**SECTION 26 56 29**

**SITE LIGHTING**

**BASED ON DFD MASTER ELECTRICAL SPEC DATED 09/03/24**

This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.

**PART 1 - GENERAL**

**SCOPE**

The work under this section includes exterior luminaires and accessories, poles, and foundations. Also included are the following topics:

PART 1 - GENERAL

 Scope

 Related Work

 Reference Standards

 Definitions

 Submittals

 Project Record Documents

 Operation and Maintenance Data

 Coordination

 Extra Materials

PART 2 - PRODUCTS

 Luminaires

 LED Luminaires

 LED Drivers

 Bi-Level Switching

 Fuses

 Wiring Connectors

 Poles

 Foundations

PART 3 - EXECUTION

 Installation

 Field Quality Control

 Adjusting

 Cleaning

 Construction Verification Items

 Agency Training

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 01 91 01 or 01 91 02 – Commissioning Process

Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables

Section 26 08 00 – Commissioning of Electrical

**REFERENCE STANDARDS**

Wisconsin Administrative Code SPS 362.1807 Shallow Post Foundations.

International Building Code IBC 1807.3 Embedded Posts and Poles.

IEEE 1789 – Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers.

RoHS – Restriction of Hazardous Substances. Council of the European Union (EC) Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

LM-79-08 (or latest) – IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.

LM-80-08 (or latest) – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.

TM-21-11 (or latest) – IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.

NEMA SSL 1-2010 (or latest) – Electronic Drivers for LED Devices, Arrays, or Systems.

**DEFINITIONS**

Driver: The power supply used to power LED luminaires, modules, or arrays.

L70, L70, or L70%: The reported life of an LED component or system to reach 70% lumen maintenance, or 70% of the LEDs original light output.

LEDs: Broadly defined as complete luminaire with light emitting diode (LED) packages, modules, light bars, or arrays, complete with driver.

LED luminaire failure: Negligible light output from more than 10 percent of the LEDs, or less than 70 percent of the listed lumen output constitutes luminaire failure.

**SUBMITTALS**

Shop Drawings: Indicate dimensions and components for each luminaire, pole, and base.

Product Data:

For each luminaire type, submit luminaire information including catalog cuts with highlighted catalog numbers, and required accessories:

* Luminaire:
	+ Manufacturer and catalog number,
	+ Type (identification) as indicated on the plans and schedule,
	+ Delivered lumens,
	+ Input watts,
	+ Efficacy,
	+ Color rendering index,
	+ Performance data, and
	+ Effective Projected Area (EPA).
* Driver:
	+ Manufacturer and catalog number,
	+ Type (Non-Dimming, Step-dimming, Continuous dimming, etc.),
	+ Power Factor, Crest Factor, THD, etc.
* Pole (if applicable):
	+ Diameter
	+ Height
	+ Pole thickness
	+ Weight

Manufacturer's Instructions:

Indicate application conditions and limitations of use stipulated by product testing agency specified under "Regulatory Requirements".

Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

Light Layout: Provide a computer-generated factory point-by-point foot-candle layout of the project for each area involved.

Post Installation Report: Provide to the Engineer and DFD the results of the measured foot-candle level for each area involved. Use a measuring device pre-approved by DFD.

**PROJECT RECORD DOCUMENTS**

Accurately record actual locations of each luminaire, pole, and underground circuit.

Provide record drawings of the final, as installed and measured, point-by-point foot-candle layout for each area involved.

**OPERATION AND MAINTENANCE DATA**

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

**COORDINATION**

Use bolt templates and pole mounting accessories to install anchor bolts in pole base.

***Coordinate Extra Materials with the facility staff. If they want spare luminaires and drivers, add a general note on the Luminaire Schedule on the drawings that states “Provide Extra Materials (spares) per specification sections 26 51 00 Interior Lighting and 26 56 29 Site Lighting.” Edit the quantity of spares below as coordinated with the facility staff.***

**EXTRA MATERIALS**

# Provide one (1) of each type of LED module, light bar, or array (if applicable). If the LEDs are integrated into the luminaire and are not separate components, then provide one (1) of each of these types of luminaires.

# Provide one (1) LED driver of each type.

Provide five (5) percent of total fuses provided for each size, but not less than one (1) of each size.

**PART 2 - PRODUCTS**

***Provide luminaire schedule on the drawings, with three catalog numbers of each type of luminaire as shown on the DFD website.***

**LUMINAIRES**

See the Luminaire Schedule on the drawings for type of luminaires and catalog numbers. Catalog numbers are shown on the drawings for quality and performance requirements only. Luminaires manufactured by others are equally acceptable provided they meet or exceed the performance of the indicated luminaires and meet the intent of the design.

Luminaire shall be certified by a Nationally Recognized Testing Laboratory (UL, ETL, or IEC).

Provide luminaires with quick-connect disconnecting means, similar to Thomas & Betts Sta-Kon.

**LED LUMINAIRES**

* LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the DesignLights Consortium’s® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category are:
	+ Minimum Light Output.
	+ Zonal Lumen Requirements.
	+ Minimum Luminaire Efficacy.
	+ Minimum CRI.
	+ L70 Lumen Maintenance.
	+ Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.

*Additional requirements:*

* Color Temperature of 3000K-4100K for interior luminaires as listed in the Luminaire Schedule on the plans. The color temperature of exterior LED luminaires should not exceed 4100K (nominal).
* Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a maximum 5-step MacAdam Ellipse binning process.
* Glare Control: Exterior luminaires shall meet DesignLights Consortium’s® criteria for Zonal Lumen Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.
* Luminaire shall be mercury-free, lead-free, and RoHS compliant.
* Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
* Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
* Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
* Lumen output shall not depreciate more than 20% after 10,000 hours of use.
* Luminaire and driver shall be furnished from a single manufacturer to ensure compatibility.

***Where color rendering is extremely important, specify a CRI of 95 and an R9 value of 80+.***

* Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires.
* LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -40°F to 104°F (-40°C to 40°C).
* Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
* Luminaire shall have a maximum Total Harmonic Distortion (THD) of <20% at full input power and across specified voltage range.
* All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
* All luminaires shall be provided with knockouts for conduit connections.
* The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).
* Provide all of the following data on submittals:
	+ Delivered lumens
	+ Input watts
	+ Efficacy
	+ Color rendering index.

*LED Luminaires used for Emergency Egress Lighting:*

* The failure of one LED shall not affect the operation of the remaining LEDs.

*Emergency LED Luminaire Compatibility with Inverters:*

* Emergency Inverters shall be sine-wave type, or have written confirmation from the luminaire manufacturer that the luminaire will function with a square-wave inverter.

**LED DRIVERS**

General:

* Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated on the luminaire schedule on the drawings.
* Minimum Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
* Driver shall have a rated life of 50,000 hours, minimum.
* Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
* Driver shall modulate current at high frequencies.
* Driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
* Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
* Driver shall have a maximum Total Harmonic Distortion (THD) of <20% at full input power and across specified voltage range.
* Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
* Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
* Provide all of the following data on submittals:
	+ Input watts
	+ Power Factor (pf)
	+ Crest Factor (cf) at full input power
	+ Total Harmonic Distortion (THD).

Dimming Drivers:

* LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC), Constant Voltage, or a hybrid of Constant Current Reduction (CCR) with Pulse Width Modulation (PWM) operation. All dimmable drivers shall operate at high frequencies.
* Step-Dimming Drivers: Easily switched from 0% to 50% to 100% output power. Both switch-leg inputs shall control 50% of the luminaire’s light output equally.

Drivers for Bi-Level Switching:

* Provide two (2) drivers, or drivers compatible with bi-level switching control from two (2) separate contactors/switch-legs in each luminaire where indicated in the luminaire schedule on the drawings.

**BI-LEVEL SWITCHING**

***Indicate on the plans and in the luminaire schedule which luminaires shall be equipped for Bi-Level Switching. Some parking/area luminaires are good candidates for bi-level control. Secure locations associated with DMA facilities, campus pathways, etc., shall not incorporate Bi-Level Switching due to security and pedestrian safety concerns. Coordinate with DFD reviewer.***

Provide bi-level switching operation where indicated on the drawings. Luminaires shall normally operate at 100% output during nighttime hours, but shall decrease to 50% output “after hours” as defined by 2015 IECC C405.2.5. Luminaires shall be compatible with bi-level switching operation.

**FUSES**

***The consultant shall size the fuse according to the load of the luminaire and indicate the fuse size on the drawings.***

Furnish and install a fuse holder and fuse in each ungrounded leg of the electrical circuit supplying the outdoor luminaire. If the voltage is 208, 240, or 480 volts, then the fuse holder needs to be a 2-pole fuse holder which simultaneously disconnects both ungrounded conductors. Every luminaire (including bollards) shall be separately fused with a water-resistant fuse holder. Size the fuse for the amperage of the luminaire. Tap the circuit conductors with a minimum #10 AWG conductor to serve the luminaire. The fuse and holder shall be accessible through the handhole. Provide sufficient wire to bring fuse holder outside of handhole.

**WIRING CONNECTORS**

Wiring Connectors shall meet the requirements of Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables.

Twist-On Wire Connectors: Solderless twist-on spring connectors (wire-nuts) with insulating covers for copper wire splices and taps. All wire connectors used in site lighting applications shall be silicone gel-filled twist connectors or connectors designed for damp and wet locations. Gel-filled twist-on connectors may be used for copper conductor sizes 6 AWG and smaller for site lighting applications. The manufacturer’s wire fill capacity must be followed.

**POLES**

Furnish products as specified in schedule on Drawings.

***The consultant shall, at a minimum, include the following pole information in the schedule on the drawings.***

***Material***

***Finish***

***Section shape and dimensions***

***Pole thickness***

***Effective Projected Area (EPA) rating***

***Height***

***Pole Top***

***Base***

***Accessories (Base cover, GFCI receptacles, ground lug, luminaire mounting arm length, etc.)***

Handhole: With removable weatherproof cover.

Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washers, and hex nuts for each pole.

***The consultant shall provide foundation details on the drawings. No precast bases are permitted. (Use DFD approved pole base detail drawings.)***

**FOUNDATIONS**

Provide foundations for poles, bollards, and ground-mounted flood and accent lighting. Construct from reinforced concrete in sizes as shown on drawings and to meet the minimum structural requirements of SPS 362.1807 Shallow Post Foundations, and IBC 1807.3 Embedded Posts and Poles.

Place the anchor bolts in pole bases so that the luminaire will be oriented perpendicular to the curb/street/sidewalk/parking lot or as indicated on the plan.

Provide a concrete-encased electrode (UFER) grounding system for grounding the foundation, luminaire, and pole:

1. Provide twenty-five (25) feet of #4 bare stranded copper grounding electrode conductor.
2. Extend three (3) feet of the grounding electrode conductor out the top of the foundation for connection to the luminaire/pole.
3. Clamp the grounding electrode conductor to the top of the rebar cage. Use a clamp rated for such use such as an Erico EK16 or similar.
4. Spiral a minimum of ten (10) feet of the grounding electrode conductor around the outside of the rebar cage.
5. Loop the remaining conductor around the rebar cage at the bottom of the foundation in direct contact with earth.

The exposed surface area of the foundation shall have the forms removed and the concrete rubbed out to a smooth finish.

Pole Base J-Boxes

For pole bases with multiple conduits to other poles/locations, the contractor may provide a non-metallic j-box with a curved cover mounted in the side of the exposed part of the base to accommodate the multiple conduits. Boxes shall be NEMA 3R Carlon Nonmetallic Curved Lid J-Boxes or equal. Mount j-box centered at 20” above grade. Use only in poles 18” in diameter and larger. Locate boxes 90-degrees or 180-degrees from traffic. Install boxes per manufacturer’s recommendations.

**PART 3 - EXECUTION**

**INSTALLATION**

Install in accordance with manufacturers' instructions.

Minimum underground conduit size is 1 inch.

Underground and exterior wire shall be minimum #10 AWG conductors, type XHHW-2 or USE-2. Number 10 AWG conductors shall be utilized for vertical wire installed within pole and for overall circuit lengths of less than 100 LF.

Protect anchor bolts 2 inches (50 mm) minimum above base.

Install all anchor bolts and handhole fasteners with anti-seize compound.

Install poles plumb. Provide shims or double nuts to adjust plumb.

Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.

Bond each luminaire, each metal accessory, the UFER ground conductor and the pole to the branch circuit equipment ground conductor with a separate ground wire sized per NEC or as shown on the drawings.

Dimmed luminaire circuits shall have separate neutrals.

Dimmed luminaires shall have a positive OFF, which requires turning off the circuit to the luminaire so that the luminaires don’t “glow” at the lowest dimmed setting. This shall be accomplished using a switch, relay, or some other means acceptable to DFD.

**FIELD QUALITY CONTROL**

Operate each luminaire after installation and connection. Inspect for improper connections and operation.

**ADJUSTING**

Aim and adjust luminaires as indicated on Drawings or as directed by the A/E.

All new luminaires shall be operational at the Substantial Completion of the project.

**CLEANING**

Clean photometric control surfaces.

Clean finishes and touch up damage.

**CONSTRUCTION VERIFICATION**

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

# **AGENCY TRAINING**

All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

END OF SECTION