STATE OF OHIO
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISIONS FOR
AESTHETIC LIGHTING LUMINAIRES, FURNISH & INSTALL
SUM-8-0175 (PID NO. 91710)
October 07, 2022

01 DESCRIPTION

01.1 Summary:

A. Section Includes:
   1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
   2. Luminaires for aesthetic lighting only.
B. Related work specified in other Sections of the Specifications includes:
   1. Related Electrical Sections
   2. Special Provisions For Aesthetic Lighting Controls, Furnish & Install.

01.2 Standards:

A. All applicable requirements of The State of Ohio govern work in this Specification.
B. Codes: Material and installation shall be in accordance with the latest revisions of the National Electrical Code and any applicable Federal, State, and local codes and regulations.
C. Listings: All fixtures shall be manufactured in strict accordance with the appropriate and current requirements of the National Electric Code as verified by Underwriters' Laboratories, Inc., or other testing agency as acceptable to local code authorities. Such a listing shall be provided for each

fixture type and the appropriate label or labels shall be affixed to each fixture in a position concealing it from normal view.

01.3 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 light output of light source, luminaire, or both.
F. Luminaire: Complete lighting unit, including light source, reflector, and housing.
G. Nit: Measured luminous intensity output of light source, luminaire, or both, expressed as one candela per square meter.

01.4 Work Included:

A. Furnish and Installation: Furnish and install all lighting fixtures in the locations shown on the drawings.
B. Furnish all materials: Furnish all materials, accessories, and any other equipment necessary for the complete and proper installation of all lighting fixtures included in this Contract.
C. Conformance: Fixtures shall be manufactured in strict accordance with the Contract Drawings and Specifications.
D. Intent: Specifications and scale drawings are only intended to convey the salient features, function and character of the fixtures, and do not undertake to illustrate or set forth every item or detail necessary for the work.
E. Details: Minor details, not usually indicated on the drawings nor specified, but that are necessary for the proper execution and completion of the fixtures, shall be included, the same as if they were herein specified or indicated on the drawings.
F. Responsibility of Fabrication: Accurate fabrication of the fixtures to the fulfillment of this specification rests with the Contractor and/or Manufacturer.

01.5 Design and Performance Requirements:

A. Lighting System shall be furnished, supplied, installed and adjusted in accordance with this Section and as specified on the Contract Documents
B. Components of the Lighting System manufactured, supplied, and installed shall comply with the requirements of NFPA 70, NFPA 101, all local codes and the requirements of OSHA.

01.6 Quality Assurance:

A. Entities manufacturing lighting fixtures, equipment, and components specified herein, and as shown on the Contract Drawings, shall have a minimum of five years of manufacturing experience and shall demonstrate prior experience on at least two projects involving complexities similar to those required under this Contract.
B. Lighting Equipment for which there is a nationally recognized standard shall be safety tested and bear the conformance labeling of the third party inspection authority, such as Underwriters

Laboratories Inc., ETL, Factory Mutual or approved equal, certifying that the lighting fixtures and equipment are listed as suitable for the purpose specified and shown on the Contract Drawings.

01.7 Delivery, Storage, and Handling:

A. Lighting fixtures shall be wrapped for protection during delivery, storage, and handling. Wet or damp wrapping shall be removed, disposed of, and replaced with dry wrapping materials to prevent staining finish.
B. Deliver materials in manufacturer's original, unopened, protective packaging.
C. Store materials in a manner to prevent soiling and physical damage, prior to installation.
D. Handle in a manner to prevent damage to finished surfaces.
E. Where possible, maintain protective covering until installation is complete and remove such coverings as part of final cleanup.

01.8 Submittals:

A. Shop Drawings
    1. For each lighting fixture type: Clearly illustrate assembly methods, detailed dimensions, mounting details, materials, finishes, electrical components, and light sources.
    2. For each lighting fixture type: Submit independent testing laboratory photometric report, and performance data in IESNA format:
        a. Luminaire, driver and lamp description and manufacturer's complete catalog number
        b. Luminaire drawing with basic dimensions
        c. Candela distribution table and curve
        d. Zonal lumen summary table
        e. Luminance summary table
        f. Input watts
        g. Luminaire efficiency and efficacy
    3. For each lighting fixture type support: Submit verification of compliance with seismic requirements of applicable codes.
    4. For each driver type: Submit manufacturer's data with description, catalog number, lamp type, input voltage, in-rush current, line current, input wattage, power factor, crest factor, minimum starting temperature, total harmonic distortion and wiring diagram.
    5. Product Data Sheets shall be submitted to the Department for all components (fixtures, DMX distribution hubs) for review and acceptance by the Department.
    6. The owner shall be supplied with an electronic copy of "as-built" drawings at the completion of the installation. These drawings shall be part of an operations and maintenance manual covering all major items installed.

B. Samples: For items indicated on the Contract Drawings submit working samples for review and approval upon request by the Engineer. Install and energize samples as shown on the Contract Drawings or as directed by the Engineer.

C. Substitutions
    1. The equipment specified is the result of efforts on the part of the owner to select equipment for reliability, ease of maintenance and suitability for the owners' purposes.

The bid shall be based upon these specifications, associated drawings, and other applicable contract documents.

2. All Substitutions must be approved by the ODOT.

01.9 Coordination:

A. Integration: Provide the services of a lighting controls “Integrator”, to ensure the successful coordination and performance of complex lighting systems such as digital addressable luminaires, sensors integrated into luminaires, dynamic lighting controls, DMX, scenes, shows, color-tuning and the like meets all the performance criteria of these contract document. Integrator shall view the contract documents, coordinate between disciplines, preview and review the shop drawing submittals, and commission the lighting system according to the contract documents.

01.10 Energization:

B. A qualified engineering representative employed by the system integrator shall visit the job site after installation is complete and prior to the energization of the system to inspect, test and adjust the system.
C. The system integrator shall instruct the owners' representatives in the operation and maintenance of the system. These services shall not exceed 4 days and shall be provided within 21 days written notice by the ODOT.

01.11 Field Conditions:

Locate exterior luminaires in accordance with plan location requirements.

01.12 Warranty:

Manufacturer agrees to repair or replace components of luminaires
that fail in materials or workmanship within specified warranty period.

02 MATERIALS

02.1 Products:

A. Products: Luminaires and components must have all of the salient characteristics outlined in this Performance Specification, including performance, durability, appearance, and size.
B. 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.
C. Aesthetic Lighting Data and Power Integration Hub for all fixture types: The Data and Power Integration Hub boosts the DMX data signal and allows a daisy-chain or star configuration. The data and power hub is required between the network switch and the fixtures. Electrical power and DMX inputs are combined into a single output. The DMX only output carries the lighting

control signal to the next box in the daisy chain. This component must be provided by the same manufacturer as the luminaires.

02.2 Materials - General:

A. The location, number, size, and type of all lighting fixtures and accessories to be installed shall be as shown on the Contract Drawings.
B. Manufacturer to provide results of salt spray testing to confirm that product complies with ASTM B117 corrosion resistance standards after 3,000 hours of exposure. Tests must be conducted with connections made to anchoring points to ensure that powder coat does not crack when connections are tightened.
C. Manufacturer to provide results of 3G vibration testing at bridge application acceleration level to confirm that product complies with ANSI C136.31 (or equivalent) Standards, including minimum testing of 100,000 cycles per axis for three axes. At the conclusion of the test, there should be no damage to the enclosure, reduction of electrical spacings, or loosening of any part of the Luminaire.
D. Luminaire and DMX distribution components to be manufactured and supplied by the same manufacturer.

02.3 Materials – Solid State Lighting Fixtures (LED):

A. General
    1. All fixtures shall conform with standards prepared by CIE, IES, UL, and other standards organizations as they apply to solid state lighting technologies, including but not limited to:
        a. 2-46 CIE/ISO standards on LED intensity measurements
        b. TC2-50 Measurements of the optical properties of LED clusters and arrays
        c. TC2-58 Measurements of LED radiance and luminance
        d. TC2-63 Optical measurement of High-Power LEDs
        e. TC2-64 High speed testing methods for LEDs
        f. IES LM-79-08 and LM-80-08
        g. RoHS
    2. Luminaires shall be listed and labeled for installation in wet locations by a Nationally Recognized Testing Lab (NRTL) acceptable to authorities having jurisdiction. The Ingress Protection (IP) rating for each luminaire must be acceptable for the specific installation conditions, but must be IP66 minimum.
B. Housing
    1. Lighting fixtures shall be of rigid construction, dimensionally stable, and shall be assembled with secure fastenings. Ferrous parts shall be protected from corrosion by plating or shall be finished with high reflectance enamel with non-yellowing binder and high pigment to binder ratio, with semi-gloss finish. Ferrous parts shall be prepared for finish by industry standard finishing process (see Finishes). Non-ferrous metals (e.g. aluminum) unless otherwise noted are to be treated with a semi-gloss polyester powder coat enamel finish.
    2. All materials, accessories, and other related fixture parts shall be new and free from defects which in any manner may impair their character, appearance, strength, durability and function, and be effectively protected from any damage or injury from the time of fabrication to the time of delivery and until final written acceptance of the work by the Owner.

3. All extruded aluminum fixtures and or components shall be fabricated of 6063-T3 alloy (min. wall thickness .120") or as otherwise noted on the drawings and in all cases shall be provided with heavy gauge internal alignment brackets in order to assure tight joints and a clean level and continuous appearance after installation. Unless otherwise noted, all end plates shall be continuously welded, filled and ground prior to application of final paint finishes so as to present a clean, seamless and monolithic appearance. Exposed fasteners on end plates shall be absolutely prohibited.
4. Metal Parts must be free of burrs and sharp corners and edges.
5. Castings: All aluminum, iron, or composite castings shall be exact replicas of the approved patterns and shall be free of sand pits, blemishes, scales and rust, and shall be smoothly furnished. Tolerance shall be provided for any shrinkage of the metal castings in order that the finished casting will accurately fit in their designated locations. Unless otherwise noted, for cast aluminum components use copper-free 319 or 443 aluminum alloy only. For cast iron components use ASTM Spec A48-83 Class 30 gray iron.
6. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging. All sheet metal work shall be free from tool marks and dents.
7. Welding: All welding shall be in accordance with recommendations of the American Welding Society and shall be done with electrodes and/or methods recommended by the manufacturers of the metals being welded. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth. All welds on or behind surfaces which will be exposed to view shall be done so that finished surfaces will be free of imperfections such as pits, runs, splatter, cracks, warping, dimpling, depressions or other forms of distortion or discoloration. All welded surfaces shall be free of weld splatter and welding oxides.
8. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use.
9. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during maintenance and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
10. Hardware and Fasteners: All fasteners at every product and assembly exposed to the elements shall be tamper resistant and stainless steel. For steel and aluminum fixtures not exposed to the elements, all screws, bolts, nuts and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel fixtures, all hardware shall be stainless steel. Whenever possible, fasteners shall be captive type. Where indicated provide tamper resistant fasteners.
11. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
12. Factory-Applied Labels: Comply with UL 1598. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles.
13. All fixtures with removable louvers, lenses, reflectors, refractors, cones or other shielding devices shall be supplied with integral safety chains. Installing contractor shall be responsible for insuring that all safety chains are securely fastened to shielding device and fixture housing.

C. Performance
    1. Luminaire performance claims shall be measured in accordance with the requirements of LM-79 and LM-80. The testing quantity for LED package lamps shall be a minimum of (20) twenty. The drive current and bin reference should be clearly documented. Manufacturer data to include:
        a. Luminaire lumen output
        b. Luminaire power
        c. Luminaire efficacy
        d. Correlated Color Temperature, CCT, and color shift over life (white LEDs)
        e. Color rendering index, and shift over life (white LEDs)
        f. Luminaire life including lumen depreciation and failure at specified ambient temperatures
        g. Luminous intensity distribution
    2. Luminaire efficacy should be calculated from the initial lumen output of the luminaire that has reached thermal stability operating in an ambient temperature of 25 degrees Celsius and based on the total power of the LEDs and driver circuit.
    3. Definition of life shall comply with Clause 10 IEC/PAS 62612. Life shall be based on lumen depreciation and failure and shall consist of an endurance test. It shall be clearly noted which part of life and lumen depreciation has been measured and what part has been calculated or extrapolated.
    4. Binning: LED binning shall guarantee a consistent color temperature within a 3-step MacAdam ellipse or no more than 5% variation from the specified CCT, whichever is less.
    5. Lumen Depreciation shall clearly document the length of time a complete LED luminaire provided more than a percentage of the rated luminous flux under standard test conditions. For illuminating luminaires the percentage shall be >70%, indicated as L70 (>70%). For direct view luminaires the percentage should be >50%, indicated as L50.
    6. Thermal Losses: The temperature of the p-n junction of the raw LED (die) (Tj) is to be measured at an ambient temperature of 25 degrees Celsius. In a luminaire the die will be operating at a higher temperature. All performance parameters are to measure the Junction Temperature and Board Temperature.
    7. Thermal Protection: All fixtures shall be provided with appropriate heat sink to maintain lamp life. Stated lamp life and output shall be measured, identified, and documented with heat sink. Any variations from stated life or output without heat sink shall be clearly identified including Junction Temperature.
    8. Color-changing luminaires utilizing discrete LED chips shall use an equal combination of each color of LED and shall be capable of a minimum of 8-bit control.

D. Photometry
    1. All fixtures shall be provided with absolute photometric tests and conducted in accordance with IES LM-79-08 Photometric Measurements of Solid State Lighting Products. Any deviations such as higher or lower drive currents or dies from other bins are to be clearly identified. Correction factors are to be provided with the results.

E. Lamp Module
    1. All manufacturer data to include LED module information including but not limited to:
        a. Manufacturer of the LED module with part number or other device identifier.
        b. LED module drive current, voltage, and power.
        c. LED module lumen depreciation curves, life, CCT, and CRI at an ambient temperature of 25 degrees Celsius.

d. Board temperature of the LED module installed in the luminaire with proper heat sink, when the luminaire is operating at an ambient temperature of 25 degrees Celsius.
e. The color bin, CCT, and color shift variation of the LED module at the operating board temperature.
f. Color rendering index at the operating board temperature.

2. All lamp modules must be field replaceable.
3. Unless otherwise noted, white LED lamp modules shall have a minimum CRI of 80 with tolerances as identified in Clause 7 IEC/PAS62612.
4. White LED modules shall be available in Correlated Color Temperatures as identified in lighting fixture schedule.

F. Lenses, Louvers and Diffusers
1. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
2. All lenses, diffusers, and shielding media shall be properly and securely mounted within fixture assemblies.
3. All fixtures with removable cones, louvers or other shielding devices shall be supplied with safety chains.
4. Unless otherwise indicated, all plastic shielding, lenses and diffusers shall be white, opal, or clear 100% UV stabilized virgin acrylic or polycarbonate.
5. Unless otherwise indicated, all glass shielding, diffusers or lenses shall be clear tempered borosilicate glass.
6. Glass used for lenses, refractors and diffusers shall be tempered for high impact and heat resistance.
7. Optical lenses shall be free from spherical or chromatic aberrations and other imperfections, which may hinder the functional performance of the lenses.
8. All lenses, louvers or other light diffusing elements shall be removable but positively held so that hinging or other normal motion will not cause them to drop out.

G. Finishes
1. Painted surfaces shall be synthetic enamel with acrylic, alkyd, epoxy, polyester or polyurethane base, light stabilized, baked on at 350 degrees Fahrenheit minimum, catalytically or photochemically polymerized after application.
2. Selection: Unless otherwise indicated, all external fixture finishes shall be as selected by the Lighting Consultant and/or Engineer.
3. Unless otherwise indicated, all fixture finishes shall be min. 4-mil semi-gloss polyester powder coat enamel.
4. Undercoat: Except for stainless steel all ferrous metal surfaces shall be given a five stage phosphate treatment or other acceptable base bonding treatment before final painting and after fabrication.
5. Unpainted non-reflecting surfaces shall be satin finished and coated with a baked-on clear lacquer to preserve the finish. Where aluminum surfaces are treated with an anodic process, the clear lacquer coating may be omitted.
6. Unpainted aluminum surfaces: Finish interior aluminum trims with an anodized coating of not less than 7 mg per square inch, of a color and surface finish as selected by the Lighting Consultant/Engineer. Finish exterior aluminum and aluminum trims with an anodized coating of not less than 35 mg per square inch of a color and surface finish as selected by the Architect/Engineer.

H. Metal finishes: Provide finishes of the color and type indicated and having the following properties:
    1. Protection of Metal from Corrosion: 5-year warranty against perforation or erosion of the finish from weathering.
    2. Color Retention: 5-year warranty against fading, staining, or chalking from weathering including solar radiation.
    3. Uniformity: Provide finish of uniform thickness and color, free from streaks, stains or orange peel texture.
    4. All exterior finishes must be corrosion resistant for the conditions expected at the project site, including road salt, marine environments and other corrosive conditions.

I. Spare Parts
    1. Provide 10 percent of each type of fixture for support parts, with a minimum of one. If the number of a type of fixture to be provided ends with a fraction, provide the whole number plus one.
    2. Provide 10 percent of each type of LED module for support parts, with a minimum of two. If the number to be provided ends with a fraction, provide the whole number plus one.
    3. Provide 10 percent of each type of LED driver, power supply, transformer, or data/power hub for support parts, with a minimum of two. If the number to be provided ends with a fraction, provide the whole number plus one.

J. Warranty
    1. Entire fixture shall carry a minimum 5 year warranty with a labor allowance for premature failure.

02.4 Luminaires:

Refer to luminaire schedule in lighting drawing sheet for luminaire details.

02.5 LED Power Supplies/ Drivers:

A. LED driver shall have a minimum 50,000 hour published life while operating at maximum case temperature and 65 percent non-condensing relative humidity.
B. Driver shall be Sound Rated A+.
C. Driver shall be > 80% efficient at full load across all input voltages.
D. Driver shall include ability to turn off at low control input rather than holding at a minimum dimming level and shall consume 0.5 Watts or less in standby/off mode. Control deadband at low control input shall be included to allow for voltage variation of incoming signal without causing noticeable variation in luminaire to luminaire output.
E. Drivers shall track evenly across multiple luminaires at all light levels and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range.
F. Control Input:
        a. Digital Multiplex 512 (DMX Low Voltage Controlled) Dimming Drivers
            1) Must meet DMX / RDM: USITT DMX512A and ANSI E1.20 (Explore & Address).
            2) Must be capable of signal interpolation and smoothing of color and intensity transitions.

02.6 Notes:

G. It is the responsibility of the contractor to coordinate the luminaires specified with the area to be installed, regardless of any catalog numbers shown. Any discrepancies should be brought to the attention of the design team immediately.
H. All luminaires shall meet the requirements of Underwriters Laboratories for the location in which it is used. If U.L. listing for the complete luminaire is waived, the electrical components of the luminaire shall meet U.L. requirements as a standalone product.
I. It is the responsibility of the contractor to assure that all luminaires are in accordance with all applicable local and national electrical codes.
J. Any discrepancy between the lighting design documentation and any other project documentation should be brought to the attention of the design team immediately.

03 CONSTRUCTION REQUIREMENTS

03.1 Examination:

Inspect all lighting fixtures, equipment, and accessories prior to installation. Replace any damaged items.

03.2 Preparation:

The Contractor shall be responsible for field verification of dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing lighting fixtures.

03.3 Installation:

A. Install all lighting equipment and accessories, as well as all lighting fixtures, complete with lamps, in the locations shown on the Contract Drawings in accordance with the manufacturer's written instructions. All lighting fixtures shall be properly secured to structural elements.
B. Lighting fixtures shall be carefully supported and aligned with necessary hangers, hardware and supporting members for proper installation, all as shown in the Contract Drawings and the Specifications, and as approved by the Engineer.
C. All lighting fixtures shall be properly wired and connected to branch circuits, tested, and left ready for operation. Bond all lighting fixtures and metal accessories to the branch circuit-grounding conductor.

03.4 Adjustments:

Prior to final inspection, contractor shall replace all lighting fixtures which have failed without any cost to the owner.
A. Contractor shall leave all lighting fixtures and accessories in good, uniform operating condition.
B. The Contractor shall replace any failed lighting fixtures during the first 100 days after the completion of the Contract without any cost to the owner.
C. Cleaning
    1. Contractor shall clean all components of the lighting system to remove conductive and deleterious materials.
    2. Contractor shall remove dirt and debris from all fixtures and lenses. Contractor shall clean finishes and touch up damage.

D. Position and lock all lighting fixtures as shown on the Contract Drawings.
E. Contractor shall focus and adjust any adjustable luminaires, at a time mutually agreeable to Contractor, Lighting Designer, Engineer and Owner. Adjustments shall be made in accordance with the Lighting Designer's intent and on site observations. Focusing shall occur after dark.
F. Contractor shall provide road closures, bucket trucks, lifts, tools, Loctite and all other materials required to complete adjustments.

03.5 Comissioning:

A. Solid State Lighting / Light Emitting Diode LED luminaires:
    1. Color Changing or Programming Support
        a. Manufacturer shall provide installation and commissioning support to the electrical contractor as required to achieve a complete and operational system that meets the intent of the Control Intent Narrative.
        b. The lighting controls Integrator shall assist the Contractor and ensure that the color changing system is installed, programmed and operating correctly, that all integral sensors are functioning properly and to verify luminaire performance. Integrator shall coordinate with contractors, other required disciplines and with luminaire manufacturers to ensure that the lighting color-changing and/or control system is coordinated between the various disciplines for a fully functioning system. Commissioning shall include intermittent testing of lighting system and other components during the process of construction, as well as up to __Two (2) full days of programming sessions with the owner's representatives and lighting designer. This shall be subsequent to the final completion of system start-up. Additional programming days may be added as required.
        c. Two (2) full day follow up site visits shall be provided by the Commissioning Agent and Integrator to ensure lasting functionality update of the lighting control system. The first visit shall take place three (3) months after installation and the second shall take place one (1) year after the installation.

03.6 Warranty:

Warranty shall cover repair or replacement of such parts determined defective upon inspection

04 METHOD OF MEASUREMENT

04.1 Aesthetic Lighting Fixtures:

The quantities to be paid for will be the quantities of complete fixtures as specified and shown on plans.

04.2 Mounting Hardware for Yoke Fixtures:

Yoke mount for fixture types F1 Series specified per individual fixture is integral to the specified fixture. The quantities to be paid for will be included with the quantities of complete fixtures as specified and shown on plans to withstand 3G vibration (ANSI C136.31 vibration rated).

04.3 Mounting Hardware for Surface Fixtures:

Fixtures types F2 Series will be mounted using stainless steel mounting bolts. The quantities to be paid for will be included with the quantities of complete fixtures as specified and shown on plans to withstand 3G vibration (ANSI C136.31 vibration rated).

04.4 Loc-Tite:

Apply Loc-Tite or similar after fixture installation and final aiming to lock luminaires in position permanently.

END OF SECTION