

SECTION 265619

LED LIGHTING

PART 1 GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior solid-state luminaires that are designed for and exclusively use LED lamp technology.
 - 2. Luminaire supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 SUBMITTALS

- A. Product Data: For each type of luminaire.
 - 1. Provide coversheet indicating project title, project location, and vendor contact information.
 - 2. Organize submittal into logical sections and provide table of contents.
 - 3. Provide itemized bill of materials indicating model number and quantity for each product.
 - 4. On datasheets with multiple products, indicate which product is provided under this project.
 - 5. Combine electronic submittals into one unified PDF document that is organized per the table of contents. The submittal shall be free of copyrighted files and proprietary file formats. Electronic links may be submitted to supplement product datasheets, but may not be used as a substitute for product datasheets that are required to be included in the unified PDF submittal.
 - 6. Manufacturers' catalog sheets with complete technical data for each item being furnished.
 - 7. Arrange in order of luminaire designation.

8. Include data on features, accessories, and finishes.
 9. Include physical description and dimensions of luminaire.
 10. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 11. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79 and IES LM-80.
 - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
 - b. Provide certification of one of the following:
 - 1) 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.
 - 2) 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 Ts 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 Ts temperature.
 12. Wiring diagrams for power, control, and signal wiring.
 13. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Sample warranty.
- C. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

1.5 QUALITY CONTROL

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.7 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:

- a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- 2. Warranty Period: Two year(s) from date of Substantial Completion.
 - 3. Warranty Period for Light Sources: Five year replacement material 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.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 1598 and listed for wet location.
- C. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- D. Bulb shape complying with ANSI C79.1.
- E. CRI of minimum 85. CCT of 3000 K.
- F. L70 lamp life of 75,000 hours.
- G. Lamps dimmable from 100 percent to 1 percent of maximum light output.
- H. Internal driver.
- I. Nominal Operating Voltage: 277 V ac.
- J. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- K. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LEDS

- 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
- 3. Color Rendering Index (CRI): greater than or equal to 85.
 - 4. Luminaire manufacturer must submit reliability reports indicating that the manufacturer of the LED (chip, diode, or package) has performed JEDEC (Joint Electron Devices Professional 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)

2.4 LED DRIVERS / POWER SUPPLYS

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.
 - a. Volts: as indicated on Luminaire Schedule.
 - 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 less than or equal to 10%.
- 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. Inrush current $<2A$
- 10. Sound rating: Inaudible in a 24 dB ambient.
- 11. Class P thermally protected.
- 12. Relative humidity: maximum 90% non-condensing.
- 13. Drivers with 0-10V dimming capability must be isolated and not allow current to leak between the power source and the 0-10V control circuit.

2.5 LED LUMINAIRES

A. Provide luminaires with integral LED thermal management system (heat sinking).

- B. Luminaires shall be equipped with an LED driver that accepts 120V through 277V, 50hz to 60hz (UNIV). Component-to-component wiring within the luminaire will carry no more than 80% of rated current and be listed by UL for use at 600 VAC at 302°F/150°C or higher. Plug disconnects shall be listed by UL for use at 600 VAC, 15A or higher.
- C. LED modules shall have a minimum L70 service life of 75,000 hours at 25°C ambient temperature and based on IESNA LM-80 methodology.
- D. Provide luminaires with individual LED arrays/ modules and drivers that are accessible and replaceable from exposed side of the luminaire. Luminaires requiring removal or replacement of entire luminaire to access LEDs and drivers will NOT be accepted.
- E. Luminaires efficiency shall be minimum of 70 lumens per watt.
- F. Warranty: 5-year warranty covering the LED arrays, and LED drivers.
- G. Continuous Flicker Free dimming range 100% to 1% measured relative light output.

2.6 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Stainless steel. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
 - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.156-inch (3.962 mm) minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
 - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 - 2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.7 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 2. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
- D. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 2. Powder coat shall comply with AAMA 2604.
 - a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.
 - b. Color: As selected by Professional from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.

- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Professional, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Fasten luminaire to structural support.
- C. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- D. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
- E. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- F. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- G. Coordinate layout and installation of luminaires with other construction.
- H. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - a. If 0-10V dimming does not perform to expectations, the contractor shall provide low pass filters at the 0-10V source to remedy performance issues.
- C. Luminaire will be considered defective if it does not pass tests and inspections.

- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.5 DEMONSTRATION

- A. Train Client Agency's maintenance personnel to adjust, operate, and maintain luminaires.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Professional.

3.7 CLEANING

- A. Clean units after installation. Use methods and materials recommended by manufacturer.

3.8 INTERIOR LUMINAIRE SCHEDULE

- A. See drawings for Light Fixture Schedule.

END OF SECTION 265619