

Western Michigan University
Facilities Management – Engineering Division

Design Guidelines for Construction:

DESIGN GUIDELINE: DG26-2 EXTERIOR LIGHTING


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Western Michigan University Exterior Lighting Policy

Western Michigan University in its endeavor to meet quality lighting, safety and energy efficiency standards has developed this Exterior Lighting Design Guideline for new and redevelopment projects on University property.

The Design Guideline will be utilized on all new projects from this date forward by the University and its contracted Professionals.



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Effective Date

SECTION A: GENERAL EXTERIOR LIGHTING REQUIREMENTS

1. GENERAL DESIGN REQUIREMENTS

- A. These guidelines apply to campus exterior lighting. Requirements for lighting other areas (i.e. sports and athletic fields, interior lighting etc.) are not covered under this Guideline.

- B. The information presented in these Design Guidelines is for use by the Professional Service Contractor (Professional) in preparation of documents for the University. They are not to be inserted into the Professionals' specifications in this format. These are general design requirements and guidelines that apply to the Electrical Division of the University Guidelines. They represent the standard

practices and level of quality required for all University projects. Deviations from these Guidelines require written approval from the University's Facilities Management-Engineering Division.

- C. In some cases these guidelines may provide guidance only for equipment selection or design practices; where specific brands and models are given, they are considered University standard equipment and deviation from these standards requires approval in writing.
- D. When the Professional utilizes standard specifications and/or company standard specifications, any differences of materials and practices from these Guidelines shall be identified to the University's Facilities Management-Engineering Division.
- E. Additional Design Requirements are identified in the Design Guideline DG26-0; General Electrical Design Guidelines and are considered part of this Guideline.

2. QUALITY OF WORKMANSHIP & MATERIALS

- A. The selection, design, and specification of the materials and workmanship to be incorporated into the electrical systems of the project should respond to the demanding environment of a major educational institution providing reliable, durable, low maintenance, long-life usage, while recognizing the budget constraints for the project.
- B. General work practices for electrical construction shall be in accordance with NECA 1, standard practices for good workmanship in electrical construction.

3. INSPECTIONS

- A. The University's electrical engineer will conduct periodic inspections which may require the participation of the contractor(s). The Professional's specification for the project shall reflect this. During project close-out, the University's Facilities Management-Engineering Division will perform an inspection for final acceptance.

4. CODES AND STADARDS

- A. Codes shall be used as minimum requirement, and where these guidelines call for an installation that exceeds and does not violate the code requirements, these guidelines shall be followed.
- B. All designs and work shall conform to the Professional's Agreement, the National Electrical Code, Life Safety Code, IBC, ASHRAE 90.1 and State of Michigan requirements. In addition the design and installation shall comply with all the requirements of MIOSHA and OSHA.
- C. All materials used shall be new and conform to the standards of the Underwriter's laboratories in every case where such standards have been established for the particular type of material and/or application in question. All materials shall be labeled as UL listed.

- D. If applicable, the Professional's specifications shall require the electrical contractor to obtain and pay for all permits identified and required by the State of Michigan. Local codes and restrictions do not apply.

5. LIGHTING DESIGN REQUIREMENTS

- A. Design shall conform to WMU "General Electrical Design Guidelines" DG26-0 as applicable.
- B. Lighting systems shall be designed to provide uniform lighting throughout the area for adequate vision, comfort and safety with minimal dark patches or pockets while being arranged so as not to cause visual interference on public thoroughfares or encroach on the visual privacy of adjacent building occupants.
- C. A Photometric layout of the area, showing proposed light fixture types shall be submitted for approval. The layout shall show point by point foot-candle distribution on ten foot centers with a summary indicating Average, Minimum, Max/Min and Ave/Min values at grade. Where parking lot is next to the property line the calculation zone shall extend five feet beyond the property line. A Light Loss Factor (LLF) of 0.95 shall be used in the calculation.
- D. In areas where the streets, parking lots or walkways are next to property boundaries, public roadways, and/or non University property, poles shall be located, aimed and/or shielded in a manner such that illumination attributable to the area lighting system does not exceed local ordinance requirements. House side shields shall be provided where poles are within 50 feet of residence halls or as directed by the University.

5.1 Luminaires

- A. Each Luminaire shall consist of an assembly that utilizes LEDs as the light source. A complete Luminaire shall consist of a housing, LED array, and electronic driver (power supply) with surge protection.
- B. Each Luminaire shall be rated for a minimum operational life of 50,000 hours of operation at an average operating time of 11.5 hours per night.
- C. The rated operating temperature range shall be -30°C to +40°C.
- D. Luminaires shall be of uniform quality and appearance.
- E. Housings shall be cast aluminum, weather- and light-tight with hinged door and stainless steel hardware. All gasketing shall be closed cell neoprene. Housing shall meet IP66 rating.
- F. Luminaires shall comply with the following:

1. Field replaceable, 10kA rated surge suppression complying with IEEE C62.41, Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits.
 2. FCC 47 CFR Part 15, Federal Code of Regulation (CFR) testing standard for electronic equipment.
 3. IESNA LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products.
 4. IESNA LM-80, Approved Method for Measuring Lumen Maintenance of LED Light Sources.
 5. IESNA TM-15, Luminaire Classification System for Outdoor Luminaires.
 6. IESNA TM-21-11, Projecting Long Term Lumen Maintenance of LED Light Sources.
 7. UL1598, Standard for Safety of Luminaires.
 8. NEMA SSL 3-2010, High-Power White LED Binning for General Illumination
 9. ANSI/ G.NEMA SSL 3-2010. Binning of LEDs
 10. DLC Qualified and/or DOE Lighting Facts Listed.
 11. UL Listed.
 12. Photometric testing shall be in accordance with IESNA LM-80, certified by an independent laboratory. All IES data shall be available on-line.
- G. Fixture Finish – TGIC polyester powder coat paint, 2.5 mil nominal. Available colors shall be Gray and Natural Aluminum.
- H. Voltage – Luminaires shall be suitable for Universal Voltage 120/208 volts and 277/480 volts.
- I. Bi Level Control-Luminaires shall be suitable for Bi-Level Control as specified below.

5.2 Poles

- A. The light pole shall be a round, tapered aluminum pole, and shall meet the following requirements:
1. Seamless, extruded structural tube complying with ASTM B 429/B 429M, Alloy 6063-T6 with access handhole in pole wall.
 2. Shape: Round, tapered
 3. Handhole: Reinforced, flush, oval-shaped, with minimum clear opening of 4 by 6 inches (for 8" dia. Poles), with cover secured by stainless-steel captive screws. Located approximately 18" above base.
 4. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, listed for attaching grounding and bonding conductors and accessible through handhole.
 5. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
 6. Structural Characteristics: Comply with AASHTO LTS-4-M.
 7. Wind-Load Strength of Total Support Assembly: Adequate to carry support assembly plus luminaires plus banners, at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of 90 mph with a gust factor of 1.3. Support assembly includes pole, brackets, arms, appurtenances, base, and anchorage and foundation.

8. **Strength Analysis:** For each pole type and luminaire combination, multiply the actual equivalent projected area of luminaires, brackets and banners by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
9. Analysis shall include support of two – 2ft x 6ft banners mounted at 12ft above pole base to bottom of banner. EPA for each banner shall equal 10.44 square-feet and weighs 30 pounds.
10. **Anchor Bolts** – Comply with ASTM A576 with (2) nuts, (2) flat washers and (2) shims. Nuts, washers and threaded portion of bolts shall be hot dip galvanized.
11. **Finish:** Powder coat finish conforming to AAMA 2604 with 5 year warranty. Color shall match the luminaire.

B. Banners

1. All light poles shall be designed for the installation of banners.
2. Banners and banner arms will be furnished and installed by the University.
3. Banners typically will be 24” by 72” and supported via clamp on style mounts with stainless steel safety cables and/or flexible arms.

C. Controls

1. **On-Off Control:** Lights shall be controlled from a lighting contactor located as close to the power source as possible. Contactor shall be Square D Class 8903 or Siemens equivalent. Contactor enclosure shall be suitable for installed location and shall be minimum NEMA 1. The contactor shall be suitable for 120V control and connected to the nearest BAS panel. Programming of the BAS system will be by the University.

5.3 Installation

A. Clearances

1. Maintain the following minimum horizontal distances of poles from surface and underground features unless approved otherwise:
 - a. Fire Hydrants and Storm Drainage Piping: 60 inches.
 - b. Underground utilities, including but not limited to Water, Gas, Electric, Communication, Steam, Condensate and Sewer Lines: 5 feet.
 - c. Trees: 10 feet from tree trunk.

B. Concrete Foundations

1. Provide concrete foundations in accordance with WMU Design SD26-3 Site Lighting Pole Bases Design. Professional may modify the depth dimensions based on engineers calculations utilizing local soil information. The “Light Pole Concrete Base” design is a worst case design for all soil conditions.
 - a. Comply with details for reinforcement and for anchor bolts, nuts, and washers.

- b. Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Verify anchor-bolt templates by comparing with actual pole bases furnished.
- c. Finish for Parts Exposed to View: Trowel and rub smooth.
- d. Pole bases located within 6' of a plowed surface shall be the 3' above grade design. Poles located outside of the 6' dimension shall be 6" above grade.

C. Pole Installation

- 1. Raise and set poles using web fabric slings (not chain or cable).
- 2. Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
- 3. Ground metal poles and support structures. Install grounding electrode for each pole unless otherwise indicated.
- 4. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

D. Electrical Requirements

- 1. Field verify existing conditions as required to determine existing equipment locations, power source, available circuits, routing requirements, and all other information required to provide a complete electrical installation.
- 2. All wiring shall be THHN-THWN, installed in raceway. University Standard wire colors shall be used. Wire insulation shall be continuously colored per:
 - a. For 480/277v: Brown, Orange, Yellow, Gray neutral and Green for ground. (no phase tape)
 - b. For 208/120v: Black, Red, Blue, White neutral and Green for ground.
- 3. Underground Raceways shall be minimum 1", Schedule 40 PVC.
- 4. Interior raceways shall be EMT.
- 5. Each Pole/Fixture shall be fused in the base of the pole.
- 6. Common neutrals shall not be used.
- 7. Provide an insulated equipment grounding conductor in all raceways.
- 8. Building Wall Penetrations: Make a transition from underground conduit to rigid steel conduit at least 10 feet (3 m) outside the building wall without reducing slope away from the building, and without forming a trap in the line. Use fittings manufactured for PVC-to-steel conduit transition. Seal conduit penetrations at building walls.
- 9. Provide Polymer, fiberglass reinforced handhole, minimum 12"Wx15"Lx18"D with "ELECTRIC" label, between building and parking lot, located minimum 5 ft. from edge of parking lot.
- 10. Provide spare conduit from each pole base that is at end of circuit run.
- 11. Wire shall be sized for maximum 3% voltage drop.
- 12. Provide fuse unit at each pole base. Fuse holder shall be Bussmann HEG Series. Size fuse as recommended by fixture manufacturer.
- 13. Provide new lighting control contactors and extend control wiring to nearest BAS panel.
- 14. All conduit and wiring and electrical equipment which has been abandoned as part of the Work shall be disconnected from its power source and removed completely from source to outlet or equipment unless indicated otherwise

15. Patch conduit openings through walls, floors, ceilings, and roofs. Patches shall be suitable for the type of structure, match the existing construction and be installed by a craftsman of that trade.
16. Provide new lamicoid engraved nameplates for all new electrical equipment. New engraved nameplates shall match existing.
17. Each pole shall be wired with an inline fuse. The fuse holder shall be a Ferraz Shawmut SHR-1 300v, 15A. The fuses shall be Bussman, HFA 250v, 20A.
18. Wire nuts shall not be used in the pole bases. Connectors shall be Burndy BIT4 one sided unitap, sized for the wire used.

E. Field Quality Control

1. Inspect each installed unit for damage. Replace damaged units.
2. After installing conductors and cables and before electrical circuitry has been energized, test for continuity and grounds.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Field test all controls for proper operation. Where Bi-Level control is provided: If motion detector has sensitivity adjustment-set to maximum sensitivity. Set time delay to 10 minutes.
5. Field verify foot-candle light levels at night. Provide written report of results.
6. Restore areas disturbed by trenching, storing of dirt, cable installation, and other work. Restore vegetation and include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with University landscaping Standards.

6. SUBMITTALS

6.1 Schematic Design Submittals

An assessment of the existing lighting will be performed by the University and will be available for review.

6.2 Design Development Submittals

- A. Refer to WMU "General Electrical Design Guidelines" DG26-0 for Basic Requirements.
- B. In addition, provide a layout drawing of the proposed lighting that includes the following:
 1. Pole locations.
 2. Fixture Basis of design with Distribution Type and Wattage
 3. Calculations: A photometric layout of the site, showing proposed light fixture locations and fixture types shall be submitted for approval. The Layout shall show point by point foot-candle distribution on ten foot centers with a summary indicating Average, Minimum, Max/Min and Ave/Min values at grade. Where parking lot, road way or walk way is next to the property line

the calculation zone shall extend five feet beyond the property line. A Light Loss Factor (LLF) of 0.95 shall be used in the calculation.

4. Proposed circuit routing, control schematics and control equipment location.
5. Indicate fuse locations on drawings.

6.3 Shop Drawing Standards

- A. Furnish Manufacturers Specification Sheet for the following:
 1. Each Luminaire Type furnished, indicating full catalog number with included accessories, and options.
 2. Each Pole Type with Catalog number, dimensions, EPA rating, anchor bolt detail.
 3. Each control device.

6.4 Operating and Maintenance Manuals

- A. O&M manuals shall include procedures for the following:
 1. Replacement of fuses, LED light bars, drivers, Surge protection and any other replaceable device.
 2. Motion detector adjustment when detector is furnished.
 3. Recommended maintenance schedules.
 4. Spare parts list.

6.5 Warranties

- A. Luminaires shall be provided with a minimum 5 year warranty covering, LEDs, drivers, paint and mechanical components.
- B. Poles and associated parts shall be warranted against defects in materials and workmanship for a minimum period of one (1) year. Factory applied finish shall be warranted against cracking, peeling or excessive fading due to normal climatic exposure for a minimum period of five (5) years.
- C. Installation by contractor shall be warranted for a period of one (1) year from date of Owner acceptance.
- D. Warranties shall be submitted in writing at substantial completion of the project. Each warranty shall clearly state the warranty period with start and end dates.

6.6 Cleaning/Turnover

- A. Clean luminaire units after installation. Use methods and materials recommended by manufacturer.
- B. Vacuum out and wipe down all panels disturbed as part of the construction work.
- C. Touch up paint and clean all scratches and mars on poles.

SECTION B: STREET LIGHTING

1. BASIC DESIGN, MATERIALS & METHODS

1.1 Design

A. All University street lighting shall utilize a standard luminaire and pole height as specified herein, unless the University Facilities Management-Engineering Division directs otherwise.

B. Illumination levels on the street surface must meet the following:

1. Minimum level	-----	0.2 horizontal foot-candles
2. Average level	-----	1.0 horizontal foot-candles
3. Uniformity Ratio (Ave/Min)	-----	4:1
4. CRI	-----	>70
5. CCT (Color Temperature)	-----	Nominal 4000K

1.2 Products

A. Luminaires

1. Manufactures - Luminaires shall be one of the following:

- a. AEL- ATB
- b. Luthonia – DSX

B. Additional Pole Requirements

1. The light pole shall be a round, tapered aluminum pole, and shall meet the following additional requirements:

- a. Height: tall enough to mount the fixture 25 feet above base top.
- b. Mounting Provisions: A356 cast aluminum alloy Butt flange with base/bolt cover(s), for bolted mounting on concrete foundation. Bolt circle shall be nominal 11.5" dia.
- c. Brackets for Luminaires: Furnished with Luminaire. Pole provided with mounting plate and/or drilled to accommodate bracket. Attached with stainless-steel bolts.

2. Manufactures – Poles shall be one of the following:

- a. Valmont
- b. Hapco – SSKPO71111C
- c. Lithonia-RTA

C. Controls

All luminaries shall be furnished with individual light sensors for local on/off control.

SECTION C: PARKING LOT LIGHTING

1. BASIC DESIGN, MATERIALS & METHODS

1.1 Design

- A. All University parking lot lighting shall utilize a standard luminaire and pole height as specified herein, unless the University Facilities Management-Engineering Division directs otherwise.
- B. Illumination Level within the Parking Lots: Illumination levels on the parking lot surface must meet the following:

Minimum level	-----	0.5 horizontal foot-candles
Average level	-----	1.5 horizontal foot-candles
Uniformity Ratio (Ave/Min)	-----	4:1
CRI	-----	>70
CCT (Color Temperature)	-----	Nominal 4000K

1.2 Products

A. Luminaires

- 1. Manufactures - Luminaires shall be one of the following:

- a. McGraw-Edison: Ventus –VTS-B0# Series
- b. BetaLED: ARE-EDG Series
- c. Lithonia: Contour or DSX Series

B. Additional Pole Requirements

- 1. The light pole shall be a round, tapered aluminum pole, and shall meet the following additional requirements:
 - a. Height: tall enough to mount the fixture 25 feet above the top of the base.
 - b. Mounting Provisions: A356 cast aluminum alloy Butt flange with base/bolt cover(s), for bolted mounting on concrete foundation. Bolt circle shall be nominal 11.5" dia.
 - c. Brackets for Luminaires: Furnished with Luminaire. Pole provided with mounting plate and/or drilled to accommodate bracket. Attached with stainless-steel bolts.
- 2. Manufactures – Poles shall be one of the following:
 - a. Valmont
 - b. Hapco
 - c. Lithonia-RTA

C. Controls

Bi-Level Control – Each pole mounted luminaire shall be provided with a motion detector that provides two level control. The motion detector shall have minimum

50 foot diameter coverage with an adjustable time delay and shall be furnished as part of the luminaire assembly. When no motion is detected after the preset period of time the fixture light output shall be reduced approximately by half. Time delay shall be set to no less than 15 minutes.

All luminaries shall be furnished with individual light sensors for local on/off control.

SECTION D: WALKWAY LIGHTING

1. GENERAL DESIGN REQUIREMENTS

1.1 Design

A. All University walkway lighting shall utilize a standard luminaire and pole height as specified herein, unless the University Facilities Management-Engineering Division directs otherwise.

B. Illumination Level for walkways: Illumination levels on the walking surfaces within 50' of a street or parking lot must meet the following:

a. Minimum level	-----	.2 horizontal foot-candles
b. Average level	-----	1.0 horizontal foot-candles
c. Uniformity Ratio (Ave/Min)	-----	4:1
d. CRI	-----	>70
e. CCT (Color Temperature)	-----	Nominal 4000K

C. Illumination levels on the walking surfaces 50' or more from a street or parking lot must meet the following:

Minimum level	-----	.1 horizontal foot-candles
Average level	-----	.5 horizontal foot-candles
Uniformity Ratio (Ave/Min)	-----	4:1
CRI	-----	>70
CCT (Color Temperature)	-----	Nominal 4000K

1.2 Products

A. Luminaires

1. Manufactures - Luminaires shall be one of the following:

- a. Luminus – W769
- b. AAL Spectra – SP1 Indirect

B. Additional Pole Requirements

1. The light pole shall be a round, aluminum pole, and shall meet the following additional requirements:

- a. Height: tall enough to mount the fixture 16 feet above the top of the base.

- b. Mounting Provisions: A356 cast aluminum alloy Butt flange with base/bolt cover(s), for bolted mounting on concrete foundation. Bolt circle shall be nominal 10.5" dia.
- c. Brackets for Luminaires: Furnished with Luminaire. Pole provided with mounting plate and/or drilled to accommodate bracket. Attached with stainless-steel bolts.

2. Manufactures – Poles shall be one of the following:

- a. PAA-516-2 XM3042 + color #
- b. PR4-16'

End of Design Guideline