

This is a guidance document which was made for the U.S. General Services Administration ARRA PMO for standardization. Any use of this content would need to be edited for applicability to the specific agency and project goals.

Attachment X

Specifications

This specification document is part of a set of documents used for ARRA relighting projects. It is an attachment to the Statement of Work which is an attachment to the Commercial Item for Construction Contract. This document is used as applicable to the specific project scope.

Edit this document based on the blue guidance text.

LED PARKING LOT LIGHTING

PART 1 - GENERAL

1.1. REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by their basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO C-HSLTS – Structural Supports for Highway Signs, Luminaires, and Traffic Signals.
- C. American National Standards Institute (ANSI)
 - 1. ANSI C62.41.1-2002 – IEEE Guide on the Surge Environment in Low-Voltage (1000V and less) AC Power Circuits
 - 2. ANSI C62.41.2-2002 – IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000W and less) AC Power Circuits
 - 3. ANSI C82.SSL1 – SSL Drivers (in ANSI development)
 - 4. ANSI C136.31-2001 – American National Standard for Roadway Lighting Equipment – Luminaire Vibration
- D. American Society for Testing and Materials International (ASTM)

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1. ASTM A 36 – Structural Steel
 2. ASTM A 123 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 3. ASTM A 153 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 4. ASTM A 595 – Steel Tubes, Low-Carbon, Tapered for Structural Use
 5. ASTM F 1554 – Anchor Bolts, Steel, 36, 55, and 105-Ksi Yield Strength
 6. ASTM B117-97 – Standard Practice for Operating Salt Spray (Fog) Apparatus
 7. ASTM G53 – Standard Practice for Operating Light and Water Exposure Apparatus (Fluorescent UV – Condensation Type) for Exposure of Nonmetallic Materials
- E. Illuminating Engineering Society of North America (IESNA)
1. DG-13-98, Guide for the Selection of Photocontrols for Outdoor Lighting Applications
 2. G-1-03, Guidelines for Security Lighting
 3. LM-10-10, Photometric Testing of Outdoor Fluorescent Luminaires
 4. LM-31-95, Photometric Testing of Roadway Luminaires Using Incandescent Filament and HID Lamps
 5. LM-64-01, Photometric Measurements of Parking Areas
 6. LM-69-95 (R2002), Interpretation of Roadway Luminaire Photometric Reports
 7. LM-79-08, IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products
 8. LM-80-08, IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources
 9. RP-20-98, Recommended Practice for Lighting Parking Facilities
 10. RP-33-99, Recommended Practice for Lighting for Exterior Environments
 11. TM-15-07 (Revised), Luminaire Classification System for Outdoor Luminaires
- F. International Electrotechnical Commission (IEC)
1. IEC 60529 – Degrees of Protection provided by enclosures (IPCode)
- G. National Electrical Manufacturers Association (NEMA)
1. ANSI/NEMA/ANSLG C78.377-2008 – American National Standard for the Chromaticity of Solid State Lighting Products

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H. National Fire Protection Association (NFPA)

1. NFPA 70 – National Electrical Code

1.2. SITE LIGHTING SYSTEM PERFORMANCE

A. Light Loss Factors:

1. Luminaire must operate for a minimum of 50,000 hours before the Lamp Lumen Depreciation (LLD) is 0.70 (L_{70}).
2. Luminaire Dirt Depreciation (LDD) must be 0.90 or greater for all luminaires.

1.3. SUBMITTALS

A. Performance Reports – Submit the following for approval:

1. Luminaire photometric reports per IESNA LM-79-08 including: laboratory name, report number, date, luminaire catalog number, luminaire, and light source specifications. Report must contain lumen values in Backlight, Uplight, and Glare (BUG) zones per IESNA TM-15-07 and Roadway Type classifications, luminous Intensity, zonal lumen summary, and an iso-footcandle diagram per LM-31 as well as documentation that specified standards and test methods were followed.
2. Provide certification of one of the following:
 - a. LM-79-08 report at $T=0$ and at $T=6000$ hours with a summary table showing the percent lumen output change and percent input power change.
 - b. LM-80-08 test data for the LEDs at the three temperatures per LM-80-08. Provide extrapolation data using an exponential decay function to show the output at 50,000 hours. Provide the T_s value from the LM-79-08 and where the point falls in relation to the LM-80-08 extrapolated data. Interpolate between the LM-80-08 data for the T_s temperature.
3. Provide safety certification and file number as required for the luminaire family that must be listed, labeled, or identified per the National Electric Code (NEC). Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).

1.4. WARRANTY

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A. Special Warranties:

1. Provide a written **five year** warranty to include on-site replacement material, fixture finish, and workmanship. On-site replacement includes transportation, removal, and installation of new products. Finish warranty must include warranty against failure or substantial deterioration such as blistering, cracking, peeling, chalking, or fading.
2. Provide a written **five year** replacement material warranty for defective or non-starting LED source assemblies.
3. Provide a written **five-year** replacement material warranty on all power supply units (PSUs).
4. Provide a written **five year** replacement warranty on all light sources (LED package, LED array, or LED module) including, but not limited to the LED die, encapsulate, and phosphor for the LEDs lumen maintenance not achieving L₇₀ after 50,000 hours.
5. Warranty period to begin at substantial completion.

PART 2 - PRODUCTS

2.1. GENERAL

- A. Luminaires must be the type specified. Fixtures of the same type must be of a single manufacturer.
- B. All fixtures must be baked-on enamel or powder-coated, unless indicated otherwise.

2.2. LIGHT SOURCE REQUIREMENTS

- A. LED sources must meet the following requirements:
 1. Operating temperature rating must be between -40°C and +50°C
 2. Correlated Color Temperature (CCT):
 - a. Nominal CCT: 2700 K (2725 ± 145)
 - b. Nominal CCT: 3000 K (3045 ± 175)
 - c. Nominal CCT: 3500 K (3465 ± 245)
 - d. Nominal CCT: 4000 K (3985 ± 275)
 - e. Nominal CCT: 4500 K (4503 ± 243)
 - f. Nominal CCT: 5000 K (5028 ± 283)
 - g. Nominal CCT: 5700 K (5665 ± 355)
 - h. Nominal CCT: 6500 K (6530 ± 510)
 - i. Du'v' tolerance of 0.001 ± 0.006

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3. Color Rendering Index (CRI): greater than or equal to 65
4. Luminaire manufacturer must submit reliability reports indicating that the manufacturer of the LED (chip, diode, or package) has performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows:
 - a. High Temperature Operating Life (HTOL)
 - b. Room Temperature Operating Life (RTOL)
 - c. Low Temperature Operating Life (LTOL)
 - d. Powered Temperature Cycle (PTMCL)
 - e. Non-Operating Thermal Shock (TMSK)
 - f. Mechanical Shock
 - g. Variable Vibration Frequency
 - h. Solder Heat Resistance (SHR)

2.3. DRIVER REQUIREMENTS

- A. LED drivers must meet the following requirements:
 1. Drivers must have a minimum efficiency of 85%
 2. Starting Temperature: -40° C
 3. Electrical Characteristics

[In the following paragraph, select the voltage available at the project site.]

- a. Volts: [120] [277] [480].
- b. Phase: Single.
- c. Hertz: 60.
4. Power supplies can be UL Class I or II output.
5. Drivers must have a Power Factor (PF) of greater than or equal to 0.90
6. Drivers must have a Total Harmonic Distortion (THD) of greater than or equal to 20%
7. Drivers must comply with FCC 47 CFR Part 15 non-consumer RFI/EMI standards.
8. Drivers must be Reduction of Hazardous Substances (RoHS) compliant.
9. Drivers must comply with requirements in section 2.5 B Controls.

2.4. LUMINAIRE REQUIREMENTS

- A. General Requirements

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1. Electrical system cavity must be wet-location rated and be field accessible for service or repair needs.
2. Optical cavity must be a minimum IEC 60529/IP65.
3. The luminaire must have a **luminaire efficacy** greater than 40 LPW
4. Fully assemble and electrically test luminaires before shipment from factory.
5. Coating must be capable of surviving ASTM B117 Salt Fog environment for 500 hrs minimum without blistering or peeling. The coating must demonstrate gloss retention of greater than or equal to 90% for 500 Hrs exposure QUV test per ASTM G53 UVB313, 4 Hr UV-B 60 °C/4 hr Condensation 50 °C.
6. Luminaire arm bolts must be type 304 stainless steel or zinc plated steel and Grade 8.
7. Luminaires must have country appropriate governing mark and certification.
8. Color of the luminaire housing must be _____.
9. If a lens not integral to the LED is used, construct the luminaire optical enclosure (lens/window) of UV resistant, clear, polycarbonate, acrylic or glass.
10. 80% of the luminaire material by weight should be recyclable at end of life. Design luminaire for end-of-life disassembly.

B. Luminaire Distribution

1. Luminaires must produce a maximum of lumens in the various vertical angles as defined by IESNA TM-15-07 Section 4.0 Luminaire Classification System (LCS):

Table 1. Maximum Allowed Lumens in the Uplight Zone for Luminaires

Lighting Zone	Uplight Low (90° – 100°)	Uplight High (100° – 180°)
LZ0	0 lumens (U0)	0 lumens (U0)
LZ1	10 lumens (U1)	10 lumens (U1)
LZ2	100 lumens (U2)	100 lumens (U2)
LZ3	500 lumens (U3)	500 lumens (U3)
LZ4	1000 lumens (U4)	1000 lumens (U4)

Table 2. Maximum Allowed Lumens in the Glare Zone for Asymmetric Luminaires

Forward High	Forward Very	Back High	Back Very
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	(60° – 80°)	High (80° – 90°)	(60° – 80°)	High (80° – 90°)
LZ0	660 lumens (G0)	10 lumens (G0)	110 lumens (G0)	10 lumens (G0)
LZ1	1800 lumens (G1)	250 lumens (G1)	500 lumens (G1)	250 lumens (G1)
LZ2	5000 lumens (G2)	375 lumens (G2)	1000 lumens (G2)	375 lumens (G2)
LZ3	7500 lumens (G3)	500 lumens (G3)	2500 lumens (G3)	500 lumens (G3)
LZ4	12000 lumens (G4)	750 lumens (G4)	5000 lumens (G4)	750 lumens (G4)

Table 3. Maximum Allowed Lumens in the Glare Zone for Bilaterally Symmetric Luminaires

	Forward High (60° – 80°)	Forward Very High (80° – 90°)	Back High (60° – 80°)	Back Very High (80° – 90°)
LZ0	660 lumens (G0)	10 lumens (G0)	660 lumens (G0)	10 lumens (G0)
LZ1	1800 lumens (G1)	250 lumens (G1)	1800 lumens (G1)	250 lumens (G1)
LZ2	5000 lumens (G2)	375 lumens (G2)	5000 lumens (G2)	375 lumens (G2)
LZ3	7500 lumens (G3)	500 lumens (G3)	7500 lumens (G3)	500 lumens (G3)
LZ4	12000 lumens (G4)	750 lumens (G4)	12000 lumens (G4)	750 lumens (G4)

C. Mechanical Vibration

1. The luminaire must be subjected to 100,000 cycles of 2 Gs at the resonant frequency of the luminaire (between 5 and 30 Hz) applied at the center of gravity of the luminaire on 3 primary axes per ANSI C136.31 without:
 - a. Damage to the luminaire.
 - b. The luminaire must be fully functional upon completing the test.

D. Electrical System Requirements

1. Surge protection devices: Listed for compliance with UL 1449.

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2. Endurance testing: Capable of protecting against and surviving 250 IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C transients without failure.
3. Primary Fuse Protection: Provide Double Fusing with Fuse Holder appropriately sized to the current. Fuse voltage must be greater than or equal to line voltage Fuse holder to be easily accessible.
4. Under voltage protection via shutoff and short circuit protection via current limitation.
5. Internal luminaire design must include modular electrical connections.

E. Other Tests

[GSA can request additional tests per extreme environmental condition (e.g. sea salt near water, extreme cold weather operation in Alaska, etc...)]

1. <Insert test>.
2. <Insert test>.
3. <Insert test>.

2.5. CONTROL REQUIREMENTS

A. Daylighting Controls

1. All exterior parking lot, drive, and front aisle areas must be controlled with a combination Photocell plus Time Switch control system that allows automatic on and off based on daylighting plus timed off after expected parking lot activity ends. Photosensor is used to energize all luminaires at dusk, and to switch-off any security lighting left on overnight by Time Switch.
2. Furnish switches or relays in NEMA I General purpose enclosure unless noted otherwise. Switches located on the exterior or in "wet" locations must have NEMA 3R, 4, or 4X enclosures as noted or required.
3. The Photocell plus Timeswitch control system must have the following characteristics:
 - a. 15 to 30 second adjustable built-in time delay to prevent response to momentary lightning flashes, car headlights or cloud movements.
 - b. Use relays that are UL 773 or UL 773A listed and designed to fail in the on position.
4. The time switch(s) must control specific circuit "off" functions during dark hours and be:

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- a. Digital microprocessor-based with battery backup capable of retaining programmed settings for at least 10 hours.
- b. 7-day, 24-hour astronomic capable.

B. Additional Controls

C. Controls installed in addition to the Photocell plus Time Switch control system include but are not limited to:

1. After hours dimming control – dims light levels after expected parking lot activity ends (a.k.a. “curfew” control)
2. After hours switching control – turns off or reduces light levels after expected parking lot activity ends (a.k.a. “curfew” control)
3. Lumen maintenance – Luminaires are initially dimmed to 70% of full output, with input power then gradually (and automatically) increased over time to compensate for LLD.
4. Occupancy Sensor Controls
 - a. Occupancy/vacancy sensors shall comply with NEMA Standard WD 7-2000 which provides for testing requirements on the issues of performance sensitivity.
 - b. Ultrasonic Type: Integral to the luminaire. Detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
 - c. Sensor must incorporate a failsafe feature such that lamps fail “on” in the event of sensor failure.

D. End-of-Life

1. Provide End-of-Life mechanism into the luminaire. When the LED die output has reached end of useful life, the luminaire should enter a “failure mode”.

PART 3 - END OF SECTION