. Include lamp lumen and light loss factors used in calculations.
2. Manuals:
- a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
- a. Certification by the Contractor that the exterior lighting systems have been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 LRFDLTS-17.....Structural Supports for Highway Signs,
 Luminaires and Traffic Signals
- C. American Concrete Institute (ACI):
 318-14Building Code Requirements for Structural
 Concrete
- D. American National Standards Institute (ANSI):
 H35.1/H35 1M-17.....American National Standard Alloy and Temper
 Designation Systems for Aluminum
- E. American Society for Testing and Materials (ASTM):
 A123/A123M-17Zinc (Hot-Dip Galvanized) Coatings on Iron and
 Steel Products
 A153/A153M-16.....Zinc Coating (Hot-Dip) on Iron and Steel
 Hardware
 B108/B108M-15Aluminum-Alloy Permanent Mold Castings
 C1089-13Spun Cast Prestressed Concrete Poles
- F. Federal Aviation Administration (FAA):
 AC 70/7460-IL-15.....Obstruction Lighting and Marking
 AC 150/5345-43H-16.....Obstruction Lighting Equipment
- G. Illuminating Engineering Society of North America (IESNA):
 HB-9-00.....Lighting Handbook
 RP-8-14.....Roadway Lighting
 LM-52-03.....Photometric Measurements of Roadway Sign
 Installations
 LM-72-97(R2010).....Directional Positioning of Photometric Data
 LM-79-08.....Approved Method for the Electrical and
 Photometric Measurements of Solid-State Lighting
 Products
 LM-80-15.....Approved Method for Measuring Luminous Flux and
 Color Maintenance of LED Packages, Arrays and
 Modules

- TM-15-11.....Luminaire Classification System for Outdoor
Luminaires
- H. National Electrical Manufacturers Association (NEMA):
- C78.41-16.....Electric Lamps - Guidelines for Low-Pressure
Sodium Lamps
- C78.42-09(R2016)Electric Lamps - Guidelines for High-Pressure
Sodium Lamps
- C78.43-13Electric Lamps - Single-Ended Metal-Halide
Lamps
- C78.1381-98.....Electric Lamps - 70-Watt M85 Double-Ended
Metal-Halide Lamps
- C81.61-17Electrical Lamp Bases - Specifications for
Bases (Caps) for Electric Lamps
- C82.4-17Ballasts for High-Intensity-Discharge and Low-
Pressure Sodium Lamps (Multiple-Supply Type)
- C136.3-14For Roadway and Area Lighting Equipment -
Luminaire Attachments
- C136.17-05(R2010)(S2017) Roadway and Area Lighting Equipment -
Enclosed Side-Mounted Luminaires for
Horizontal-Burning High-Intensity-Discharge
Lamps - Mechanical Interchangeability of
Refractors
- ICS 2-00(R2005)Controllers, Contactors and Overload Relays
Rated 600 Volts
- ICS 6-93(R2016)Enclosures
- I. National Fire Protection Association (NFPA):
- 70-17National Electrical Code (NEC)
- 101-18.....Life Safety Code
- J. Underwriters Laboratories, Inc. (UL):
- 496-17Lampholders
- 773-16.....Plug-In, Locking Type Photocontrols for Use
with Area Lighting
- 773A-16Nonindustrial Photoelectric Switches for
Lighting Control
- 1029-94.....High-Intensity-Discharge Lamp Ballasts
- 1598-08Luminaires
- 8750-15.....Light Emitting Diode (LED) Equipment for Use in
Lighting Products

1.6 DELIVERY, STORAGE, AND HANDLING

Provide manufacturer's standard provisions for protecting pole finishes during transport, storage, and installation. Do not store poles on ground. Store poles so they are at least 305 mm (12 inches) above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

PART 2 - PRODUCTS

SPEC WRITER NOTE: Ensure that material requirements agree with applicable requirements specified in the referenced Applicable Publications. Update and specify only that which applies to the project.

2.1 GENERAL REQUIREMENTS

Luminaires, materials and equipment shall be in accordance with NEC, UL, ANSI, and as shown on the drawings and specified.

2.2 POLES

A. General:

1. Poles shall be as shown on the drawings, and as specified. Finish shall be as specified on the drawings.

SPEC WRITER NOTE: Designer shall insert wind loading requirements for the location in which the poles are installed.

2. The pole and arm assembly shall be designed for wind loading of //161 km/hr (100 mph)// // // minimum, as required by wind loading conditions at project site, with an additional 30% gust factor and supporting luminaire(s) and accessories such as shields, banner arms, and banners that have the effective projected areas indicated. The effective projected area of the pole shall be applied at the height of the pole base, as shown on the drawings.
3. Poles shall be //embedded// //anchor-bolt// type designed for use with underground supply conductors. Poles shall have handhole having a minimum clear opening of 65 x 125 mm (2.5 x 5 inches). Handhole covers shall be secured by stainless steel captive screws.
4. Provide a steel-grounding stud opposite handhole openings, designed to prevent electrolysis when used with copper wire.
5. Provide a base cover that matches the pole in material and color to conceal the mounting hardware pole-base welds and anchor bolts.

6. Hardware and Accessories: All necessary hardware and specified accessories shall be the product of the pole manufacturer.
7. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, provide finishes as indicated in Section 09 06 00, SCHEDULE FOR FINISHES.

SPEC WRITER NOTE: Edit paragraph below to conform to project requirements.

B. Types:

- //1. Aluminum: Provide //round// //square// aluminum poles manufactured of corrosion-resistant AA AAH35.1 aluminum alloys conforming to AASHTO LTS-4. Poles shall be seamless extruded or spun seamless type. //
- //2. Steel: Provide //round// //square// steel poles having minimum 11-gauge steel with minimum yield/strength of 48,000 psi and// hot-dipped galvanized// //iron-oxide primed// factory finish.
//Galvanized steel poles shall comply with ASTM A123 and A153.// //
- //3. Concrete: Provide //round// //square// //multi-sided// concrete poles conforming to ASTM C1089 with integral cast bases. Poles shall have hollow core suitable as a raceway.//

SPEC WRITER NOTE: A/E shall provide structural details for pole bases. Provide details as necessary for installation in turf, concrete, and paved areas; for bases flush with grade or raised above grade; and for bollards, poles, and other types of mounting.

2.3 FOUNDATIONS FOR POLES

- A. Foundations shall be cast-in-place concrete, having 3000 psi minimum 28-day compressive strength.
- B. Foundations shall support the effective projected area of the specified pole, arm(s), luminaire(s), and accessories, such as shields, banner arms, and banners, under wind conditions previously specified in this section.
- C. Place concrete in spirally-wrapped treated paper forms for round foundations, and construct forms for square foundations.
- D. Rub-finish and round all above-grade concrete edges to approximately 6 mm (0.25-inch) radius.
- E. Anchor bolt assemblies and reinforcing of concrete foundations shall be as shown on the drawings. Anchor bolts shall be in a welded cage or properly positioned by the tie wire to stirrups.

- F. Prior to concrete pour, install electrode per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

SPEC WRITER NOTE: Provide fixture schedule on drawings, showing fixture designation, voltage, wattage, lamping, light distribution and cutoff characteristics, lensing, finishes, mounting height, accessories, and other information.

2.4 LUMINAIRES

- A. Luminaires shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat, and safe cleaning and relamping.
- B. Illumination distribution patterns, BUG ratings and cutoff types as defined by the IESNA shall be as shown on the drawings.
- C. Incorporate ballasts in the luminaire housing, except where otherwise shown on the drawings.
- D. Lenses shall be frame-mounted, heat-resistant, borosilicate glass, with prismatic refractors, unless otherwise shown on the drawings. Attach the frame to the luminaire housing by hinges or chain. Use heat and aging-resistant, resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- E. Lamp sockets for high intensity discharge (H.I.D) fixture shall have locking-type porcelain enclosures in conformance to the applicable requirements of ANSI C81.61-09 and UL 496-08.
- F. Pre-wire internal components to terminal strips at the factory.
- G. Bracket-mounted luminaires shall have leveling provisions and clamp-type adjustable slip-fitters with locking screws.
- H. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.
- I. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, match finish process and color of pole or support materials. Where indicated on drawings, provide finishes as indicated in Section 09 06 00, SCHEDULE FOR FINISHES.
- J. Luminaires shall carry factory labels, showing complete, specific lamp and ballast information.

2.5 LAMPS

- A. Install the proper lamps in every luminaire installed //and every existing luminaire relocated or reinstalled //as shown on the drawings.
- B. Lamps shall be general-service, outdoor lighting types.

- C. High-Pressure Sodium (HPS) Lamps: Comply with NEMA C78.42, Color Rendering Index (CRI) 21 (minimum), wattage as indicated on fixture schedule. Lamps shall have minimum average rated life of 24,000 hours.
- D. Low-Pressure Sodium (LPS) Lamps: Comply with NEMA C78.41, wattage as indicated on fixture schedule. Lamps shall have minimum average rated life of 18,000 hours.
- E. Metal-Halide Lamps: Comply with NEMA C78.43 or NEMA C78.1381. Lamps shall be pulse start or ceramic type with wattage and correlated color temperature as indicated on fixture schedule.

SPEC WRITER NOTE: A/E is encouraged to consider LED lighting for parking garages and other outdoor applications when appropriate. Edit the paragraph below to conform to project requirements.

//F. LED sources shall meet the following requirements:

1. Operating temperature rating shall be between -40 degrees C (-40 degrees F) and 50 degrees C (120 degrees F).
2. Correlated Color Temperature (CCT): //2700K// //3000K// //3500K// //4000K// //4500K// //5000K// //5700K// //6500K//.
3. Color Rendering Index (CRI): ≥ 85 .
4. The manufacturer shall have performed reliability tests on the LEDs luminaires complying with Illuminating Engineering Society (IES) LM79 for photometric performance and LM80 for lumen maintenance and L70 life.//

G. Mercury vapor lamps shall not be used.

2.6 HIGH INTENSITY DISCHARGE BALLASTS

- A. Per NEMA C82.4 and UL 1029. Ballasts shall be //encapsulated// single-lamp, copper-wound, constant-wattage autotransformer type, designed to operate on the voltage system to which they are connected, and capable of open-circuit operation without reducing lamp life.
- B. Ballasts shall have individual overcurrent protection in each ungrounded supply conductor.
- C. Ballast shall have an allowable line voltage variations of $\pm 10\%$, with a maximum 20% lamp wattage regulation spread.
- D. Power factor shall be not less than 90%.
- E. Ballast shall have a minimum starting temperature of -30 degrees C (-22 degrees F), and a normal ambient operating temperature of 40 degrees C (104 degrees F).

- F. Lamp current crest factor shall be 1.8 or less, in accordance with lamp manufacturer recommendations.

2.7 METAL HALIDE CORE AND COIL BALLASTS

- A. Shall be pulse start, linear reactor type for 277 volt luminaires and constant-wattage autotransformer (CWA) type for other voltage luminaires (if not otherwise specified).
- B. Ballasts shall have individual overcurrent protection in each ungrounded supply conductor.
- C. Power factor shall be not less than 90%.
- D. Ballast shall have an allowable line voltage variation of $\pm 5\%$ for linear reactor type and $\pm 10\%$ for CWA, with a maximum 20% lamp wattage regulation spread.
- E. Ballast shall have a minimum starting temperature of -40 degrees C (-40 degrees F).
- F. Lamp current crest factor shall be 1.8 or less, in accordance with lamp manufacturer recommendations.

2.8 METAL HALIDE ELECTRONIC BALLASTS

- A. Ballast shall be low-frequency electronic type, and shall operate pulse start and ceramic metal halide lamps at a frequency of 90 to 200 Hz square wave.
- B. Ballast shall be labeled Type '1' outdoor, suitable for recessed use, Class 'P'.
- C. Ballast shall have auto-resetting thermal protector to shut off ballast when operating temperatures reach unacceptable levels.
- D. Ballast shall have an end of lamp life detection and shut-down circuit.
- E. Lamp current crest factor shall be 1.5 or less.
- F. Ballasts shall comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
- G. Ballast shall have a minimum ballast factor of 1.0.
- H. Input current THD shall not exceed 20% for the primary lamp.
- I. Ballasts shall have ANSI C62.41, category 'A' transient protection.
- J. Ballasts shall have power factor greater than 90%.
- K. Ballast shall have a Class 'A' sound rating.

SPEC WRITER NOTE: A/E is encouraged to consider LED lighting for parking garages and other outdoor when appropriate. Refer to VA Electrical Design Manual for additional information. Edit the paragraph below to conform to project requirements.

//2.9 LED DRIVERS

- A. LED drivers shall meet the following requirements:
1. Drivers shall have a minimum efficiency of 85%.
 2. Starting Temperature: -40 degrees C (-40 degrees F).
 3. Input Voltage: 120 to 480 ($\pm 10\%$) volt.
 4. Power Supplies: Class I or II output.
 5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μ s, 10kA/8 x 20 μ s) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
 6. Power Factor (PF): ≥ 0.90 .
 7. Total Harmonic Distortion (THD): $\leq 20\%$.
 8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
 9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.//

//2.10 EXISTING LIGHTING SYSTEMS

- A. For modifications or additions to existing lighting systems, the new components shall be compatible with the existing systems.
- B. New poles and luminaires shall have approximately the same configurations, dimensions, lamping and reflector type as the existing poles and luminaires, except where otherwise shown on the drawings.//

SPEC WRITER NOTE: Where obstruction lighting is required by FAA, coordinate with the latest FAA requirements and modify the following paragraphs accordingly.

//2.11 OBSTRUCTION LIGHTING

- A. Refer to Section 26 09 23, LIGHTING CONTROLS for control devices.
- B. For Buildings:
1. Incandescent type luminaires shall comply with FAA, AC 70/7460-1K, and AC 150/5345-53, and be Type L-810 duplex units with red Fresnel lenses and steady burning 100 W, type A-21, clear, traffic-signal lamps in each unit.
 2. LED type luminaires shall comply with FAA, AC 70/7460-1K, and AC 150/5345-53, and be Type L-810 duplex units with red steady burning light from and LED light source with minimum 50,000 hour lamp life and employing Night Vision Goggles (NVG) friendly technology.

3. Mount the luminaires on galvanized rigid steel pipe masts attached to the roof of the buildings so the luminaires extend 305 mm (12 inches) above the level of the highest item on the building, including items attached to the roof.
4. Locate luminaires in accordance with the applicable FAA Standards.
- C. For Smoke Stacks: Luminaires shall be in accordance with the referenced details shown on the drawings. All lamps shall be the type shown on the drawings.
- D. For Water Tanks and Cooling Towers: Luminaires shall be FAA, AC 70/7460-1K, and AC 150/5345-53, Type L-810 duplex units with incandescent or LED light source.//

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.
- B. Pole Foundations:
 1. Excavate only as necessary to provide sufficient working clearance for installation of forms and proper use of tamper to the full depth of the excavation. Prevent surface water from flowing into the excavation. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath, and the end of conduit.
 2. Set anchor bolts according to anchor-bolt templates furnished by the pole manufacturer.
 3. Install poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.
 4. After the poles have been installed, shimmed, and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material. Provide a plastic or copper tube, of not less than 9 mm (0.375-inch) inside diameter through the grout, tight to the top of the concrete base to prevent moisture weeping from the interior of the pole.
- C. Install lamps in each luminaire.
- D. Adjust luminaires that require field adjustment or aiming.

3.2 GROUNDING

Ground noncurrent-carrying parts of equipment, including metal poles, luminaires, mounting arms, brackets, and metallic enclosures, as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL

SYSTEMS. Where copper grounding conductor is connected to a metal other than copper, provide specially-treated or lined connectors suitable and listed for this purpose.

3.3 ACCEPTANCE CHECKS AND TESTS

Verify operation after installing luminaires and energizing circuits.

SPEC WRITER NOTE: A/E shall include the paragraph below when required and indicate mounting height on drawings

//3.4 WATER TANKS AND COOLING TOWERS

Mount the luminaires at the extreme top of tank and tower as shown on drawings.//

- - - E N D - - -