

**SECTION 26 56 00
EXTERIOR LIGHTING**

PART 1 - GENERAL

1.01 DESCRIPTION

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

1.02 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings, and boxes for raceway systems.
- C. Section 26 05 13, MEDIUM-VOLTAGE CABLES.
- 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 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground handholes and conduits.
- F. 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.

1.03 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting, details, materials, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, poles, luminaries, lamps and controls.
- C. Manuals: Two weeks prior to final inspection, submit four copies of operating and maintenance manuals to the COR. Include technical data sheets, wiring and connection diagrams, and information for ordering replacement parts.

- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:
 - 1. Certification 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.

1.04 APPLICABLE PUBLICATIONS

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 the basic designation only.

- A. Aluminum Association Inc. (AA):
AAH35.1-2006 Alloy and Temper Designation Systems for Aluminum
- B. American Association of State Highway and Transportation Officials (AASHTO):
LTS-4-2003 Structural Supports for Highway Signs, Luminaries and Traffic Signals
- C. American Concrete Institute (ACI):
318-2005 Building Code Requirements for Structural Concrete
- D. American National Standards Institute (ANSI):
C57.12-2000 General Requirements For Liquid-Immersed Distribution, Power, and Regulating Transformers
C81.61-2005 Electrical Lamp Bases
- E. American Society for Testing and Materials (ASTM):
A123/A123M-2002 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A153/A153M-2001 Zinc Coating (Hot-Dip) on Iron and Steel Hardware – AASHTO No.: M232
B108-03a -2003 Aluminum-Alloy Permanent Mold Castings
D3487-2000 Mineral Insulating Oil Used in Electrical Apparatus
- F. Federal Aviation Administration (FAA):
AC 70/7460-IK CHG 1-2000 Obstruction Lighting and Marking
AC 150/5345-43E-1995 Specification for Obstruction Lighting Equipment
- G. Illuminating Engineering Society of North America (IESNA)
HB-9-2000 Lighting Handbook
RP-8-2000 (R-2005) Roadway Lighting
- H. National Electrical Manufacturers Association (NEMA):
C78.41-2001 Electric Lamps – Guidelines for Low-Pressure Sodium Lamps
C78.42-2004 Electric Lamps – Guidelines for High-Pressure Sodium Lamps

- C78.43-2005 Electric Lamps – Single-Ended Metal-Halide Lamps
- C78.1381-1998 (R 1997) Electric Lamps – 70-Watt M85 Metal-Halide Lamps
- C82.4-2002 Ballasts for High-Intensity-Discharge and Low-Pressure Sodium
Lamps (Multiple-Supply Type)
- C136.17-2005 Roadway Lighting Equipment – Enclosed Side-Mounted
Luminaries for Horizontal-Burning High-Intensity-Discharge
Lamps
- ICS 2-2005 Industrial Control and Systems Controllers, Contactors and
Overload Relays Rated 600 Volts
- ICS 6-2001 Industrial Control and Systems Enclosures
- I. National Fire Protection Association (NFPA):
 - 70-2005 National Electrical Code (NEC)
- J. Underwriters Laboratories, Inc. (UL):
 - 496-2004 Edison-Base Lamp holders
 - 773-1995 Plug-in, Locking Type Photo controls, for Use with Area Lighting
 - 773A-2006 Non-industrial Photoelectric Switches for Lighting Control
 - 1029-1994 High-Intensity-Discharge Lamp Ballasts
 - 1598-2004 Luminaries

1.05 DELIVERY, STORAGE, AND HANDLING

Steel Poles: Do not store poles on ground. Store poles so they are at least 305 mm (one foot) above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

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

2.02 POLES

- A. General:
 - 1. Poles shall be straight round cast aluminum alloy as shown on the drawings, and as specified. Finish shall be as specified on the drawings.
 - 2. The pole assembly shall be designed for wind loading of 161 km/hr (100 miles per hour), with an additional 30 percent gust factor, supporting luminaire(s) having 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 anchor-bolt type designed for use with underground supply conductors. Poles shall have oval-shaped handhole having a minimum clear opening of 65 by 125 mm (2.5 by 5 inches). Handhole cover shall be secured by stainless steel captive screws.
 4. Provide a steel-grounding stud opposite hand hole openings.
 5. Provide a base cover matching the pole in material and color to conceal the mounting hardware pole-base welds and anchor bolts.
 6. Hardware: All necessary hardware shall be 300 series stainless steel.
- B. Types:
1. Aluminum: Provide 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.

2.03 FOUNDATIONS FOR POLES

- A. Foundations shall be cast-in-place concrete.
- B. Foundations shall support the effective projected area of the specified pole, arm(s), and luminaire(s) 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 (1/4 inch) radius.
- E. Concrete shall have 3000 psi minimum 28 day compressive strength.
- F. Anchor bolt assemblies and reinforcing of concrete foundations shall be as shown on the drawings and meet ACI 318. Anchor bolts shall be in a welded cage or properly positioned by the tie wire to stirrups.
- G. Prior to concrete pour, install a copperclad steel ground rod, not less than 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, below each foundation. Drive the rod vertically under the foundation so not less than 1800 mm (6 feet) of rod is in contact with the earth. Remainder of rod may be in the concrete pour. Where rock or layered rock is present, drill a hole not less than 50 mm (2 inches) in diameter and 1800 mm (6 feet) deep, backfill with tamped fine sand and drive the rod into the hole. Bond the rod to the pole with not less than number 6 AWG bare copper wires. The method of bonding shall be approved for the purpose.

2.04 LUMINAIRES

- A. UL 1598 and NEMA C136.17. Luminaries 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. IESNA HB-9 and RP-8 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, prismatic refractors. 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 luminary 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 luminaries 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. IESNA Cutoff Category: cutoff.

2.05 LAMPS

- A. Install the proper lamps in every luminaire installed.
- B. Lamps to be general-service, outdoor lighting types.
- C. High-Pressure Sodium (HPS) Lamps: NEMA C78.42, wattage as indicated. Lamps shall have average rated life of 16,000 hours minimum for 35 watt lamps and 24,000 hours minimum for all higher wattages.
- D. Low-Pressure Sodium (LPS) Lamps: NEMA C78.41.
- E. Metal-Halide Lamps: NEMA C78.43 or NEMA C78.1381
- E. LED sources shall meet the following requirements:
 - 1. Operating temperature rating shall be between -40° F and 120° F.
 - 2. Correlated Color Temperature (CCT): 3500K or as shown on drawings.
 - 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), Power 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.

2.06 HIGH INTENSITY DISCHARGE BALLASTS

- A. For low voltage systems, the ballasts shall be the high efficiency, high power factor, copper-wound constant wattage type and shall meet the requirements of UL 1029 and NEMA C82.4.

1. Ballasts shall operate the discharge lamp of the type, wattage, and voltage shown on the drawings.
 2. Ballasts shall have individual overcurrent protection (inline fuse holder) as recommended by the ballast manufacturer.
 3. Ballasts shall be capable of providing reliable starting of the lamps at minus 30 degrees C.
 4. Open-circuit operation shall not reduce the average life.
- B. For series systems, the ballasts shall be the high power factor, copper wound constant current type.
1. Provide ballasts to operate the discharge lamp of the type, wattage, and voltage shown on the drawings.
- C. Locate protective devices for ballasts to be accessible if the devices are not integral with ballasts.
- D. Each ballast shall operate not more than one lamp except where otherwise shown on the drawings.

2.07 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.

2.08 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 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.

2.09 LIGHTING CONTACTORS

NEMA ICS 2, electrically held contactors. Rate contactors as indicated. Provide in NEMA 4 enclosure conforming to NEMA ICS 6. Contactors shall have silver alloy double-break contacts and coil clearing contacts for mechanically held contactor] and shall require no arcing contacts.

2.10 CONTROLS

- A. Each Lighting System:
 1. Shall be controlled by one of the following methods as shown for each system on the drawings:
 - a. A photocell to act as the pilot device. The photocell shall be the type which fails safe to the closed position meeting UL 773 or 773A.
 - b. A time clock to act as the pilot device.
 - c. A combination, photocell-time clock to act as dual pilot devices connected in series. The photocell shall provide the "on" function at dusk and the time clock(s) shall control specific circuit "off" functions during dark hours.
 - d. A time clock to act as the pilot device for a circuit (or circuits) when luminaries are individually photocell controlled.
 - e. The pilot devices shall control the power circuit through the contractor or relay as shown on the drawings.
 2. Mount and connect photocells and time clocks as shown on the drawings.
 3. Photocells shall have the following features:
 - a. Quick-response, cadmium-sulfide type.
 - b. A 15 to 30 second, built-in time delay to prevent response to momentary lightning flashes, car headlights or cloud movements.
 - c. Energizes the system when the north sky light decreases to approximately 1.5 footcandles, and maintains the system energized until the north sky light increases to approximately 3 to 5 foot candles.
 4. Time clocks shall have the following features:

- a. A 24-hour astronomic dial, motor-driven.
 - b. A spring-actuated, reserve power mechanism for operating the timer during electrical power failures and that automatically winds the spring when the electrical power is restored.
5. The arrangement and method of control and the control devices shall be as shown on the drawings.

2.11 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 luminaries shall have approximately the same configurations and dimensions as the existing poles and luminaries except where otherwise shown on the drawings.

2.12 AUXILIARY EQUIPMENT

- A. Parallel-Type Systems: Shall be supplied power as shown on the drawings.

2.13 OBSTRUCTION LIGHTING

- A. Control devices shall be weatherproof, quick-response, cadmium sulfide type, photoelectric cell relays which will energize the lights at approximately 35 footcandles as the daylight decreases and will de-energize the lights at approximately 85 footcandles as the daylight increases. Mount and position control devices in suitable outdoor locations so they will be actuated by the north skylight.
- B. All circuit raceways or wiring methods exposed to weather, including fittings, shall be weatherproof and include gaskets where required.
 1. Minimum conductor size number 12 AWG, copper.
 2. Wiring method as shown on the drawings.
- C. For Buildings:
 1. Lighting fixtures 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 watt, type A-21, clear, traffic-signal lamps.
 2. Mount the lighting fixtures on galvanized, rigid, steel pipe masts attached to the roof of the buildings so the lighting fixtures extend 305 mm (one foot) above the level of the highest item on the building, including items attached to the roof.
 3. Locate lighting equipment in accordance with the applicable FAA Standards.
- D. For Smoke Stacks: Lighting fixtures shall be in accordance with the referenced details shown on the drawings. All lamps shall be the type shown.

- E. For Water Tank and Cooling Tower: Lighting fixtures FAA, AC 70/7460-1K and AC 150/5345-43E, Type L-810 duplex units with red fresnel lenses and 100 watt, type A-21, clear, traffic-signal lamps.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.
- B. Steel Poles:
 - 1. Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 1.57 rad 90 degrees at the bottom end. Provide galvanized nuts, washers, and ornamental covers for anchor bolts. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.
 - 2. 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 (3/8-inch) inside diameter, through the grout tight to the top of the concrete base for moisture weeping.
- C. Foundation Excavation: Depth shall be as indicated. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 150 mm (6 inch) maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.
- D. Photocell Switch Aiming: Aim switch according to manufacturer's recommendations.

3.02 GROUNDING

Ground noncurrent-carrying parts of equipment including metal poles, luminaries, 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.

3.03 SMOKE STACKS:

- A. Mount the lighting fixtures at uniform intervals in a horizontal plane around the stack at each elevation, in accordance with the manufacturer's instruction, so not less than two lighting fixtures at each elevation will be visible from any direction.
- B. Securely attach the lighting fixtures to permanent structures including bracing on each side and upwards for each fixture.

- C. Install an individual winch and cable for each lighting fixture in accordance with manufacturer's recommendations:
 - 1. Anchor the guide lines to eyes in the stack foundation and maintain tension with turnbuckles.
 - 2. Install conduit protection for the winch lines.
- D. At each elevation, divide the lighting fixtures between three phases.

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