

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. Use this section for low
voltage parallel-type systems and medium-
voltage series-type systems.

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of exterior luminaires, poles, and supports.

1.2 RELATED WORK

- A. Section 09 06 00, SCHEDULE FOR FINISHES: Finishes for exterior light poles and luminaires.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- //C. Section 26 05 13, MEDIUM-VOLTAGE CABLES: Medium voltage cables for series-connected street lighting. //
- D. Section 26 05 21, 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

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:

- 1. Clearly present sufficient information to determine compliance with drawings and specifications.

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

- 2. Include electrical ratings, dimensions, mounting, details, materials, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, poles, luminaires, lamps, and accessories. // Include electronic photometric files in IES format, or provide link (URL) to manufacturer's website that contains photometric data for each specific fixture used, excluding wallpack fixtures.//

C. Manuals: Two weeks prior to final inspection, submit four copies of operating and maintenance manuals to the //Resident Engineer// //COTR//. Include technical data sheets, wiring and connection diagrams, and information for ordering replacement lamps, ballasts, and parts.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the //Resident Engineer// //COTR//:

- 1. Certification by the manufacturer that the materials are in accordance with the drawings and specifications.
- 2. Certification by the contractor that the complete installation has 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. Aluminum Association Inc. (AA):

AAH35.1-06 Alloy and Temper Designation Systems for Aluminum

C. American Association of State Highway and Transportation Officials (AASHTO):

LTS-5-09 Structural Supports for Highway Signs, Luminaires and Traffic Signals

D. American Concrete Institute (ACI):

318-05 Building Code Requirements for Structural Concrete

E. American National Standards Institute (ANSI):

- C81.61-09 Electrical Lamp Bases - Specifications for
Bases (Caps) for Electric Lamps
- F. American Society for Testing and Materials (ASTM):
- A123/A123M-09 Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
- A153/A153M-09 Zinc Coating (Hot-Dip) on Iron and Steel
Hardware
- B108-03a-08 Aluminum-Alloy Permanent Mold Castings
- C1089-06 Spun Cast Prestressed Concrete Poles
- G. Federal Aviation Administration (FAA):
- AC 70/7460-IK-07 Obstruction Lighting and Marking
- AC 150/5345-43F-06 Obstruction Lighting Equipment
- H. Illuminating Engineering Society of North America (IESNA)
- HB-9-00 Lighting Handbook
- RP-8-05 Roadway Lighting
- RP-20-98 Lighting for Parking Facilities
- RP-33-99 Lighting for Exterior Environments
- LM-5-96 Photometric Measurements of Area and Sports
Lighting Installations
- LM-50-99 Photometric Measurements of Roadway Lighting
Installations
- LM-52-99 Photometric Measurements of Roadway Sign
Installations
- LM-64-01 Photometric Measurements of Parking Areas
- LM-72-97 Directional Positioning of Photometric Data
- LM-79-08 Approved Method for the Electrical and
Photometric Measurements of Solid-State Lighting
Products
- LM-80-08 Approved Method for Measuring Lumen Maintenance
of LED Light Sources
- I. National Electrical Manufacturers Association (NEMA):
- C78.41-06 Electric Lamps - Guidelines for Low-Pressure
Sodium Lamps
- C78.42-07 Electric Lamps - Guidelines for High-Pressure
Sodium Lamps
- C78.43-07 Electric Lamps - Single-Ended Metal-Halide
Lamps

- C78.1381-98 Electric Lamps - 70-Watt M85 Double-Ended
Metal-Halide Lamps
- C82.4-02 Ballasts for High-Intensity-Discharge and Low-
Pressure Sodium Lamps (Multiple-Supply Type)
- C136.3-05 For Roadway and Area Lighting Equipment -
Luminaire Attachments
- C136.17-05 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 (R2006) Enclosures
- J. National Fire Protection Association (NFPA):
- 70-08 National Electrical Code (NEC)
- K. Underwriters Laboratories, Inc. (UL):
- 496-08 Lampholders
- 773-95 Plug-In, Locking Type Photocontrols for Use
with Area Lighting
- 773A-06 Nonindustrial Photoelectric Switches for
Lighting Control
- 1029-94 High-Intensity-Discharge Lamp Ballasts
- 1598-08 Luminaires
- 8750-08.....Light Emitting Diode (LED) Light Sources 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 12 in [305 mm] 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 MATERIALS AND EQUIPMENT

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: Insert wind loading requirements for the location in which installed.

2. The pole and arm assembly shall be designed for wind loading of //100 mph [161 km/hr]// // //, with an additional 30% gust factor, 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 2.5 x 5 in [65 x 125 mm]. 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 0.25 in [6 mm] 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 tiewire 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. Per UL 1598 and NEMA C136.17. 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. Light distribution pattern types 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 and UL 496.
- 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//.
- B. Lamps shall be general-service, outdoor lighting types.
- C. High-Pressure Sodium (HPS) Lamps: NEMA C78.42, CRI 21 (minimum), wattage as indicated. Lamps shall have minimum average rated life of 24,000 hours.
- D. Low-Pressure Sodium (LPS) Lamps: NEMA C78.43.
- E. Metal-Halide Lamps: NEMA C78.43 or NEMA C78.1381.

SPEC WRITER NOTE: A/E is encouraged to consider LED lighting for parking garages and other outdoor applications when appropriate. Refer to VA Electrical Design Manual for additional information. 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° F [-40° C] and 120° F [50° C].

2. Correlated Color Temperature (CCT): //2700K// //3000K// //3500K//
//4000K// //4500K// //5000K// //5700K// //6500K//.
3. Color Rendering Index (CRI): ≥ 65 .
4. The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature Cycle (PTMCL), Non-Operating Thermal Shock (TMSK), Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).//
- 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 -22°F [-30°C], and a normal ambient operating temperature of 104°F [40°C].
- 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 variations 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°F [-40°C].
- 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° F [-40° C].
 - 3. Input Voltage: 120 to 480 (±10%) V.
 - 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 µs, 10kA/8 x 20 µs) 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): = 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 and dimensions as the existing poles and luminaires, except where otherwise shown on the drawings.

SPEC WRITER NOTE: New series-type systems shall not be designed or installed. Projects shall take every opportunity to remove existing series-type lighting systems. The following paragraphs shall be edited as necessary where modifications to existing systems are required.

//2.11 SERIES LIGHTING SYSTEMS

- A. Series-Type Systems:
 - 1. Provide components specifically for constant-current series type lighting systems.
 - 2. Constant-Current Transformers:
 - a. Self-cooled by natural convection, liquid-immersed, fully automatic, outdoor type.
 - b. Liquid shall be oil, conforming to ASTM D3487, except where otherwise shown.
 - c. Temperature rises shall not exceed the following test values for the respective insulation systems:
 - 1) Standard, 131° F [55° C] by resistance and 149° F [65° C] hottest spot.
 - 2) Thermally upgraded, 149° F [65° C] by resistance and 180° F [80° C] hottest spot.
 - d. Core Coil Assemblies:
 - 1) Braced to withstand the stresses caused by the maximum current possible under all conditions and rough handling during shipment.
 - 2) Cores, silicon steel.
 - 3) Coils, continuous windings without splices, except for taps.
 - e. Bring primary and secondary leads out through wet-process, porcelain bushings, pressure-tight. Terminals shall be suitable for the specific cables being connected to them.

- f. Series-type systems shall have capacitors for power factor improvement. The value of power factor under the percent of full load rating shall be as shown on the drawings.
 - g. Series-type systems shall regulate the secondary current within 1% over the entire load rating range while the primary voltage remains within 5% of the rated voltage.
 - h. Operation of the transformers shall not be adversely affected while the transformers are mounted five degrees off of perpendicular.
 - i. Provide tanks and covers of steel to meet NEMA and ANSI requirements, cleaned, phosphatized, and painted at the factory with primer and the manufacturer's standard extremely durable finish.
 - j. Sound levels shall not exceed 45 db.
 - k. Standard ANSI features and accessories including a pressure relief device, ground pad, lifting provisions, and diagrammatic nameplate.
 - l. Dimensions and configurations shall conform to the spaces designated for installations.
 - m. Install the transformers such that they will have adequate air circulation for heat removal.
3. Controllers:
- a. Oil-immersed, rated-load-interrupter, outdoor type, with heavy duty, silver-alloy contacts.
 - b. Oil, ASTM D3487.
 - c. Operate at 120 V, 60 Hz.
 - d. Have an auxiliary hand lever for manual operation during emergencies.
 - e. The depth below the oil surface of the contacts shall be not less than the depth of the switch mechanism.
 - f. Bring leads out through wet-process, porcelain bushings, pressure-tight. Terminals shall be suitable for the specific cables being connected to them.
 - g. Provide steel tanks and covers, thoroughly cleaned, phosphatized, and painted at the factory with primer and the manufacturer's standard durable finish.
 - h. Dimensions and configurations shall conform to the spaces designed for installations.

4. Provide protective relays to de-energize the control circuits for the controllers, thereby de-energizing the series lighting load circuits when open circuit faults occur in the series lighting load circuits.
5. Transformer, equipment enclosure, lightning arresters, and primary and secondary protection shall be provided.
6. Disconnecting devices shall be watertight, submersible type, suitable for the cables being installed and for use in outdoor lighting systems.//

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

//2.12 OBSTRUCTION LIGHTING

- A. Refer to Section 26 09 23, LIGHTING CONTROLS for control devices.
- B. For Buildings:
 1. Luminaires shall comply with FAA, AC 70/7460-1K, and AC 150/5345-43E, and be Type L1-810 duplex units with red Fresnel lenses and 100 W, type A-21, clear, traffic-signal lamps.
 2. Mount the luminaires on galvanized rigid steel pipe masts attached to the roof of the buildings so the luminaires extend 12 in [305 mm] above the level of the highest item on the building, including items attached to the roof.
 3. 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 150/5345-43E, Type L-810 duplex units with red Fresnel lenses and 100 W, type A-21, clear, traffic-signal lamps.

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 0.375 in [9 mm] 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: Include the paragraph below when required.

//3.4 WATER TANKS AND COOLING TOWERS

Mount the luminaires at the extreme top of tank and tower. //

- - - E N D - - -