

## PART 1 - GENERAL

## 1.01 SUMMARY

- A. Section includes interior luminaires, lamps, ballasts and accessories.
- B. Related Sections:
  - 1. Division 09 - Luminous Ceilings.
  - 2. Division 09 - Integrated Ceiling Assemblies.
  - 3. Section 23 37 00 - Air Outlets and Inlets: For interface with air handling fixtures.
  - 4. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
  - 5. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

## 1.02 REFERENCES

- A. American National Standards Institute:
  - 1. ANSI C82.1 - American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
  - 2. ANSI C82.4 - American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

## 1.03 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections, unless noted otherwise. Contractor shall be allowed one initial submission and one resubmission to meet all specification requirements. If the fixture submittals are not acceptable for approval after one resubmission, Contractor shall be required to provide fixtures exactly as specified, except where otherwise noted by the Architect and/or Engineer.
- B. Substitutions: Substitutions for the specified lighting products are not acceptable and will not be considered without approval prior to bid. Failure to include the specified products as part of the base bid may invalidate the entire lighting product bid and exclude the bidding contractor from further consideration.
  - 1. Contractor-offered substitutions must be submitted for pre-qualification at least 15 business days in advance of the bid. Failure to submit substitutions within that deadline constitutes a guarantee that the specified products will be supplied. The time required to pre-qualify substitutions shall be invoiced to the contractor at a rate and number of hours agreed to by the Lighting Consultant. Submittal of a substitution package and/or submittal of a bid for

this project shall include a written acknowledgement of the contractor's understanding of these terms.

2. Some luminaires included in this specification are unique designs, available only from the specified manufacturer. No attempt shall be made to solicit bids from other manufacturers to copy or "knock-off" these luminaires. Attempts to do so may invalidate the entire lighting bid and exclude the contractor from further consideration.
- C. Product Data: Fixtures, lamps, ballasts and poles or other mounting components. Arrange Product Data for fixtures in order of fixture designation. Include data on features and accessories and the following:
1. Outline drawings indicating dimensions and principal features of fixtures.
  2. Electrical Ratings and Photometric Data: Certified results of independent laboratory tests for fixtures and lamps. Provide data for the specified lamp or lamp/ballast combination.
- D. Provide data as required to demonstrate that the submitted product meets or exceeds the performance of the specified fixture.
1. Include photometric data charts: C.U., candlepower distribution and/or luminance information as necessary.
  2. Where technical charts alone cannot substantiate compliance, the submitting manufacturer may be required to provide a full photometric study of a specific project application for verification.
  3. Lamp Data: Manufacturer, ordering code and technical information.
  4. Ballast Data: Manufacturer, ordering code and technical data showing compliance with requirements.
    - a. Where a fixture manufacturer will utilize ballasts from multiple manufacturers depending on availability, technical data must indicate the minimum characteristics that will be met in all cases.
- E. Scaled shop drawings detailing nonstandard fixtures and indicating dimensions, weights, method of field assembly, components, features, and accessories. Details shall be scaled at not less than half full size.
1. Scaled shop drawings of continuous run fixtures shall indicate overall length of each run, lamp combinations used to achieve the length, and any accessory components required.
- F. Wiring diagrams detailing wiring for control system showing both factory-installed and field-installed wiring for specific system of this Project, and differentiating between factory-installed and field-installed wiring.
- G. Coordination Drawings showing fixtures mounted on, in, or above ceiling. Indicate coordination with ceiling grids and other equipment installed in vicinity.

- H. Product certificates signed by manufacturers of lighting fixtures certifying that their products comply with specified requirements.
- I. Field test reports indicating and interpreting test results specified in Part 3 of this Section.
- J. Maintenance data for fixtures to include in the operation and maintenance manual specified in Division 01.

#### 1.04 QUALIFICATIONS

- A. Fixture Materials: Provide fixture parts and components that are constructed of materials most appropriate to their use or function, and that are resistant to corrosion in a marine environment and mechanical stresses encountered in the normal application and function of the fixtures.
- B. Manufacturers: Provide fixtures from manufacturers making like products for not less than five years prior to bid.
- C. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL.
- D. Listing and Labeling: Provide fixtures and accessory components specified in this Section that are listed and labeled for their indicated use and installation conditions on Project.
  - 1. Special Listing and Labeling: Provide fixtures for use in damp or wet locations and recessed in combustible construction that are specifically listed and labeled for such use. Provide fixtures for use in hazardous (classified) locations that are listed and labeled for the specific hazard.
  - 2. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
  - 3. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- E. Applicable Codes: Fixtures shall be made and installed in accordance with the current version of the National Electric Code, the Uniform Building Code, the Federal Occupational Safety & Health Act, local codes and any other applicable regulations.
- F. Measuring and Testing Equipment: Instruments for the measurement of voltage, luminaire temperature, lighting level and fixture brightness level shall be available at all times on the site.

#### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Luminaires and lighting equipment shall be delivered to the project complete, including mounting devices, lamps, and components necessary for the proper operation of the equipment.

- B. Marking: All equipment must be clearly and boldly identified as to the fixture type and, where practicable, the fixture location.
  - 1. Voltage Identification: Fixtures designed for voltages other than 110-125 volt circuits shall be clearly marked.
  - 2. Lamp Ballast Coordination: Fixtures equipped with ballasts for operation of rapid start lamps shall be plainly marked "Use Rapid Start Lamps Only." Similarly, fixtures equipped with ballasts or other components requiring use of specific types of lamps shall be plainly marked. Markings must be clear and shall be located to be readily visible to service personnel *but invisible from normal viewing angles* when lamps are in place.
- C. Timely Purchase: Luminaires, associated lamps and other allied equipment shall be ordered in a timely fashion and securely stored to be available to meet the project schedule.

## 1.06 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
  - 1. Lamps: 10 lamps for every 100 of each type and rating installed. Furnish at least one of each type.
  - 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
  - 3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
  - 4. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.
  - 5. Parabolic Louvers and Reflector Cones: 1 for every 100 of each type. Furnish at least one of each type.
- B. Custom Luminaires: When 10 identical custom fixtures are furnished, furnish one complete spare custom fixture as attic stock.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Available Products: Subject to compliance with the submittal requirements of this specification, fixtures that may be incorporated into the Work include, but are not limited to, the products specified in the Lighting Fixture Schedule at end of this Section. The photometric performance of all submitted products must meet or exceed the performance of the specified fixtures where proposed.

## 2.02 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- A. Sheet Metal Components: Provide the required dimensional thickness of metal, plastic and composite materials so that all fixtures are rigid, stable and will resist deflection, twisting, warping under normal installation, and relamping procedures.
  - 1. All luminaire housings shall be minimum 0.84 mm cold rolled steel, unless a heavier gauge is specified or required by code.
  - 2. All aluminum extrusion housings shall be minimum 5 mm thick.
  - 3. All spun, hydro-formed or sheet aluminum reflectors shall be fabricated from # 12 aluminum sheets minimum, 1.45 mm or heavier. Material shall be 3002 alloy, 99.5 percent pure aluminum with uniform grain structure.
  - 4. All spun aluminum housings shall be of an alloy of the 5000 series (ANSI/ASTM-B209-1977) or of an alloy that is found to have equal corrosion resistance.
- B. Joints: Provide positive, durable, means of connection at all joints as required. No hollow rivets, unless specifically approved.
- C. Gaskets: Provide neoprene, silicone, rubber, or other appropriate gaskets, stops, and barriers where required to prevent light leak, control sound and vibration, prevent water leaks and, if pertinent, water vapor penetration.
- D. Edges: Provide finished product with the following minimum qualities:
  - 1. Ground and/or burr free metal edges.
  - 2. Tight fitting connections, hinges, and closures.
  - 3. Clean neat corners, edges, trims, and frames.
- E. Castings: All cast parts, including die-cast members, shall be of uniform quality; free from blow holes, pores, hard spots, shrinkage defects, cracks, and/or other imperfections that affect strength and appearance, or are indicative of inferior metals or alloys.
- F. Reflecting Surfaces: Minimum reflectance as follows, except as otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
  - 4. Laminated Silver Metallic Film: 90 percent.
- G. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or water white, annealed crystal glass, except as otherwise indicated. Greenish-tinted lenses are not acceptable. Heat resistant where required: borosilicate or Pyrex glass.

1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  2. Lens Thickness: 0.125 inch (3 mm) minimum; except where greater thickness is indicated.
- H. Doors, Frames and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers and other pieces to prevent accidental falling during relamping and when secured in operating position.
- I. Fixture Support Components: Comply with Division 26 Section "Hangers and Supports for Electrical Systems."
1. Single-Stem Hangers: ½ inch (12 mm) steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture
  2. Twin-Stem Hangers: Two, ½ inch (12 mm) steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.
  3. Rod Hangers: 3/16 inch (5 mm) minimum diameter, cadmium-plated, threaded steel rod.
  4. Hook Hanger: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord and locking-type plug.
- J. Instant Restrike Device: Solid-state, potted module, mounted inside HPS fixture and compatible with HPS lamps, ballasts and sockets up to 150 W.
1. Restrike Range: 105 to 130 VAC.
  2. Maximum Voltage: 250 V peak or 150 VAC RMS.
- K. Auxiliary, Instant-On, Quartz System: Automatically switches quartz lamp when fixture is initially energized and when momentary power outages occur. Turn quartz lamp off automatically when HID lamp reaches approximately 60 percent light output.
- L. Track-Lighting Systems: Provide components, including track, fittings and fixtures from same manufacturer and as recommended by manufacturer for intended use.
1. Maintain a continuity of conductors through feeds, splices and boxes. The relative positions of live and neutral conductors must always be maintained along a continuous run so that track fittings connect into the track in a consistent manner.
  2. Install surface mounted track straight and true regardless of the ceiling contour.
- M. Pole-mounted Fixtures: Provide reinforcement for all exterior pole mounted luminaires in accordance with manufacturer's recommendations. Reinforcement shall be designed to prevent overturning or permanent deflection in winds up to 160 km/hr. with a gust factor of 1.3, or in winds equal to the local maximum annual

wind velocity, whichever is greater. Existing soil conditions should be taken into account. Include in submissions details of all pole reinforcements for approval by Structural Engineer.

1. Conform to AASHTO LTS-3.
  2. Arm, Bracket, and Tenon Mount Materials: Match pole's finish.
  3. Mountings, Fastenings and Appurtenances: Corrosion-resistant items compatible with support components. Use materials that will not cause galvanic action at contact points. Use mountings that correctly position luminaire to provide indicated light distribution.
  4. Pole Shafts: As indicated.
  5. Pole Bases: Anchor type with galvanized steel hold-down or anchor bolts, leveling nuts and bolt covers.
  6. Steel Poles: Conforming to ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psi (317 MPa), unless otherwise indicated. Poles are 1-piece construction up to 12 m in length.
  7. Cast Iron Poles: 1-piece heavy wall construction, ASTM A 48-83 Class 30. Provide access handhole in pole base.
  8. Metal Pole Grounding Provisions: Welded ½ inch (12 mm) threaded lug, accessible through handhole.
  9. Metal Pole Brackets: Designed to match pole metal.
  10. Pole-Top Tenons: Fabricated to support fixture or fixtures and brackets indicated and securely fastened to pole top.
  11. Concrete for Pole Foundations: Comply with Division 03 Section "Cast-in Place Concrete." Use 3000 psig (20.7-MPa) strength, 28 day concrete.
- N. Cast-in Fixture: Housings installed directly in concrete shall be fabricated of hot dip galvanized steel or cast aluminum. Where cast aluminum housings are used, give two coats of asphaltum paint prior to installation. To prevent direct contact of housings to concrete, 3 mm thick x 51 mm diameter solid neoprene grommets shall be furnished at every point light fixture surfaces are mounted to concrete structure.

## 2.03 FINISHES

- A. Manufacturer's standard, except as otherwise indicated, applied over corrosion-resistant treatment or primer, free of streaks, runs, holidays, stains, blisters and similar defects.
1. Prior to finishing, all surfaces must be free from foreign materials such as dirt, rust, oil, polishing compounds and mold release agents.
  2. Where necessary, surface cleaned by accepted chemical means shall receive corrosion inhibiting phosphating treatment assuring positive paint adhesion.

3. All castings and extrusions shall be machined, sanded or similarly treated, and given minimum one coat of baked-on clear methacrylate lacquer, unless a painted finish is specified.
4. Aluminum surfaces exposed to weather (other than anodized reflectors covered elsewhere) receive a duronodic or polyester powder paint finish as specified for corrosion resistance.
5. Sheet steel fixture housings, iron and steel parts, which have not received phosphating treatment ("Bonderizing" or similar process) or are to be utilized in exterior applications, are to be made corrosion resistant by zinc or cadmium plating or hot-dip galvanizing.
6. Anodized aluminum reflectors required for exterior use shall have a minimum of 0.02 mm anodizing thickness.

## 2.04 LAMPS

- A. Available Products: Lamps of the same type (such as fluorescent or HID) shall be supplied from the same manufacturer. Where a specific lamp manufacturer has been indicated in the Luminaire Schedule within this Section, lamps shall be supplied from the named manufacturer only. Provide fluorescent lamps from Osram Sylvania or Philips Lighting only.
- B. Fluorescent Color Temperature and Minimum Color-Rendering Index (CRI): 3000 K and 85 CRI, except as otherwise indicated.
- C. Non-compact Fluorescent Lamp Life: Rated average is 20,000 hours at 3 hours per start when used on rapid start circuits.
- D. Metal Halide Color Temperature and Minimum Color-Rendering Index (CRI): 3600 K and 70 CRI, except as otherwise indicated. Environmentally Responsible Lamp Technology: Use only fluorescent and metal halide sources that are low mercury and TCLP-compliant, except where not available in a specified lamp type.
- E. Environmentally Responsible Lamp Technology: Use only fluorescent and metal halide sources that are low mercury and TCLP-compliant, except where not available in a specified lamp type.
- F. Lamp Burn-in Period: Fluorescent and metal halide lamps that are specified for dimming shall be burned-in, or run continuously in a non-dim state, for a period of 100 hours prior to dimming the lamps.
- G. Light Emitting Diode (LED):
  1. All LEDs must be batch sorted for color and brightness visual consistency, and must be manufactured by a reputable LED manufacturer, such as Philips Lumileds, Osram Sylvania, Nichia, Cree or equal.
  2. Where LEDs shall be dimmed, that dimming must be accomplished by means of pulse width modulation, not by varying voltage. Drivers must not over-drive the LEDs beyond LED manufacturer recommendations and must



provide uniform, smooth, full-range dimming to 1%. LEDs must maintain consistent brightness and color throughout the dimming range. Drivers must allow for manual fine-tuning to assure that LEDs remain consistent in appearance from those controlled on one driver to the next.

## 2.05 LAMPHOLDERS

- A. Screw Base: Screw base sockets for incandescent and metallic vapor lamps shall be of heavy duty heat resistant porcelain with spring center contacts and plated screw shells. For ceramic metal halide lamps with electronic ballasts, provide minimum 4 KV pulse rated lampholders.
- B. Fluorescent Sockets: Fluorescent lamp sockets operating with an open circuit voltage in excess of 300 volts shall be of the safety type that opens the supply circuit when the lamp is removed from the sockets.

## 2.06 BALLASTS

- A. Fluorescent Ballasts: Electronic integrated circuit, solid-state, full-light-output, energy-efficient rapid start type, unless otherwise indicated; must be compatible with lamps and lamp combinations to which connected.
  - 1. Underwriters Laboratories (UL) listed, Class P, Type 1.
  - 2. Certification by Certified Ballast Manufacturers Association (CBM).
  - 3. Ballast shall be rapid start, unless otherwise indicated. Ballast starting parameters shall be consistent with lamp manufacturer's recommendations and shall provide full rated lamp life under normal operating conditions.
  - 4. Ballast shall have audible noise rating of Class "A" except as otherwise indicated.
  - 5. Voltage: Match connected circuits.
  - 6. Lamp Flicker: Less than 5 percent.
  - 7. Minimum Power Factor: 95 percent.
  - 8. Total Harmonic Distortion (THD) of Ballast Current: 20 percent or less.
  - 9. Minimum Ballast Factor (relative light output): 88 percent for T8 lamps, 87 percent for T5 compact fluorescent, 97 percent for all T4 compact fluorescent, and 100 percent for linear T5.
  - 10. Multi-Lamp Ballasts: Use 2-lamp ballasts for multi-lamp fixtures where possible. Supply 3- or 4-lamp ballasts only if the ballasts comply with the other requirements of this specification.
  - 11. Lamp-ballast connection method shall not reduce normal rated life of lamps.
  - 12. Ballast shall comply with all applicable local, state and federal efficiency standards.

13. For lamps smaller than 1 inch in diameter (all T2, T4 and T5 lamps), ballasts shall be equipped with a cut-off circuit that senses an over-voltage condition to the lamp for end-of-life protection.
14. Low-Temperature Fluorescent Ballasts: Comply with above requirements, except ballast may be Class P electromagnetic type. Starting temperature shall be minus 20 deg. F or colder, or the minimum available depending on lamp type.
15. Dimming Ballasts: Electronic rapid start type providing smooth dimming over a minimum range from 100 to 1 percent light output (unless otherwise specified). Listed for use with specific fluorescent dimming system provided.
16. Remote Ballasts: Where ballasts must be mounted remotely from fixtures, provide locations that fall within the manufacturer's recommended distance limitations.

B. HID Ballasts: Include the following features, except as otherwise indicated.

1. Constant wattage auto-transformer (CWA) or regulating high-power-factor type, unless otherwise indicated.
2. Conform to UL 1029 and ANSI C82.4.
3. Operating Voltage: Match system voltage.
4. Single-Lamp Ballasts: Minimum starting temperature of minus 30 deg F.
5. Normal Ambient Operating Temperature: 40 deg F.
6. Open circuit operation will not reduce average life.
7. High-Pressure Sodium (HPS) Ballasts: Equip with a solid-state igniter/starter having an average life in pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 deg F.
8. Encapsulation: Manufacturer's standard epoxy-encapsulated model designed to minimize audible fixture noise.
9. Electronic HID Ballasts: Provide electronic ballasts for ceramic metal halide lamps that include the following features:
  - a. Integrated electronic ballast, igniter and capacitor.
  - b. Operating Voltage: Match system voltage, or universal voltage.
  - c. Minimum Power Factor: 95 percent.
  - d. Total Harmonic Distortion (THD) of Ballast Current: 15 percent or less.
  - e. Sound Rating: Class "A".
  - f. Lamp Current Crest Factor: Less than 1.3.

- g. Ballast shall be equipped with a "Turn Off" safety function to prevent excessive ballast pulsing under conditions of: failed lamp, no lamp, or other sustained abnormal conditions such as rectification or glow mode.
- h. Ballast shall have not more than +/- 0.5 percent variation in output power with a +/- 10 percent in input line voltage.
- i. The lamp manufacturer shall approve or warrant the specified lamps for use on the designated Electronic Metal Halide ballast.
- j. Safety: Ballast shall comply with FCC Part 18C for non-consumer limits for EMI and RFI. Ballast shall be UL listed.
- k. Approved Manufacturer: Aromat Corporation.

## 2.07 TRANSFORMERS

- A. Suitability: Transformers shall be of the best quality and sized to compensate for voltage drop over indicated distances and meet with the following requirements:
  - 1. Where possible transformers have an integral line voltage switch.
  - 2. All transformers shall be locally fused.
- B. Provide adequate ventilation to meet code and manufacturers' requirements concerning temperature rise.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Set units plumb, square and level with ceiling and walls, and secure according to manufacturer's written instructions and approved Shop Drawings. Support fixtures according to requirements of Division 26 Section "Hangers and Supports for Electrical Systems".
- B. Support for Recessed and Semi-recessed Grid-Type Fluorescent Fixtures: Units may be supported from suspended ceiling support system, unless prohibited by local codes. No movement permitted after installation. Install ceiling support system rods or wires at a minimum of 4 rods or wires for each fixture, located not more than 6 inches (150 mm) from fixture corners.
  - 1. Install support clips for recessed fixtures, securely fastened to ceiling grid members, at or near each fixture corner.
  - 2. Fixtures Smaller than Ceiling Grid: For fixtures that normally mount at the ceiling grid on at least one side, install a minimum of 4 rods or wires for each fixture and locate at corner of ceiling grid where fixture is located. Provide additional ceiling grid to frame out fixture. Do not support fixtures by ceiling acoustical panels.

3. Fixtures of Sizes Less than Ceiling Grid: Center in acoustical panel. Support fixtures independently with at least two ¾ inch (20 mm) metal channels spanning and secured to ceiling tees.
- C. Support for Suspended Fixtures: Brace pendants and rods over 48 inches (1200 mm) long to limit swinging. Support stem-mounted, single-unit, suspended fluorescent fixtures with twin-stem hangers. For continuous rows, use tubing or stem for wiring at one point and tubing or rod or cable for suspension for each unit length of chassis, including one at each end.
  1. Provide all mounting components required for installation, including hickeys, stud-extensions, ball-aligners, canopies and stems.
  2. Provide stems on pendant fixtures of the correct length to uniformly maintain the fixture heights shown on the drawings or established in the field.
- D. Air Handling Fixtures: Install with dampers closed.
- E. Cast-in Fixtures: Housings installed directly in concrete shall be fabricated of hot dip galvanized steel or cast aluminum. Where cast aluminum housings are used, give two coats of asphaltum paint prior to installation. To prevent direct contact of housings to concrete, 3 mm thick x 51 mm diameter solid neoprene grommets shall be furnished at every point light fixture surfaces are mounted to concrete structure.
- F. Concrete Foundations: Construct according to Division 03 Section "Cast-in-Place Concrete".
  1. Comply with details and manufacturer's recommendations for reinforcing, anchor bolts, nuts and washers. Verify anchor-bolt templates by comparing with actual pole bases furnished.
  2. Finish: Trowel and rub smooth parts exposed to view.
- G. Pole Installation: Use web fabric slings (not chain or cable) to raise and set poles.
- H. Fixture Attachment: Fasten to indicated structural supports.
- I. Fixture Attachment with Adjustable Features or Aiming: Attach fixtures and supports to allow aiming for indicated light distribution.
- J. Lamping: Where specific lamp designations are not indicated, lamp units according to manufacturer's instructions.
- K. Installation Sequence: Install fixture mounting frames, plaster rings, etc. prior to the trim assembly, which shall not be installed until the project is "broom-clean." Where the fixture location or construction does not permit sequential installation, all reflectors, lenses, flanges and other visible surfaces shall be carefully protected.
- L. Ground and bond interior luminaires in accordance with Section 26 05 26.

### 3.02 WIRING

- A. Minimum Standards: All wiring shall comply with the following standards:

1. All wiring within lighting fixtures or from the splice with the building wiring shall be as specified under "Low Voltage Electrical Power Conductors and Cables."
2. Wiring between fluorescent lamp holders and associated operating and starting equipment shall be of similar or heavier gauge than the leads furnished with the approved ballasts.
3. Wire leads to the receptacle or connector of any side prong incandescent lamp or any "cool-beam" lamp, or any lamp 200 watts or over shall be SF-2 (silicone rubber insulated) stranded wire.
4. Wiring within fixture construction is to be concealed, except where the fixture design or mounting dictates otherwise.
5. Joints in wiring within lighting fixtures and connections of the fixture wiring to the wiring of the building shall be as specified under "Low Voltage Electrical Power Conductors and Cables" with special attention to paragraphs relating to high amperage, low voltage conditions.
6. Insulated bushings shall be installed at points of entrance and exit of flexible wiring.

### 3.03 GROUNDING

- A. Ground fixtures and metal poles according to Division 26 Section "Grounding and Bonding For Electrical Systems". Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values.
  1. Poles: Install 8ft driven ground rod at each pole.
  2. Non-metallic Poles: Ground metallic components of lighting unit and foundations. Connect fixtures to grounding system with No. 6 AWG conductor.

### 3.04 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Give advance notice of dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests: Verify normal operation of each fixture after fixtures have been installed and circuits have been energized with normal power source.
- E. Replace or repair malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.
- F. Report results of tests.
- G. Replace fixtures that show evidence of corrosion during Project warranty period.

### 3.05 CLEANING AND ADJUSTING

- A. Clean Fixtures After Installation: Remove all protective strippable coatings, dust, finger marks, paint spots, and any materials deleterious to the appearance or functioning of the fixtures. Use methods and materials recommended by manufacturer. Abrasive cleaners are not permitted.
- B. Focusing and Adjustment: After installation of all lighting fixtures, finishes and furnishings has been completed, provide personnel, ladders or lifts, spare lamps, and any other equipment necessary to expeditiously focus all lighting. Focusing shall be performed after dark, unless all visible daylight can be screened out of the focusing area, and shall take place under supervision of the Architect. All work shall be performed in accordance with union rules, should they be in force, and applicable codes. Where pre-aiming diagrams or angles have been provided by the Architect, this information shall be considered preliminary aiming, which is being provided to help expedite the process of night focusing. Pre-aiming by the Contractor does not eliminate the requirement for final focusing after dark.
  - 1. Aim all adjustable lighting fixtures according to instructions.
  - 2. Program preset dimming system "scene" lighting levels, where applicable.

### 3.06 FINAL INSPECTION

- A. Upon completion of the installation, lighting equipment must be in first class operating order and free from defects in condition or finish.
  - 1. At time of final inspection, all fixtures and equipment must be installed and lamped with *new* lamps and be complete with all lenses, diffusers, reflectors, side panels, louvers or other necessary components. Lamps that have been operating longer than the following time limits or that have already burned out must be replaced with new lamps prior to final completion.
    - a. Halogen Incandescent lamps: 200 hours (approximately 25 eight-hour days).
    - b. Non-halogen Incandescent lamps: 75 hours (approximately 9 eight-hour days).
    - c. Fluorescent lamps: 1000 hours (approximately 125 eight-hour days).
    - d. HID lamps: 1000 hours (approximately 125 eight-hour days).
  - 2. Fixtures shall be completely clean and free from finger marks, dust, plaster or paint spots.
    - a. Any reflectors, lenses, diffusers, side panels or other parts damaged prior to the final inspection shall be replaced.
    - b. Exterior poles, bollards, bases and other exterior fixtures shall be painted to match factory color where finish has been scratched or damaged.

- c. Housings shall be rigidly installed and adjusted to a neat flush fit with the ceiling.
- d. No light leaks shall be permitted at the ceiling line or from any visible part or joint.

### 3.07 SCHEDULES

- A. Refer to contract drawings for Luminaire schedule.

END OF SECTION