SECTION 265100 LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes interior and exterior luminaires, emergency lighting units, exit signs, lamps, ballasts, drivers, and accessories.

B. CCT: Correlated Color Temperature. The standard unit of color temperature measurement is expressed in Kevin (K)

C. CRI: Color Rendering Index. A method for describing the effect of light source on the color appearance of objects.

D. Fixture: See "Luminaire."

E. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

F. LED: Light Emitting Diode. A solid-state semiconductor device that allows current to flow in one direction and convert electrical energy to visible light.

G. LED Arrays: A combination of LEDs on a circuit board. LED arrays may require additional optics, housings and/or heat sinks. A separate power supply is required. LED arrays are typically integrated into a luminaire.

H. LED Module: A combination of LEDs on a circuit board with an integrated optic and /or heat sink. A separate power supply is required. LED modules are typically integrated into a luminaire.

I. Lumen: Measured output of lamp and/or LEDs and luminaire, or both.

J. Luminaire: Complete lighting unit, including lamp and/or LEDs, optical components, power supplies, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include battery and charger data for emergency lighting units.
5. Include lamp life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Include driver / ballast data, including ballast factor.

7. Photometric data and adjustment factors based on laboratory tests, complying with IESNA 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.

    a. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
    b. LED products are tested in accordance with IESNA LM-79-19. Include L70 performance results.

8. Submit project-specific, factory-produced shop drawings for linear LED mounted in continuous rows. Drawings shall show housing lengths, LED layout, joiners, supports, endcaps, corners, and unlighted end sections, as applicable, for all unique row lengths, suspension installation hardware or components.
9. Submit dimming compatibility certificates signed by the lighting control system manufacturer certifying that proposed dimming drivers are compatible with proposed dimming systems.
10. Manufacturer shall provide submittals with fixture installation instruction sheets.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal and control wiring.

D. Samples as required: For each luminaire and for each color and texture with standard factory-applied finish.

1. Include Samples of luminaires and accessories to verify finish selection.
2. Lamps or LEDs, installed.
3. Cords and plugs.
4. Pendant support system.
5. Unless otherwise noted, all samples shall be provided with specified lamp(s) and/or LEDs and ballast(s) and/or drivers and equipped with a cord and plug for operation at 120V.

E. Product Schedule: For luminaires, LEDs and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.

3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches (300 mm) of the plane of the luminaires.
4. Structural members to which equipment and or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

    a. Other luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Ceiling-mounted projectors.
    g. Fire Alarm Devices

7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
2. Ballasts: Three for every 100 of each type and rating installed. Furnish at least one of each type.
3. Luminaire-mounted emergency battery pack: One for every 50 emergency lighting units.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.
5. LED's: One for every 40 of each type and rating installed. The spare component shall be the smallest discrete element that the manufacturer recommends servicing in the field without voiding the warranty. In some cases, this will be a snap-in diode. In other cases, it will be a replacement fixture. Furnish at least one of each type.
6. LED drivers: One for every 40 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

D. Comply with NFPA 70 as amended by state and local codes.

E. Electrical Components of luminaires are listed and labeled by UL where applicable.

F. Provide luminaires and accessory components specified in this Section that are listed and labeled for their indicated use and installation conditions on Project.

1. Luminaires specified for installation in damp or wet locations are listed and labeled for use in such locations.
2. Luminaires specified for installation in insulated ceilings are IC-rated if insulation comes within 3 inches (76 mm) of sides of luminaire housings, or within 6 inches (152 mm) of top of luminaire housings.
3. Luminaires specified for installation in hazardous locations conform to UL 844.

1.9 DELIVERY, STORAGE, AND HANDLING

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

1.10 COORDINATION

A. For ceiling-mounted luminaires, coordinate luminaires, mounting hardware, and trim with ceiling system and other items, including work of other trades, which must be mounted on ceiling or in ceiling space.

B. Luminaires, ballasts, drivers, lamps, LEDs and other components meet or exceed the requirements of all applicable federal, state, and/or municipal energy codes.

C. Coordinate lamps and dimming ballasts or LEDs and drivers with lighting control systems. Before ordering any equipment, verify with manufacturers that proposed dimming ballasts or drivers are compatible with proposed lighting controls, and that proposed lamps are compatible with proposed dimming ballasts or drivers.

1.11 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. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty for Light Emitting Diodes: Manufacturer's standard form in which manufacturer agrees to repair or replace products which fail in materials or workmanship within specified warranty period.

1. Warranty Period for Light Emitting Diodes: Five years from date of Substantial Completion.
2. Warranty Period for Light Emitting Diode Power Supplies and Drivers: Five years from date of Substantial Completion.

C. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with project requirements, luminaires and related lighting controls requirements are specified in the Luminaire Schedule as basis of design. General Contractor to provide equivalent or better where substitution may be required.

B. Ballasts shall be manufactured by Universal, Advance, Robertson Worldwide, or Lutron unless otherwise indicated.

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. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. UL Compliance: Comply with applicable UL standards.

1. Fluorescent Fixtures conform to UL 1570.
2. Incandescent Fixtures conform to UL 1571.
3. High Intensity Discharge (HID) Fixtures conform to UL 1572.
4. Track-Lighting Systems conform to UL 1574.
5. Exit Signs conform to UL 924.

D. Lamp base shall comply with applicable ANSI standards.

E. Luminaire shall comply with applicable NEMA standards.

F. Nominal Operating Voltage: as indicated on the drawings. Luminaires and components shall be suitable for operation at the voltage of the building circuits to which they are connected.

G. Lampholders shall be suitable for operation of the specified lamps and are set so that lamps are positioned in optically correct relation to all luminaire components. All lampholders comply with applicable requirements of ANSI C81. All fluorescent lampholders comply with UL 542.

H. Luminaires for use in damp or wet locations shall be suitably gasketed to prevent the entrance of moisture and shall be listed for such use.

I. Luminaires utilizing ballasts, drivers or transformers bear identification, by means of a label on the reflector or body, of the circuit voltage at which they are intended to operate.

J. All components of track lighting systems, including track, fittings, and luminaires, are provided by one manufacturer.

K. Luminaires are complete with all internal wiring and all flexible conduits, pigtails, and the like necessary for external connections. All wire utilized for connections to or between individual lamp sockets and lamp auxiliaries (i.e., wires which do not constitute "through circuit" wiring) are minimum #16 gauge, industry standard, fixture wire suitable for the temperature, current and voltage conditions to which it is subjected. Internal wiring contains a minimum number of splices. Splices in internal wiring are made with approved insulated "wire nut" type mechanical connectors, suitable for the temperature and voltage conditions to which they are subjected.

L. Grounding-type flexible conduit is used for luminaire pigtails, and grounding type connectors are used for installing same. Include grounding conductor if upstream overcurrent device exceeds 20 amps.

M. Luminaires specified with integral emergency battery packs (also known as emergency ballasts) incorporate a test switch and indicator light within the luminaire. Test switch and indicator light are discretely located, so that they are not visible from ordinary viewing angles, but so that they are readily accessible to maintenance personnel, as required by code. Luminaires incorporating emergency battery packs are wired so that they may be switched or dimmed as part of their assigned lighting control zone without causing the battery pack to energize the lamps.

N. General Construction:

1. Luminaires are constructed with joints made only by means of welded, brazed, screwed, or bolted construction methods. Soldered joints will not be permitted. No self-tapping screws, bled metal tapping methods, or rivets are employed for fastening any parts to or in any wireway or wiring chamber, for fastening any parts which must be removed to gain access to electrical components requiring service or replacing, or for fastening any electrical component or support for same.
2. All ferrous parts and supports, other than parts manufactured of stainless steel, are completely rustproofed after fabrication, and before finish coatings are applied. Rustproofing is by means of galvanizing, bonderizing, zinc plating, or by treatment with other industry standard rust-preventing processes providing rustproofing qualities equal to the processes mentioned above.
3. All screws, bolts, nuts and other fastening and latching hardware are cadmium or equivalent plated.

4. All metallic cast or extruded parts are close grained, sound, and free from imperfections or discolorations. Cast or extruded parts are rigid, true to pattern, and of ample weight and thickness. Cast or extruded parts are properly fitted, filed, ground buffed, and chased to provide finished surfaces and joints free of imperfection with all details or ornamentation brought out. Finished thickness of all cast parts is not less than 1/8 inch (3 mm).
5. Housings are constructed so that all electrical components are easily accessible and replaceable without removing housings from their mountings.

O. Sheet metal components are fabricated of steel, except as indicated. Form and support sheet metal to prevent warping and sagging.

P. Doors, frames, and other means of internal access operate smoothly, free from light leakage under operating conditions, and are arranged to permit relamping without use of tools, unless indicated otherwise on drawings. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

Q. Specular, semi-specular, and laminated silver metallized film reflectors have a non-iridescent coating when used with triphosphor fluorescent lamps. Reflectors have total hemispheric reflectances equal to or greater than the following values, unless otherwise noted:

1. White surfaces: 90 percent.
2. Specular surfaces: 87 percent.
3. Semi-specular surfaces: 84 percent.
4. Laminated silver metallized films: 95 percent.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:

1. Comply with UL 935 and with ANSI C82.11.
2. Designed for type and quantity of lamps served.
3. Ballasts shall be designed for full light output unless another ballast factor, dimmer, or bi-level control is indicated.
4. Sound Rating: Class A, except Class B for T12/HO and T12/Slimline lamp ballasts.
5. THD Rating: Less than 10 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Operating Frequency: 42 kHz or higher.
8. Lamp Current Crest Factor: 1.7 or less.
9. Ballast Factor: 0.88 or higher unless otherwise indicated.
10. Power Factor: 0.95 or higher.

B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.

C. Electronic Programmed-Start Ballasts Lamps: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.

D. Electromagnetic Ballasts: Comply with ANSI C82.11; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.

1. Ballast Manufacturer Certification: Indicated by label.

E. Single Ballasts for Multiple Luminaires: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

F. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.
2. Where indicated for low temperature operation - temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.

G. Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on EMI and RFI for consumer equipment.

H. Ballasts for Dimmer-Controlled Luminaires: Electronic type.

1. Dimming Range: 100 to 1 percent of rated lamp lumens, except that ballasts utilized for daylight harvesting may be 100 to 10 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
4. Control: Coordinate wiring from ballast to control device to ensure that ballast, controller, and connecting wiring are compatible.

I. Ballasts for Bi-Level Controlled Luminaires: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level operation and off.

a. High-Level Operation: 100 percent of rated lamp lumens.
b. Low-Level Operation: 30 percent of rated lamp lumens.

2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

J. Ballasts for Tri-Level Controlled Luminaires: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level operation and off.

a. High-Level Operation: 100 percent of rated lamp lumens.
b. Low-Level Operation: 30 and 60 percent of rated lamp lumens.

2. Ballast shall provide equal current to each lamp in each operating mode.

3. Compatibility: Certified by manufacturer for use with specific tri-level control system and lamp type indicated.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: Class A.
4. THD Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher unless otherwise indicated.
9. Power Factor: 0.95 or higher.
10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on EMI and RFI for non-consumer equipment.

B. Ballasts for Dimmer-Controlled Luminaires: Additional requirements:

1. Dimming Range: 100 to 1 percent of rated lamp lumens, except that ballasts utilized for daylight harvesting may be 100 to 10 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
4. Control: Coordinate wiring from ballast to control device to ensure that ballast, controller, and connecting wiring are compatible.

2.5 EMERGENCY POWER UNIT

A. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast.

1. Emergency Connection: Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast. Emergency battery-inverter unit is wired so that luminaire may be switched or dimmed as part of their assigned lighting control zone without causing the battery-inverter unit to energize the lamps while normal power is available.
2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Fluorescent luminaire operation: Operate one lamp continuously upon loss of normal power. Minimum initial lumen output per lamp shall be:

   a. T-5: 825 lumens
   b. T-8: 825 lumens

c. T-5 HO: 1,300 lumens
d. T-5 "biax" 2G11-base: 825 lumens
e. Compact Fluorescent: 650 lumens

4. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

   a. Ambient Temperature: Less than 0 deg F (minus 18 deg C) or exceeding 104 deg F (40 deg C), with an average value exceeding 95 deg F (35 deg C) over a 24-hour period.
   b. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C).
   c. Humidity: More than 95 percent (condensing).
   d. Altitude: Not exceeding 3300 feet (1000 m).

5. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.

   a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

6. Battery: Sealed, maintenance-free, lead-acid type.
7. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

2.6 FLUORESCENT LAMPS

A. T8 rapid-start lamps, rated 32-W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI of 80 (minimum), color temperature of 3500 K, and average rated life of 20,000 hours unless otherwise indicated.

B. T8 rapid-start lamps, rated 17-W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI of 80 (minimum), color temperature of 3500 K, and average rated life of 20,000 hours unless otherwise indicated.

C. T5 rapid-start lamps, rated 28-W maximum, nominal length of 45.2 inches (1150 mm), 2900 initial lumens (minimum), CRI of 80 (minimum), color temperature of 3500 K, and average rated life of 20,000 hours unless otherwise indicated.

D. T5HO rapid-start, high-output lamps, rated 54-W maximum, nominal length of 45.2 inches (1150 mm), 5000 initial lumens (minimum), CRI of 80 (minimum), color temperature of 3500 K, and average rated life of 20,000 hours unless otherwise indicated.

E. Compact Fluorescent Lamps: Four-pin, CRI of 80 (minimum), color temperature of 3500 K, average rated life of 10,000 hours at three hours of operation per start, and suitable for use with dimming ballasts unless otherwise indicated.

2.7 LED LUMINAIRES

A. LED shall have a rated source life of 50,000 hours. LED "rated source life" is defined as the time when a minimum of 70% of initial lumen output.

B. Correlated color temperature of light emitting diodes shall be as specified in the lighting fixture schedule. Where no indication is made in the fixture schedule, provide light emitting diodes with a correlated color temperature of 3,000 K

C. Light emitting diodes shall be binned such that they fall within a 4-step MacAdam ellipse surrounding their nominal rated color temperature.

D. Light emitting diode products are provided complete with all appurtenances and accessories necessary for operation, including but not limited to power supplies and drivers, heat sinks, optical components, etc.

E. Light emitting diode products which are connected to dimming systems shall be provided with dimmable power supplies and drivers which are compatible with the specified dimmer or dimming system.

F. Electronic Drivers: Include the following features unless otherwise indicated:

1. Minimum Starting Temperature: Minus 20 deg F (Minus 29 deg C).
2. Rated Ambient Operating Temperature: 130 deg F (54 deg C).
3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
6. Power Factor: 0.90 or higher.
7. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.

2.8 EXIT SIGNS

A. Exit signs comply with the following:

1. Color, letter height, and letter stroke comply with all requirements of applicable state and local building codes.
2. Edge-lit exit signs which are visible from two directions have a mylar film inserted in the center of the panel, so that the letters are not visible from the wrong direction.

B. Self-illuminated exit signs equipped with integral battery packs for emergency operation comply with the following:

1. The battery is a sealed, maintenance-free nickel-cadmium battery with a five-year warranty.
2. The charger is solid-state, fully automatic with a sealed transfer relay.
3. When the input voltage drops to 80 percent of normal or below, the relay energizes the lamps from the battery pack, instead of the normal building power. When normal power is restored, the relay energizes the lamps from the normal building power, automatically recharge the battery, and float it on the charger.

2.9 MATERIALS

A. Metal Parts: Free of sharp edges and burrs.

B. Sheet Metal Components: Steel unless otherwise indicated. 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.

D. Lenses, Diffusers, and Globes:

1. Glass: Annealed crystal glass unless otherwise indicated.
2. Acrylic Lighting Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
3. Lens thickness is at least 1/8 inch (3mm), unless otherwise noted.

E. Housings:

1. Extruded-aluminum housing and heat sink.
2. Finish as indicated.

F. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Labels shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. Ballast type for fluorescent and HID luminaires.
d. CCT and CRI for all luminaires.

2.10 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.11 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5 mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

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 to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the **Contractor**'s Engineer, use permanent luminaires for temporary lighting. Install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires; disassemble, clean, and install new lamps; and reinstall luminaires.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Remote Mounting of Ballasts: Distance between the ballast and luminaire shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

C. Remote Mounting of LED Drivers: Distance between the driver and luminaire shall not exceed that recommended by driver manufacturer. Verify, with driver manufacturers, maximum distance between driver and luminaire.

D. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

E. Install lamps in each luminaire.

F. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them.

G. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100

percent of luminaire weight and vertical force of 400 percent of luminaire weight.

H. Ceiling-Grid-Mounted Luminaire Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inches (150 mm) from luminaire corners.
2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.
3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

I. Flush-Mounted Lighting Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

J. Wall-Mounted Lighting Luminaire Support:

1. Attached to structural members in walls.
2. Attached to a minimum 1/8-inch(3-mm)backing plate attached to wall structural members.
3. Attached using through bolts and backing plates on either side of wall.
4. Do not attach luminaires directly to gypsum board.

K. Suspended Lighting Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing, rod, or wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

L. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

M. Provide low voltage circuitry as required between dimming equipment and driver / ballasts in accordance with manufacturer's instructions.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Install wiring labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for

identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. 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.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.3.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265100