




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Design Directive

To: Distribution

From: Joseph A. Pavao, Jr., P.E. 
Acting Chief Engineer

Date: August 24, 2022

RE: Design Standards – Lighting Levels and Fixtures

Design submissions for all new construction and renovation projects for stations and facilities must design lighting levels and fixtures in accordance with the following table and text.

Project Managers for all Design firms, Consulting Groups and 3rd Party Engineering Review Groups are required to verify that this requirement is included in the designer's contract, and that all applicable codes and reference standards are utilized and listed on the code sheet in the drawing set. They will also schedule, coordinate, and document joint working sessions with the MBTA Office of the Chief Engineer, the MBTA Environmental Department and the MBTA Engineering and Maintenance Department at 30%, 60%, and 90% design reviews to ensure the design direction and to accommodate evolving technology as the design develops.

When a designer advises that any aspect of these requirements is not applicable to a project, an evaluation of the requirements must be made, and the Project Manager shall prepare the attached waiver request for signature by the Chief Engineer. The waiver request must be made in advance of any submittal to which it would apply.

Lighting System Criteria

The lighting system(s) shall be designed in accordance with the current MBTA Lighting Guideline along with all current applicable standards, AASHTO standards for highway signs and luminaires, NFPA standards, IESNA Recommended Practices and Guidelines (latest editions), and the Massachusetts Building and Electrical Codes. Other standards included by reference are also applicable, and the most stringent criteria shall govern where differing requirements exist.

Illumination Levels

Initial illumination levels for various areas shall be provided as shown in Table 1. The method for calculating these levels shall be in accordance with the IESNA Lighting Handbook (latest edition) and the ANSI/IES RP-8-18 (or latest edition) Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting with modifications or other requirements stated in this section. The "Point-By-Point" method of computing illumination shall be used to verify or confirm illumination and uniformity levels.

(In the event that conflicts occur between the IESNA recommended practices 'Lighting for Transport' and the MBTA requirements, the higher and more stringent of the two criteria will be designed to.)

Table 1

Location Type	MBTA Initial Illumination Level (Foot-candles at Finished Floor or Unfinished Grade)
Parking Lot - Revenue Collection Area	20
Parking Lot – Parking Area	6
Garage *	10
Outdoor Plazas	10
Bus Loading Zone	15
Exterior Pedestrian Walkways	10
Outdoor Entrance to Escalator and Stairway	35
Passageways	40
Stairways and Escalators	40
Entrance Lobbies	55
Fare Vending Machines	65
Fare Collection Array	65
CSA Booth	50
Platform Tactile Edge (Interior or Covered Platforms)	60
Platform Tactile Edge (Uncovered Platforms)	30
Customer Assistance Area	65
Waiting Area-Interior	45
Waiting Area -- Exterior (Covered)	30
Waiting Area – Exterior (Uncovered)	30
Starter's Room	40
Concession Area	40
Mechanical and Electrical spaces	40
Toilets	40
Storage Rooms	25
Bus Parking	6
Task lighting – depends on work being performed	50-100
Maintenance Track Pits	40
Tunnel	10

* For other locations within parking garages, use standards in this table for those areas.

Lighting Systems

The lighting system shall be designed with customer safety and system access as the main considerations along with minimizing initial capital cost and frequency and expense of maintenance. All lighting systems shall adhere to the following general requirements and all requested information shall be provided with the system lighting design.

- Product Data: For each type of lighting fixture, arranged in order of fixture designation, include data on features, accessories, finishes, and the following:
 - a. Physical description of lighting fixture, including dimensions.
 - b. LED power supply and driver data.
 - c. Energy-usage data (wattage).
 - d. Lamp photometric testing data. (LM-79 for LED)
 - e. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps (LM-80 and TM-21 for LED).
 - f. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, drivers, and accessories identical to those indicated in the specification.
 - g. Warranty information to be provided with each fixture specified (see warranty requirements below).
 - h. Written documentation showing that all fixtures being utilized have a minimum ingress protection of 66 (IP-66) as tested by IEC 60529.
 - i. Documentation for UL 1598 listing for Wet Locations on UL letterhead.
 - j. Documentation of 3G Vibration rating test results, per ANSI C136.31, for the specified luminaire, as appropriate.
- Energy Usage Documentation & Verification
 - a. Evaluate all lighting solutions to balance initial capital costs with energy consumption, with the goal of minimizing each without compromising MBTA lighting standards for illumination levels.
 - b. Document and provide Pre and Post design load studies, identifying energy savings.
 - c. Provide and document methods of verification to be utilized (lighting and control load summaries to be provided)
 - d. Document and provide return on investment (ROI) analysis for all proposed lighting solutions, should they deviate from the standard MBTA specifications.
 - e. Document and verify all proposed lighting in compliance with DLC standards.
- Life Cycle
 - a. Document all materials utilized within each fixture and verify the proposed materials ability to withstand corrosive and unconditioned environments.
 - b. Document and provide a life cycle analysis assuming a 35-to-40-year life span for the proposed lighting system.
- Manufacturers
 - a. Manufacturers of luminaires and controls shall have been in business for 10+ years; and have been engaged in research, development, and marketing of lighting products during those years.

- Existing Conditions
 - a. For work performed at existing MBTA stations, and prior to proceeding with any lighting design, a visual existing conditions study/survey needs to be performed and documented. The following are to be studied and documented:
 1. Quantities, types, and locations of existing lighting (functional and non-functional)
 2. Visual evaluation of the condition and functionality of all lighting fixtures (inclusive of gasketing, lensing, sockets, and mounting)
 3. Visual evaluation of the condition of the wiring
 4. Visual evaluation of the condition of the conduit
 5. Visual inspection of the lighting panel
 6. Visual evaluation of the condition of the controls and sensors
 7. Existing lighting levels
 8. Lamp types (technology, wattage, and color temperature)
 9. Any potential safety concerns, as they relate to the existing lighting and electrical equipment

Demolition Plans

- a. Plans identifying all existing lighting, wiring, conduit, and control equipment to be demolished or removed as part of the construction process need to be provided.

- Controls

- a. Provide point-of-use controls and, in areas where applicable, use daylight responsive controls, central lighting control systems, time clocks, photoelectric controls, lighting contactors, emergency shunt relays, and occupancy sensors.
- b. Occupancy sensors are not permitted in public spaces; appropriate innovative technology (such as astronomical timers) shall be used for control of luminaires in public areas, including sidewalk and parking lot areas, surface level transit stops, and any other outdoor areas.
- c. Lighting controls shall provide the means to automatically dim or turn off 30% of station interior lighting between the hours of 1:00 AM and 5:00 AM.
- d. For any lighting control, the system shall have “Fail On” functionality; in the event the control system malfunctions, illumination will still occur.
- e. Provide the following for design review:
 1. Cut sheets of all equipment specified.
 2. Interconnection diagrams showing field-installed wiring.
 3. Diagrams for power, signal, and control wiring.
 4. Load and Panel Schedules to include the following:
 - a) Actual connected load per circuit
 - b) Total connected load
 - c) Load type
 - d) Voltage per circuit
 - e) Circuits and their respective control zones
 - f) Circuits that are on emergency
 - g) System and panel capacity
 - h) Phase and corresponding circuit numbers.
 5. Schematic of system.
 6. Warranty information
- f. Require the following as Contractor Submittals:
 1. Cut sheets of all equipment.
 2. Interconnection diagrams showing field-installed wiring.

3. Diagrams for power, signal, and control wiring.
 4. Load and Panel Schedules to include the following:
 - a) Actual connected load per circuit
 - b) Total connected load
 - c) Load type
 - d) Voltage per circuit
 - e) Circuits and their respective control zones
 - f) Circuits that are on emergency
 - g) System and panel capacity
 - h) Phase and corresponding circuit numbers.
 5. Schematic of system.
 6. Warranty information.
 7. Start-up guides and user manuals.
 8. Verification of training time (time allotted).
- Emergency Lighting
 - a. Emergency lighting shall be provided to permit passenger egress from the station during loss of normal power. Emergency lighting shall be provided throughout the platform, stairs, ramps, pedestrian overpass, elevator areas, and entranceways in accordance with NFPA 101 minimum required illumination.
 - b. Power for exit and emergency lights shall be supplied from an approved emergency standby system.
 - c. Emergency power for lighting shall be capable of carrying their connected loads for a minimum of 24 hours.
 - Safety and Security
 - a. Any required illumination shall be arranged and wired so that the failure of any single lighting unit or circuit shall not leave the area in total darkness.
 - b. Poles and foundations shall be designed in accordance with AASHTO Standards for wind loading in the project area.
 - c. Satisfy both security requirements and the need to provide a pleasant environment.
 - Good Neighbor. Lighting shall be designed to avoid light "spill" and glare.
 - a. All site photometrics to include adjacent properties, with the lighting calculation grid continuing a minimum of 30' past the property line to demonstrate compliance.
 - b. Sectional and elevational studies showing no direct exitance of lighting from the proposed structure onto adjacent, non-MBTA properties, must be provided.
 - c. All lighting fixtures and pole placements, along with pole elevations, must account for light trespass. Unless specifically designated by the MBTA at the onset of the project, the lighting zone classification shall be from IES RP-8-18, Table 4.1. Light trespass shall comply with requirements in Table 4.2.
 - d. Exceptions may be made where MBTA stations are surrounded by roads and light trespass would not affect neighbors. At stations where neighbors are directly adjacent, where compliance with illuminance levels cannot be achieved without light trespass at the property line, the light trespass value shall apply to the house or dwelling instead of the property line.
 - e. Any 'house-side' shielding being utilized needs to be called out in the fixture specification.
 - f. Site lighting with a maximum 'U0' and 'G1' B.U.G. Rating classification shall be utilized.

- Calculations
 - a. Design illumination calculations shall be prepared for each area, space, or room (broken out per the “Initial Illumination Level” chart above), utilizing the following design criteria:
 1. Floor Reflectance – 20% maximum
 2. Wall Reflectance – 30% maximum
 3. Ceiling Reflectance – 50% maximum
 4. Light Meter – Horizontal Meter and Grid Setting
 - b. Design summary for each area to include the following information (per area, space, or room):
 1. Luminaire Schedule:
 - a) Luminaire Label (to match layout label)
 - b) Quantity
 - c) Total Lamp/Fixture Lumens
 - d) Total Lamp/Fixture Wattage
 - e) Light Loss Factor
 - f) Illuminating Engineering Society (IES) Distribution Classification
 - g) Backlight, Uplight, Glare (BUG) Rating
 2. Calculation Summary:
 - a) Average Illumination
 - b) Maximum Illumination
 - c) Minimum Illumination
 - d) Average/Minimum Ratio 3:1
 - e) Maximum/Minimum Ratio
- Warranty
 - a. All LED fixtures to be provide, by the manufacturer, with a 10-year non-depreciating warranty
 1. Manufacturer’s warranty shall agree to fully repair or replace lighting fixtures and standards that fail in finish, material, and workmanship within 10 years.
 2. The 10-year Warranty shall begin 90 days after shipment, this shall be stated in the warranty language.
 3. The manufacturer is to provide a statement to the Quality Assurance Manager that installation of their equipment meets their installation guidelines.
 4. Protection of Metal from Corrosion: Warranty against perforation or erosion of finish due to weathering.
 5. In the event of a systematic failure that affects more than 10% of the luminaires or their component parts, all material required to repair all affected fixtures will be provided. The materials and components can also be replaced at the Contractor's discretion.
 6. Claims against the warranty will be valid regardless of who performs the installation. The manufacturer will be allowed to inspect, at no cost to the MBTA, the initial installation of the product and after the time a repair has been made. The manufacturer has the right to waive these inspections prior to the final issuance of the warranty specified.
 - b. All dimming and control equipment to provide, by the manufacturer, with a 5-year non-depreciating warranty.

- Fixtures
 - a. All LED fixtures to be protected via a filter (in-line or integral to the fixture) to account for the presence of DC power in the electrical system and for unaccounted electrical surges (20kV/15kA min).
 - b. Luminaires shall have porcelain enamel, stainless steel, or other durable finish, with a successful, proven, and documented track record in transportation-related installations.
 - c. All fixtures shall include integral fusing and quick disconnects for driver removal without the use of tools.
 - d. Linear luminaires shall include solid frame, gasketed vandal-proof diffusers hinged on one side (i.e., not removable) to mitigate water and dust intake (IP66 rating, minimum).
 - e. Reflector-dependent luminaires will utilize reflectors with a minimum 90% reflectance.
 - f. All drivers will be rated for low temperatures (-40F).
 - g. All luminaires located over stairwells will have two power feeds and will go to full output during “emergency” situations or in the event of a power failure.
 - h. Lamp, fixture, and driver types will be minimized to the greatest extent possible.
 - i. Only LED luminaires with replaceable LED modules will be utilized. Manufacturers contact information and replacement module order code(s) will be located on all modules.
 - j. All lighting and LED modules to be provided with a consistent Correlated Color Temperature (CCT) of 4,000 Kelvin.
 - k. All lighting and LED modules to be provided with a minimum Color Rendering Index (CRI) of 80.
 - l. Incandescent, halogen, fluorescent (linear and/or compact), induction, high pressure sodium, low pressure sodium, metal halide, and mercury vapor lamps will not be utilized.
 - m. Fixtures shall have a minimum ingress protection of 66 (IP-66) as tested by IEC 60529.
 - n. Unprotected jumper cables between fixtures are not to be utilized, unless protected by Zero Halogen Low Smoke Conduit.

- Mounting
 - a. Interior fixtures are to be mounted no more than 20 feet above finished floor, or above stairs and escalators.
 - b. Exterior areas may utilize lighting above 20 feet, if readily accessible with a bucket truck. Max allowable mounting height of 40’.
 - c. The integration of lighting into handrails will not be allowed, without prior authorization by the MBTA.
 - d. The integration of lighting into escalators will not be allowed, without prior authorization by the MBTA.
 - e. In-ground/In-grade lighting will not be utilized, without prior authorization by the MBTA.
 - f. All lighting designs will take into account bird roosting and take measures to avoid roosting and nesting.

- Samples
 - a. During construction, samples of all proposed fixture types must be submitted for approval to the MBTA and the Engineer.

MBTA Pre-Approved Lighting Fixtures

The following is a list of MBTA reviewed and pre-approved manufacturers / luminaires, sorted by type. It is intended to provide guidance in the fixture selection process and does not preclude the use of other luminaires, assuming they comply with the above standards and requirements.

Fixture Type	Option A: Manufacturer / Series	Option B: Manufacturer / Series	Option C: Manufacturer / Series	Option D: Manufacturer / Series
Track Edge				
Pendants	Atlantic Lighting / Zoom	Apogee / "Bullnose" Series	ClearVu Lighting / Metro Platform	Picasso Lighting / SD18 Series
Surface	Atlantic Lighting / Zoom	Apogee / "Bullnose" Series	ClearVu Lighting / Metro Platform	Picasso Lighting / SD18 Series
Retrofit Kits	Match Manufacturer / or by Remphos Technologies	Match Manufacturer / or by Remphos Technologies	Match Manufacturer / or by Remphos Technologies	Match Manufacturer / or by Remphos Technologies

General Lighting - Linear				
Recessed	Metalumen / Rail 4 Outdoor	Kurtzon / VL Series	Eclipse / RFS Series	Finelite / HP WL Series
Pendant	Metalumen / Rail 4 Outdoor	Apogee / VR4	PAL / Microlinea - Series 3 Wet	Finelite / HP WL Series
Surface	Metalumen / Rail 4 Outdoor	Apogee / VR4	PAL / Microlinea - Series 3 Wet	Finelite / HP WL Series
Wall	Metalumen / Rail 4 Outdoor	Apogee / VR4	PAL / Microlinea - Series 3 Wet	Finelite / HP WL Series

General Lighting - Wrap Around	Kenall / EnviroSeal	LC Doane / VR LED 'VSA' Series	Apogee / 200 LED Series	Kurtzon / Vega Series
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Wall Wash - Linear				
Recessed	Metalumen / Rail 4 Outdoor	Finelite / HP WL Series	PAL / Microlinea - Series 3 Wet	Apogee / VR3
Pendant	Metalumen / Rail 4 Outdoor	Finelite / HP WL Series	PAL / Microlinea - Series 3 Wet	Apogee / VR4
Surface	Metalumen / Rail 4 Outdoor	Finelite / HP WL Series	PAL / Microlinea - Series 3 Wet	Apogee / VR4
Wall	Metalumen / Rail 4 Outdoor	Finelite / HP WL Series	PAL / Microlinea - Series 3 Wet	Apogee / VR4

Fixture Type	Option A: Manufacturer / Series	Option B: Manufacturer / Series	Option C: Manufacturer / Series	Option D: Manufacturer / Series
General Lighting - Round				
Surface	Kenall / Senscape Series	RAB / BAYLED	New Star Lighting / T-Series "TRO"	Signify Gardco / Softview Series
Pendant	Kenall / Senscape Series	RAB / BAYLED	New Star Lighting / T-Series "TRO"	Signify Gardco / Softview Series

Downlights				
Recessed	Kenall / LuxTran 6"	Kurtzon / WL Series	New Star Lighting / StarMed 'DLM6'	Williams / DR Series
Pendants	Luminis / Syrios Round	Gotham / Incito	WE EF / DAC240	FC Lighting / FCC Series
Surface	Luminis / Syrios Round	Gotham / Incito	WE EF / DAC240	FC Lighting / FCC Series
Wall	Luminis / Syrios Round	Gotham / Incito	WE EF / DAC240	FC Lighting / FCC Series

1x4's				
Recessed	LC Doan / RXS Series	Kurtzon / WL Series	New Star Lighting / StarClean V LED	Williams / MCT Series
Pendants	LC Doan / RXS Series	Kurtzon / WL Series	New Star Lighting / 53 LED Series	Williams / MCT Series
Surface	LC Doan / RXS Series	Kurtzon / WL Series	New Star Lighting / 53 LED Series	Williams / MCT Series

2x2's				
Recessed	LC Doan / RXS Series	Kurtzon / WL Series	New Star Lighting / StarClean V LED	Williams / MCT Series
Pendants	LC Doan / RXS Series	Kurtzon / WL Series	New Star Lighting / 53 LED Series	Williams / MCT Series
Surface	LC Doan / RXS Series	Kurtzon / WL Series	New Star Lighting / 53 LED Series	Williams / MCT Series

2x4's				
Recessed	LC Doan / RXS Series	Kurtzon / WL Series	New Star Lighting / StarClean V LED	Williams / MCT Series
Pendants	LC Doan / RXS Series	Kurtzon / WL Series	New Star Lighting / 53 LED Series	Williams / MCT Series
Surface	LC Doan / RXS Series	Kurtzon / WL Series	New Star Lighting / 53 LED Series	Williams / MCT Series

Flood Lights	Lumascap / LS9140 Series	Lumenpulse / Lumenbeam	WE EF / FLC Series	Insight / Spot Series
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Corner Mounted Linears	Kurtzon Lighting / VL 'COR' Series	Kenall / Mighty Mac 'TCD' Series	New Star Lighting / StarClean Series	Eclipse / SCS Series
Fixture Type	Option A: Manufacturer / Series	Option B: Manufacturer / Series	Option C: Manufacturer / Series	Option D: Manufacturer / Series
Utility Strip Lights	Remphos Lighting / LIV Series	Eaton / Line Series	Acuity / HZL & CLX Series	Kurtzon / WL-A Series

Utility Wall Sconces	RAB / VX Series	Hubbell / VTH Series	Eaton / VT Series	Phoenix Lighting / Cube Series
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Pit Lights / Work Lights	Kurtzon / Vega	Apogee / 200LED Series	Kenall / TES5 Series	New Star Lighting / Unger Series
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2' Emergency Lighting	Kurtzon Lighting / Vega 'D Series'	Apogee / 100LED Series	ClearVu / Metro Platform	LC Doane / VSB Series
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Exit Signs	Signal Tech / Outdoor LED Sign	LC Doane / Exit Series	New Star Lighting / Clean Room Exit ' ESC Series'	Emergi Lite / Survive All Series
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Post Tops				
Platform	Kenall / TopDek	Hubbell / Altitude - Size 2&3	RAB / ALED Series	Eaton / PRV Series
Parking Lot	Kenall / TopDek	Hubbell / Altitude - Size 2&3	RAB / ALED Series	Eaton / PRV Series
Pedestrian	Kenall / TopDek	Hubbell / Altitude - Size 1&2	RAB / ALED Series	Eaton / PRV Series

Sign Lighting	Lumascap / LS90 Series	i2Systems / V Line Series	Eaton / Line Series	Lumenpulse / Lumenfacade Series
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Controls	Lutron	Encelium	Acuity / nLight	Wattstopper
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