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1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
 2. Handle lockable in OFF position.
- C. Enclosures: NEMA KS 1.
1. Interior Dry Locations: Type 1.
 2. Exterior Locations: Type 3R.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install fuses in fusible disconnect switches per manufacturer's nameplate rating.
- C. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.02 FIELD QUALITY CONTROL

- A. Inspect and test each switch per manufacturer's recommendations.

SECTION 26 5113 INTERIOR LUMINAIRES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior luminaires and accessories
- B. LED Drivers
- C. Emergency power supply
- D. Emergency Transfer Device

1.02 REFERENCES

- A. Meet ANSI (American National Standard) standard requirements
- B. Install per NECA (National Electrical Contractors Association)
- C. Meet NEMA (National Electrical Manufacturers Association) standard requirements
- D. Install per NFPA 70 (National Electrical Code; National Fire Protection Association)
- E. Install per NFPA 101 (Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association)
- F. RoHS – Restriction of Hazardous Substances. Council of the European Union (EC) Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
- G. DLC
- H. Energy Star
- I. LM-79-08 (or latest) – IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
- J. LM-80-08 (or latest) – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- K. TM-21-11 (or latest) – IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.
- L. NEMA SSL 1-2010 (or latest) – Electronic Drivers for LED Devices, Arrays, or Systems.

1.03 SUBMITTALS

- A. See Section 26 0500 - Basic Electrical Requirements - Submittal procedures.
- B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- C. Verify the type of ceiling and suspension method prior to ordering fixtures.
- D. Product Data: For each luminaire type, submit luminaire information including catalog cuts with highlighted catalog numbers and required accessories:
- Luminaires:
 - o Manufacturer and catalog number,
 - o Type (identification) as indicated on the plans and schedule,
 - o Delivered lumens,
 - o Input watts,
 - o Efficacy
 - o Color rendering index.
 - Driver:
 - o Manufacturer and catalog number,
 - o Type (Non-Dimming, Step-dimming, Continuous dimming, etc.),
 - o Power Factor, Crest Factor, THD, etc.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation and Maintenance Data: Instructions for each product.

1.04 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70 and NFPA 101.
- B. LED Luminaires shall meet all Design Lights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the Design Lights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category are:
- o Minimum Light Output.
 - o Zonal Lumen Requirements.
 - o Minimum Luminaire Efficacy.
 - o Minimum CRI.
 - o L70 Lumen Maintenance.
 - o Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
- C. Energy Star Listed
- D. Luminaire shall be certified by a Nationally Recognized Testing Laboratory (UL, ETL, or IEC).
- E. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' experience.
- F. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.05 UNIT PRICING

- A. Provide unit pricing for all single name specification fixture types.

PART 2 PRODUCTS

2.01 LUMINAIRES

- A. Furnish products as indicated in Schedule included on the Drawings. If the fixture designation is omitted from a light fixture, assume a fixture of the type used in similar areas in preparing Bid. Confirm type with Owner's Representative prior to ordering.
- B. Substitutions: See Section 26 0500 – Basic Electrical Requirements: Product Substitutions.
1. Pre-Qualification of contractor –offered substitutions are required (7 days prior to bid date. Failure to submit within the deadline constitutes a guarantee that only the base specified product(s) will be supplied and no other products will be considered.
 - Provide calculations showing performance of proposed fixture, coordinate with engineer for reflectance's and architectural components that may affect light level, and provide photometric file in .ies format to Engineer.
 - Provide PDF submittal of proposed substitution to engineer.
- C. Refer to fixture schedule for lamping of fixture. Manufacturer to label all fixtures as maximum allowable socket wattage per lamping noted in schedule. This is for current and future LEED documentation purposes.

2.03 LED LUMINAIRES

- A. Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a maximum 5-step MacAdam Ellipse binning process.
- B. Glare Control: Exterior luminaires shall meet DesignLights Consortium's® criteria for Zonal Lumen Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.
- C. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- D. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RF/EMI standards.
- E. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
- F. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
- G. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- H. Luminaire and driver shall be furnished from a single manufacturer to ensure compatibility.
- I. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires or as noted on light fixture schedule.
- J. LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -20°F to 122°F (-29°C to 50°C)
- K. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- L. Luminaire shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.
- M. All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
- N. All luminaires shall be provided with knockouts for conduit connections.
- O. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).

- P. Provide all of the following data on submittals:
- a. Delivered lumens
 - b. Input watts
 - c. Efficacy
 - d. Color rendering index.
- Q. The failure of one LED shall not affect the operation of the remaining LEDs.
- R. Emergency Inverters shall be sine-wave type, or have written confirmation from the luminaire manufacturer that the luminaire will function with a square-wave inverter.

2.04 LED DRIVERS

- A. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated on the luminaire schedule on the drawings.
- B. Minimum Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
- C. Driver shall have a rated life of 50,000 hours, minimum.
- D. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
- E. Driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
- F. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- G. Driver shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.
- H. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance. Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
- I. Provide all of the following data on submittals:
- a. Input watts
 - b. Power Factor (pf)
 - c. Crest Factor (cf) at full input power
 - d. Total Harmonic Distortion (THD).
- K. LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC) or Pulse Width Modulation (PWM) operation.
- L. Continuous Dimming Drivers: LED luminaires shall dim to (20%, 15%, 10%, 5%, or 0.1%) as specified in the Luminaire Schedule on the plans without visible flicker or "popcorn effect". "Popcorn effect" is defined as the luminaire being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre-set level when power is returned to the luminaire. Continuous Dimming Drivers shall use 0-10V control.

PART 3 EXECUTION

- A. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).
- B. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- C. Support luminaires larger than 2 x 4-foot size independent of ceiling framing, unless local codes require all fixtures to be supported independent of ceiling framing.
- D. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- E. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- F. Exposed Grid Ceilings: Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.
- G. Install recessed luminaires to permit removal from below.
- H. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- I. Install clips to secure recessed grid-supported luminaires in place.
- J. Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated on Drawings.
- K. Install accessories furnished with each luminaire.
- L. Connect luminaires and exit signs to branch circuit outlets provided under Section 26 0537 as indicated.
- M. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- N. Bond products and metal accessories to branch circuit equipment grounding conductor.
- O. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.
- P. Install downlights with clean gloves on. No fingerprints should be seen on downlight reflectors.
- Q. Dimmed luminaire circuits shall have separate neutrals.
- S. Dimmed LED luminaires shall have a positive OFF, which requires turning off the circuit to the luminaire so that the luminaires don't "glow" at the lowest dimmed setting. This shall be accomplished using a switch, relay, or some other means acceptable to DFDD.
- T. Fixtures shall not be turned on unless temperatures are above 50 degrees unless cold weather rated ballasts are utilized.
- U. Provide controls as indicated on the plans. Controls shall be compatible with the drivers being installed

3.02 ZERO-TO-10V DIMMING CONTROL WIRING INSTALLATION

- A. Zero-to-10V dimming control conductors are classified by the NEC as Class 2 conductors and shall be kept separate from line-voltage conductors per NEC 725.136(A). Matching the insulation rating of Conductors of Different Systems does not apply to Class 2 conductors per NEC 300.3(C)(1). Informational Note No.1
- B. Wall box dimmers will typically have two conduits: One conduit for line-voltage power, and one conduit or conduit stub for the 0-10V control wiring.
- C. The 0-10V wiring may be routed in free air if:
- The room is approximately 900 sq. ft. or less,
 - The 0-10V wiring stays within the room,
 - The ceiling space is a non-plenum space, and
 - All splices of 0-10V wiring are spliced in a box.
 - The 0-10V wiring may be tie-wrapped to the outside of the luminaire fixture whip per NEC 300.11(B)(2). Tie-wraps shall be UL listed for UV resistance.
- D. At each luminaire, separate openings (either manufactured knock-outs or punched openings) shall be used for the line-voltage power and the 0-10V wiring. The EC shall use an NM cable connector at the opening for the 0-10V wiring. Zero-to-10V conductors entering and within a luminaire enclosure shall maintain a minimum separation of 6 mm (0.25 in.) per NEC 725.136(D).
- E. METAL-CLAD (MC) CABLE
- Metal-Clad (MC) type cable that combines power and Class 2 circuits into a single cable may be used for the luminaire wiring within a single room. Examples of such products are Encore Wire® MC-LEDTM or Southwire® MC-PCS DuoTM. Manufacturer's names and catalog numbers are used for quality and performance only. MC Cables manufactured by others shall be equally acceptable provided they meet or exceed in performance and quality as specified.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection to verify all fixtures are operational.
- B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.04 CLEANING

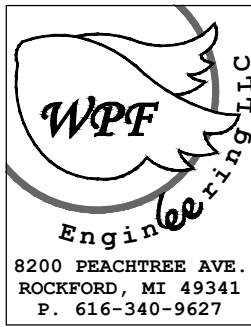
- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

3.05 SCHEDULE - See Drawings

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E704