

SECTION 26 50 10 – ELECTRICAL ARCHITECTURAL LIGHT FIXTURES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior luminaires, poles and accessories.
 - 2. Interior luminaires, lamps, ballasts and accessories.
- B. Related Sections:
 - 1. Section 09 54 16 – Luminous Ceilings
 - 2. Section 09 58 00 – 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
 - 6. Section 26 52 00 – Emergency Lighting

1.3 DEFINITIONS

- A. BF: Ballast Factor
- B. CCT: Correlated color temperature
- C. CRI: Color rendering index
- D. HID: High-intensity discharge
- E. IP: International Protection or Ingress Protection Rating
- F. LED: Light-emitting diode
- G. LER: Luminaire efficacy rating
- H. Lumen: Measured output of lamp and luminaire, or both
- I. Luminaire: Complete lighting fixture, including ballast housing if provided.
- J. Pole: Luminaire support structure, including tower used for large area illumination.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and support structure, applied as stated in AASHTO LTS-4-M.
- B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4-M.
- C. Ice Load: Load of 3 lbf/sq. ft (145 Pa), applied as stated in AASHTO LTS-4-M Ice Load Map.
- D. Basic wind speed for calculating wind load for poles 50 feet (15m) or less is [100 mph (45 m/s)] [90 mph (40 m/s)] <Insert value from AASHTO LTS-4-M for this project>
 - 1. Wind Importance Factor: 1.0
 - 2. Minimum Design Life: 25 years

3. Velocity Conversion Factors: 1.0

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire, arranged in order of fixture designation. Include data on features, accessories, finishes, (poles and support component-if applicable) and the following:
1. Physical description of luminaire, including materials, dimensions, and (effective projected area- if applicable).
 2. Details of attaching luminaires and accessories.
 3. Details of installation and construction.
 4. Life, output (lumens, CCT, and CRI), and Energy-efficiency data.
 5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the light fixtures as applied in this Project IES LM-79 and IES LM-80.
 - 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.
 6. Materials, dimensions, and finishes of poles- if applicable
 7. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 8. Anchor bolts for poles- if applicable.
 9. Manufactured pole foundations- if applicable.
- B. Shop Drawings: For non-standard or custom lighting fixtures.
- a. Include plans, elevations, sections, mounting and attachment details.
 - b. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - c. Include diagrams for power, signal, and control wiring.
- C. Samples: For products designated for sample submission in the fixture schedule. Each sample shall include the following:
Specified lamps and ballasts, installed.
Finish, and color of fixture specified, including full size lens patterns.
Cords and plugs.
Pendant support system.
- D. Installation Instructions.

1.6 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. Lighting luminaires
 2. Suspended ceiling components.
 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
 4. Initial access modules for acoustical tile, including size and locations.
 5. 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. Occupancy sensors.
- 6. Moldings
- B. Pole and support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.
- C. Qualification Data: For testing laboratory providing photometric data for luminaires.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

1.7 LIGHTING PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Considerable effort and time have gone into designing and specifying the lighting and the act of substituting packages should not be considered lightly. The lighting design and fixtures have been vetted based on value, performance, size, aesthetics, availability and carefully reviewed and approved by the design team and ownership. Please review carefully the procedures and make sure your requests comply to all items noted. Substitutions will not be allowed unless specifically submitted and approved in accordance with the following provisions.
- B. At bid time, the contractor shall submit unit pricing for each specified fixture type in a matrix format. This shall be for fixture costs only and does not include installation. Bids not in this format are deemed rejected. This criterion is in addition to bid instructions in the general conditions. In the event bids are not submitted per the criteria of the contract documents, the owner can recommend a national distributor. Any increased costs associated with utilizing the national distributor and the specified products shall remain the responsibility of the contractor.
- C. Substitutions shall be considered only if submitted in accordance with Division 01 of the general conditions and criteria noted below. If there are conflicting requirements between sections, the more stringent requirement will govern.
- D. Alternate fixtures must be submitted in a matrix format showing the specified product unit cost, alongside the alternate fixture with its associated cost. This is a document in 8 1/2" x 11" format with manufacturer, model number and unit costs indicated. In a separate document, the associated cut sheets shall be submitted and labeled to indicate fixture number with the specification items neatly highlighted. Basic cutsheets not highlighted are deemed rejected.
- E. Contractor is required to provide written reason for the substitution. Requests for approval of substitute manufacturer or material shall be submitted on the substitution request form attached. Limit each request to one fixture type.
- F. The design team can select all or portions of the alternate package, and where the alternates are not selected the "as specified" product shall be provided at the unit prices noted in the matrix.
- G. The contractor shall submit lighting fixture "as specified" bids based on the manufactures listed in the specifications/fixture schedule and noted above.
- H. Alternate fixture specifications shall not be submitted just for the purpose of creating a "package" provided by one representative.
- I. Alternates must be submitted 8 working days prior to final bids being submitted and shall not be included in the project bid, unless they have been pre-accepted as alternates.

- J. Requesting approval of alternates after the bid is submitted or during the submittal review is not permitted. These requests are deemed rejected even without written reply and the as specified products shall be provided at no increased cost to the owner.
- K. Prior to submitting substitutions, the GC shall confirm with the Electrical Engineer that Energy Code calculations or compliance submittals will not require modification and shall submit this in writing to the Electrical Engineer. If this is not received along with the other requested information, no review will take place.
- L. Contractor shall provide photometric studies as required to validate light levels of any proposed substituted fixtures critical to meeting established light level criteria at the discretion of the lighting designer. Calculations to follow these requirements:
 - 1. Along with the alternate fixtures- Provide photometrics of the specified fixtures for a side-by-side comparison.
 - 2. Calculation grid shall be 5'x5', with a light loss factor of .9.
 - 3. Reflectance values of architectural finishes shall be confirmed with the Architect. Provide a letter from the architect indicating they have provided finishes for the various spaces.
 - 4. Provide calculations in both PDF and AGI format. Calculations shall clearly identify the space location, room number and floor level.
- M. By KGM rejecting an insufficient submittal will not be deemed a delay by the construction team.
- N. The construction team has had the Contract Documents for considerable time, to suggest a product is not available in a timely manner is not justification for substitutions. Any delay is the result of waiting too long to start the procurement process. Associated delay costs will be the sole responsibility of the construction team.
- O. Substitutions submitted by the GC must comply to all criteria noted above and accompanied by a check of \$2,500 for the first review. (Payable to KGM Architectural Lighting 270 Coral Circle, EL Segundo CA 90245). It is likely the substitutions will not comply with the design intent and/or not provide adequate value to the Owner. In the event additional reviews are required, an additional check of \$2,500 will be required for each review. Please note, there is a chance the substitution packages will not be approved, and no credit will be provided for the review payments.

1.8 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 and LED modules used on the Project; use ANSI and manufacturers' codes.

1.9 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. Lamps: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Glass and plastic lenses, cover and other optical parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Globes and guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.10 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with experience and capability to conduct 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.

- B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- C. 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.
- D. Comply with NFPA 70.
- E. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. Mock-ups
 - 1. Provide lighting fixtures for mock-ups where required, complete with power and control connections.
 - 2. Obtain Architect's approval of fixtures for mock-ups before starting installations.
 - 3. Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work.
 - 4. Approved fixtures in mock-ups may become part of the completed work if undisturbed at time of Substantial Completion.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660
- B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than ¼ inch (6 mm) deep. Do not apply tools to section of pole to be installed below ground line.
- D. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- E. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.
- F. Protect finishes of exposed surfaces by applying a strippable temporary protective covering before shipping.

1.12 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse or unauthorized repairs or alterations from special warranty coverage.
 - 1. Warranty period for luminaires: 5 years from date of Substantial Completion
 - 2. Warranty period for Metal Corrosion: 5 years from date of Substantial Completion.
 - 3. Warranty period for Color Retention: 5 years from date of Substantial Completion.

1.13 REFERENCE STANDARDS

- A. All fixtures and components shall be made in accordance with the National Electrical Code (NEC), and bear the Underwriter's Laboratories (UL) or Factory Mutual label.

- B. All fixtures shall be fabricated, wired, and installed in compliance with Applicable Code Requirements. Contractor to certify and provide all required labels indicating compliance with above standards, affixed to each fixture in a position concealing it from normal view.
- C. All fixtures shall comply with the Certified Ballast Manufacturers Association (CBM), Illuminating Engineering Society (IESNA), the American Society for Testing and Materials (ASTM), the American National Standards Institute (ANSI), and the National Fire Protection Association (NFPA).
- D. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- E. "Luminaire Photometric Data Testing Laboratory Qualifications" Paragraph below is to set qualifications for testing laboratories performing testing, in lighting fixture manufacturer's factory, that are creating the photometric data required in "Action Submittals" Article.
- F. 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, complying with the IESNA Lighting Measurements Testing & Calculation Guides.
- G. 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.
- H. Comply with NFPA 70.

1.14 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.15 QUALIFICATION OF MANUFACTURERS, FABRICATORS/INSTALLERS

- A. Manufacturers listed in the fixture schedule shall be assumed capable of supplying the listed fixtures unless exceptions are set forth in their quotations. Any such exceptions shall immediately be brought to the attention of the Client. Manufacturers not listed must meet the following criteria:
- B. Manufacturer shall have a minimum of five years' experience in design and manufacture of lighting fixtures of the type and quality shown. Submissions must include a list of completed projects and dated catalog pages or drawings indicating length of experience.
- C. Submit manufacturer's prototype sample of each fixture for review by the Client. Prototype samples shall be sufficiently detailed and operational to allow evaluation of compliance with the salient features of the specification. Preliminary design or shop drawings shall not be accepted in place of prototype samples.
- D. The Client shall be the sole judge in determining whether the prototype sample complies with the specifications and shall reserve the right to disqualify any manufacturers.
- E. The fabricator/installer shall have a minimum of five years' experience in fabricating and installing specialty lighting components and fixtures.

1.16 GUARANTEE

- A. Furnish to Client a written guarantee for fixture ballasts and LED fixtures against all defects in materials and workmanship for 5 years from the date of acceptance. Refer to Section 01 78 00, CLOSE OUT SUBMITTALS for submittal form.

1.17 JOBSITE CONDITIONS

- A. Install new lamps not earlier than 48 hours before the date of final inspection.
- B. Install exposed parts of fixtures after construction, painting, and general cleanup in the area have been completed.
- C. Inspect surfaces and structures to, and on, which products will be installed before the work of the Section begins and ensure that these surfaces are capable of supporting the products. Surfaces that will be concealed by products shall be finished before products are installed.
- D. For all lensed and louvered fixtures, surfaces shall be wiped clean of all dust and material particles following installation and prior to project completion.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Exterior Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable authorities having jurisdiction.
- C. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- H. Exposed Hardware Material: Stainless steel.
- I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- J. Interior Globes and Diffusers:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
- K. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- L. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.

2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
- M. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- N. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- O. Factory-Applied Finish for Steel luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
- P. Factory-Applied Finish for Aluminum luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- Q. Air-Handling Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Division 23 Section "Diffusers, Registers, and Grilles."

2.3 LIGHT EMITTING DIODE (LED)

- A. Light Emitting Diode (LED) Lighting, wherein the LED fixture consists of a LED luminaire assembly, LED driver, and mounting hardware, fixture requirements are as described below:
1. The input to the LED lighting fixture shall be 120 to 277VAC ($\pm 10\%$), 60Hz or as indicated in the contract documents.
 2. Correlated Color Temperature (CCT) shall be minimum 2700K or as indicated in the contract documents.
 3. Color Rendering Index (CRI) shall be ≥ 90 , and a R9 value > 50 .
 4. A minimum of 50,000 operating hours before reaching the L70 lumen output degradation point without catastrophic failure, or as indicated in the contract documents.
 5. Conform to UL 8750.
 6. Power factor shall be ≥ 0.9 .
 7. Lamps must fall within a 2-step MacAdam ellipse from the designated CCT.
 8. All LED lamps shall be capable of continuous dimming, flicker and noise free, from 1-100%.
 9. Fixtures shall be certified by manufacturer for use with specific dimming control system and lamp type indicated.
 10. Coordinate control wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.
 11. Projects located in California State require that the lamps be manufactured in compliance with all applicable law regarding toxic material content and recyclability.

2.4 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4-M.
1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.

2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 1. Materials: Shall not cause galvanic action at contact points.
 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
 3. Anchor-Bolt Template: Plywood or steel.
- D. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."
- F. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.
- G. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4-M.

2.5 STEEL POLES

- A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.
- B. Steel Mast Arms: Single-arm, Truss or Davit type (indicated on drawings), continuously welded to pole attachment plate. Material and finish same as pole.
- C. Brackets for Luminaires: Detachable, cantilever, without underbrace.
- D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- E. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.
- F. Intermediate Handhole and Cable Support: Weathertight, 3-by-5-inch handhole located at midpoint of pole with cover for access to internal welded attachment lug for electric cable support grip.
- G. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- H. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
- I. Platform for Lamp and Ballast Servicing: Factory fabricated of steel with finish matching that of pole.
- J. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

- K. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.
- L. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
 - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
 - 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

2.6 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B 429/B 429M, Alloy 6063-T6 with access handhole in pole wall.
- B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.
- C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
 - 1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
 - 2. Finish: Same as pole.
- F. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- G. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Retain one of four subparagraphs below or revise to suit Project.
 - 3. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
 - 4. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 5. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

2.7 LAMINATED WOOD POLES

- A. Species and Grades for Structural Glulam Timber: Engineer and fabricate structural laminated wood poles, complying with ANSI A190.1.
- B. Features: Include wood bracket, wood crossarm or pole-top adapter for mounting luminaire(s), metal pole cap and concealed raceway path connected to access handhole.

- C. Appearance Grade: Architectural appearance grade complying with AITC 110.
- D. Preservative Treatment: Pressure treat lumber before gluing according to AWPAC28 for waterborne preservatives. After dressing and end-cutting each member to final size and shape, apply a field-treatment preservative to comply with AWPAC M4 to surfaces cut to a depth of more than 1/16 inch.
- E. Adhesive: Wet-use type complying with ASTM D 2559.
- F. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- G. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.8 POLE ACCESSORIES

- A. Duplex Receptacle: 120 V, 20 A in a weatherproof assembly complying with Division 26 Section "Wiring Devices" for ground-fault circuit-interrupter type.
 - 1. Recessed 12 inches above finished grade.
 - 2. Nonmetallic polycarbonate plastic or reinforced fiberglass, weatherproof in use, cover, that when mounted results in NEMA 250, Type 3R or Type 4X enclosure.
 - 3. With cord opening.
 - 4. With lockable hasp and latch that complies with OSHA lockout and tag-out requirements.
- B. Minimum 1800-W transformer, protected by replaceable fuses, mounted behind access cover.
- C. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.
- D. Transformer Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and accept indicated accessories.

2.9 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "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 steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.10 WIRING

- A. All wiring shall comply with the following:
 - 1. Wiring between fluorescent lampholders and associated operating and starting equipment shall be of similar or heavier gauge than the leads furnished with the approved types of ballasts with equal or better insulating and heat-resistant characteristics.
 - 2. Wire leads to the receptacle or connector of any side-prong incandescent lamp or any "cool-beam" lamp utilizing a dichroic reflector shall be SF-2 silicone rubber insulated

- stranded wire. Wire within housing shall be entirely covered with flexible woven fiberglass sleeve.
3. Wiring shall be protected with tape or tubing at all points where abrasion may occur. Wiring shall be concealed within the fixture construction except where design or mounting dictates otherwise.
 4. Minimize splices. Make splices with approved mechanical insulated steel spring type connectors, suitable for temperature and voltage conditions to which splices are to be subjected.
 5. Connections of wires to terminals of lampholders and other accessories shall be made in a neat and workmanlike manner and electrically and mechanically secure with no protruding or loose strands.
 6. Wiring channels and wireways shall be free from projections and rough or sharp edges throughout, and all points or edges over which conductors must pass and may be subject to injury or wear, shall be rounded and bushed.
 7. Insulated bushings shall be installed at points of entrance and exit of flexible wiring.
 8. Junction boxes attached to lighting fixtures shall be manufactured in accordance with the National Electrical Code and approved for the number of conductors indicated on the drawings. Supplementary junction boxes shall be installed where required to comply with Code.
 9. All exposed wire shall be jacketed with a flexible woven fiberglass sleeve or similar flexible metallic or armored cable (BX) or EMT type conduit.
 10. When allowed to be exposed, all junction boxes and conduit to be painted as per the Client's request.

2.11 MARKING OF FIXTURES

- A. Fixtures designed for voltages other than 110-125 volts shall be marked with operating voltage.
- B. Fixtures equipped for operation of 265 MA or 325 MA rapid start lamps shall be clearly marked to indicate the appropriate lamp type.
- C. Similarly, fixtures equipped for operation of instant start or other type lamps shall be clearly marked "USE INSTANT START LAMPS ONLY", or as appropriate for other types as required. Clearly mark multi-level output ballasts as such and indicate proper terminals for various outposts. Markings shall be clear and located to be readily visible to service personnel, but invisible from normal viewing angles when lamps are in place.
- D. Fixtures designed for operation of lamps below the rated enclosure maximum shall be clearly marked "Lamp Watts Not to Exceed ____" to maintain the design energy load.

2.12 LAMPS

- A. Provide electric lamps as shown in specifications or as modified in reviewed shop drawings plus 10 percent additional spare lamps of all types. All incandescent or quartz tungsten halogen lamps shall not be operated other than for testing prior to final inspection. Use inexpensive A-lamps during construction for all incandescent fixtures having medium base sockets.
- B. Lamps as specified for the individual luminaires or lighting equipment shall be delivered and installed in fixtures and lighting equipment leaving these completely lamped with new lamps and in normal operating condition.
- C. Tungsten halogen (quartz) lamps: Use lamps and lighting fixtures with compatible temperature ratings.
- D. Fluorescent lamps, unless otherwise designated, shall be of the rapid start type T8 and deliver not less than 3150 initial lumens for straight lamps. Fluorescent lamps are Triphosphor 3000° Kelvin unless noted otherwise. Lamps shall have reduced mercury contents that meet US

Environmental Protection Agency (EPA) Toxic Characteristic Leaching Procedure (TCLP) test for non-hazardous fluorescent light waste pursuant to 22 CCR Section 66260.200 (e).

- E. Provide all incandescent lamps 130V, inside frosted, unless noted otherwise.
- F. Light Emitting Diode (LED) Lighting: Refer to Section 2.3 Light Emitting Diode (LED).

2.13 LAMPHOLDERS

- A. Lamp sockets shall be rigidly attached to fixture enclosure or husk.
- B. Incandescent and high intensity discharge lamp sockets shall be made of heavy-duty heat-resistant porcelain over copper screw shells.
- C. Fluorescent lamp sockets operated with an open circuit voltage in excess of 300 volts shall be of the safety type and open the supply circuit when the lamp is removed from the sockets.
- D. Provide nickel-plated brass or nickel-and silver-plated contacts in all lampholders for tungsten halogen lamps, lamps in outdoor fixtures, and mogul base incandescent, metal halide or mercury vapor lamps.
- E. Light Emitting Diode (LED) luminaire assembly requirements are as described below:
 - 1. Definition: Luminaire assembly is the LED assembly without the LED driver.
 - 2. Input voltage shall be 12VDC, 24VDC or as indicated in the contract documents.
 - 3. CCT, CRI, Minimum life and UL conformity requirements are as defined in the above section 2.09 regarding LED lighting fixtures.
- F. All lamp sockets shall be suitable for the indicated lamps and shall be set so that lamps are positioned in optically correct relation to all light fixture components. All adjustable sockets shall be preset at the factory for lamp specified.

2.14 FLUORESCENT AND HIGH INTENSITY DISCHARGE LAMP BALLASTS

- A. All fluorescent and high intensity discharge lamp ballasts shall be suitable for electrical characteristics of supply circuits to which connected, and conform to the following:
 - 1. All ballasts shall be "Class P" indicating approved integral ballast protection. Fuses in the primary leads shall be provided in addition to the "Class P" ballast. Install fuses readily accessible and easy to replace. Provide smallest acceptable fuses.
 - 2. All ballasts shall be of the high-power factor type, energy saving, "super low heat" as manufactured by Universal, or equal.
 - 3. All HID ballasts to be encapsulated and have a maximum crest factor of 1.6.
 - 4. All HID ballasts shall meet UL standards for "Class H" operations (180°C) and shall be constant-wattage autotransformers (CWA) type, unless noted otherwise.
 - 5. UL and ANSI specifications with labels and/or symbols of approval by the UL and of certification by the Certified Ballast Manufacturers (CBM) as tested by the ETL
 - 6. The component parts shall be designed, fabricated, and assembled in accordance with the latest requirements of the NEC
 - 7. Ballasts shall provide safe and reliable operation of the specified lamps.
 - 8. For the operation of pre-heat, instant start, and slimline lamps, lead-lag type ballasts shall be used.
 - 9. Whenever possible, provide two-lamp ballasts for fixtures with two fluorescent lamps or multiples of two lamps. Three-lamp ballasts and four-lamp ballasts shall be used only as indicated.
 - 10. Identical ballasts from the same manufacturer shall be installed within each fixture type.
 - 11. Provide the lowest sound rating available for the lamps specified and clearly show their respective sound ratings. Ballasts found by the Client to be unduly noisy shall be replaced

without charge prior to acceptance of the Work. Inform Client in writing if ballasts with sound rating "A" are not available.

12. Dimmer type ballasts shall be of a design recognized and approved under the UL component program. These ballasts must coordinate with the dimming control devices specified for the particular application.
13. Ballasts intended for outdoor use shall have a minimum lamp starting temperature of -20°F, except as noted otherwise.
14. Where ballasts are remote from fixture housing, provide suitable enclosures for installation with the conduit and wire from the ballast to the lamp socket clearly marked "Caution", "High Voltage". All remote ballasts shall be installed within the recommended distance from the lamp socket as per the manufacturer with access plates for maintenance and on neoprene pads for sound absorption.

2.15 ELECTRONIC BALLASTS, ADDITIONAL REQUIREMENTS

- A. Physically interchangeable with electromagnetic ballasts in new or existing fixtures.
- B. Operate lamps at frequencies between 25 and 40 KHz from 60 Hz input source with less than 10% flicker, at ambient temperature of 50°F to 105°F with 60°C maximum case temperature during operation.
- C. Maximum light regulation $\pm 5\%$ with $\pm 10\%$ input voltage variation.
- D. Suitable for operation of 28T5, F21T5, F15T5, or F17T8, F25T8 and F32T8, one or two lamp, types as indicated or specified, designed for optimum operation of the specified lamps.
- E. Solid-state consisting of rectifier, high frequency inverter, power control and regulation circuitry, in steel case, marked with manufacturer's name, part number, supply voltage, sound rating, power factor, open circuit voltage, RMS current draw, input watts, starting current, crest factor, efficiency and UL listing.
- F. Ballast life to be unaffected by lamp failure.
- G. Minimum ballast factor of 95%.
- H. Maximum current crest factor of 1.7.
- I. Maximum total harmonic distortion of 15%, maximum third harmonic distortion of 10%.
- J. Minimum power factor of 90%.
- K. Withstand line transients per IEEE 587, Category A.
- L. Rated life of 30,000 hours based on 10 hours per day.
- M. Submit with shop drawings a certified test report from an independent test laboratory-illustrating conformance with specified requirements.
- N. Submit evidence with shop drawings from ballast supplier of three projects of significant magnitude, employing the proposed ballasts, in satisfactory operation for a minimum of one year. Identify projects, operating personnel familiar with the ballast performance, and frequency of ballast failure.
- O. Except where noted otherwise, rigidly mount ballasts to inside top of fixture housing, with ballast surfaces and housing in complete contact for efficient conduction of ballast heat. Secure ballasts with removable fasteners (screws or bolts) instead of rivets.
- P. Contractor to coordinate ballast line side voltage with branch circuit voltage as shown on Contract Drawings.

2.16 TRANSFORMERS (INCANDESCENT, COLD CATHODE, NEON)

- A. All transformers shall be sized to accommodate the intended load and utilized to operate lamps in a method approved by Underwriters Laboratory and shall not exceed the following:
- B. Neon: 9,000 volts, 60 VA.
- C. Cold Cathode: 500 VA.
- D. Incandescent: 500 VA.
- E. Provide self-contained, UL listed transformers in 16 gauge steel housings with secondary and primary wiring compartments, mount all transformers securely to the fixture housings (if integral) or to the building structure (if remote) with neoprene pads to isolate vibration and noise.
- F. Provide all transformers with secondary over-current protection and a primary disconnect switch, which will automatically disconnect the primary switch when the wiring compartment cover is removed.
- G. All transformers shall be installed in accessible and ventilated locations with a maximum 100°F ambient temperature with air circulation on all sides.
- H. All winding type transformers will be high power with a maximum crest factor of 1.6.
- I. All regulating transformers shall be tested to have an output regulated to ± 3 percent for input variations of 15 percent to 25 percent, less than 3 percent distortion with a minimum load efficiency of 85 percent, and operating temperature of -20°C to 70°C.

2.17 DRIVERS (LIGHT EMITTING DIODE [LED] LIGHTING)

- A. LED driver requirements are as described below:
 - 1. Must operate input voltage between 120VAC to 277VAC ($\pm 10\%$) or as indicated in the contract documents
 - 2. Operating frequency must be 60Hz.
 - 3. Must be rated to operate between -40°C to +50°C.
 - 4. Must have a minimum efficiency of 85%.
 - 5. Self-protected including short circuit protection.

2.18 REFLECTORS

- A. Reflectors and reflecting cones or baffles shall be as follows:
 - 1. Absolutely free of any tooling marks including spinning lines, indentations caused by riveting or other assembly techniques.
 - 2. No rivets, springs, or other hardware visible after installation.
 - 3. First quality polished, buffed and anodized finish.
 - 4. Low iridescence for fluorescent sources.
 - 5. Specular finish color as selected by the Client.
 - 6. All reflectors and baffles of modified elliptical contour, with no apparent brightness from above 40° above the nadir, with no lamp image or any part of the lamp visible from above 40° above the nadir.
 - 7. Cone flange formed as an integral part of the cone and with identical color and finish, unless specified otherwise. Width of the flange covers all ceiling opening without light leaks or hardware visible.

2.19 LENSES

- A. All lenses secured by positive means with neoprene or silicone gasketing or washers as required to hold the lens tight within a frame or attach to a housing.

- B. All glass lenses shall be heat treated (tempered) or sealed with a clear acrylic laminate layer to provide a "safety glass" rating. All lenses which require removal for relamping or normal maintenance shall be attached to the fixture housing by a minimal length of safety chain to prohibit the lens from falling and striking surrounding surfaces. Glass edges exposed during the relamping process shall be gasketed to prevent chipping or cracking.
- C. Acrylic lenses shall be 100 percent virgin acrylic polymer, colorless, as manufactured by Rohm & Haas, Dupont or equal unless noted otherwise.

2.20 LOUVERS

- A. All fluorescent light fixture specular and semi-specular louvers shall be low iridescence parabolic and shall be rated at 90 percent or over on the Visual Comfort Probability (VCP) index.
- B. All plastic parabolic louvers shall be staticized before and after fabrication to insure minimum maintenance and retard dirt accumulation.
- C. All louvers shall be heat tested to withstand lamp-operating temperatures with no deformation of shape, paint blistering or discoloration.

2.21 FIXTURE TRIMS

- A. Provide trim details as shown on the Drawings or as specified, which are indicative of appearance and dimensional requirements. The trim finish and dimensions shall be subject to the approval of the Client.
- B. Provide a mounting frame or ring with lock at recessed or semi-recessed light fixtures to secure the mounting frame to the ceiling and support any reflectors, trims or lenses. Ring shall be compatible with the ceiling and of sufficient strength to rigidly support the fixture and any stress applied in relamping.

2.22 SUPPORTS

- A. Comply with all applicable seismic codes requiring independent support for lighting fixtures.
- B. Provide plaster frames and mounting frames for fixtures as required, appropriate for ceiling construction in which installed.
- C. Provide formed, rolled, or cast metal attachment devices including brackets, plaster rings, saddle hanger and tie bars, of rigidity and strength to maintain continuous alignment of installed fixtures.
- D. Provide necessary hardware including stems, plates, plaster frames, hangers, and similar items, for safe support of fixture.
- E. Provide fastening devices of positive locking type, not requiring special tools to apply or remove. Do not use tie wires in place of fastening devices.
- F. Provide fixture supports adequate to support the weight of fixture.
 - 1. Provide surface passivated supporting members; primed or paint-dipped to resist corrosion.
 - 2. Finish exposed hanging devices to match fixture finish unless indicated otherwise.

2.23 LIGHTING CONTROL EQUIPMENT

- A. Requirements: Lighting control components shall be suitable for the lighting system specified and compatible for interface with other associated control devices. Lighting control components shall be rated for continuous service and shall operate satisfactorily in every respect while the branch circuit power supply voltage to each system is within $\pm 10\%$ of rated voltage at 60Hz.

- B. All HID lamps which are on 24 hours on time shall be programmed to have 15 minutes rest period per week. The programming of the rest period shall be done in such a way that all the circuits are not off at the same time.
- C. Photoelectric Sensor:
 - 1. Conform with UL 773.
 - 2. Provide operation in temperature range of -0°F to +110°F.
 - 3. Provide dusk-to-dawn operation, with adjustments from 2 to 50 footcandles with a five-second time delay to preclude false switching.
 - 4. Provide waterproof and tamperproof equipment.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install fixtures complete with lamps and with equipment, materials, parts, attachments, devices, hardware, hangers, cables, supports, channels, frames and brackets necessary to make a safe, complete, and fully operative installation.
- B. Do not install reflector cones, apertures, plates, lenses, diffuses, louvers, and decorative element of fixtures until completion of wet work, plastering, and general clean up in area of fixtures.
- C. Mount fixtures at heights and locations indicated on Drawings. Fixture locations indicated on Electrical Drawings are generalized and approximate. Carefully verify locations with the plans, reflected ceiling plans and other reference data prior to installation. Check for adequacy of headroom and non-interference with other equipment, such as ducts, pipes or openings. Bring conflicts to the Client's attention before proceeding with work and ordering fixtures.
- D. Adequately protect housing of recessed lighting fixtures during installation by internal locking or framing to prevent discoloration of sides, and discoloration of threaded lugs; maintain perfect lug alignment and match corresponding holes in frames and rims. Insert holding screws freely without forcing, easily removable for servicing.
- E. Upon completion of installation, lighting fixtures and lighting equipment shall be in first class operating order and free from defects in condition and finish. At time of final Inspection, all fixtures and equipment shall be clean, fully lamped, and complete with required lenses; replace damaged diffusers, reflectors, side panels and other parts prior to final inspection.
- F. Support Services:
 - 1. Lighting Control System Startup: Provide factory-trained technician to confirm proper installation and operation of system components.
 - 2. Training: Provide factory trained application engineer to train Client's personnel in operation and programming of lighting control.
 - 3. Programming: Provide following manufacturer's system programming on CD compatible with central PC:
 - a. Wiring documentation.
 - b. Programmable panel and system switch operation.
 - c. Telephone overrides.
 - d. Operating schedules.

3.2 INSTALLATION- INTERIOR

- A. Lighting fixtures:
 - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
 - 2. Install lamps in each luminaire.

- B. Temporary Lighting: If it is necessary, and approved by Architect, to 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 thoroughly, install new lamps, and reinstall.
- C. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
 - 1. Install ceiling support system rods or wires, for each fixture. Locate not more than 6 inches from lighting fixture corners.
 - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
 - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- D. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
 - 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- E. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 INSTALLATION- EXTERIOR

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Adjust luminaires that require field adjustment or aiming.

3.4 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:
 - 1. Fire Hydrants and Storm Drainage Piping: 60 inches.
 - 2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
 - 3. Trees: 15 feet from tree trunk.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.

2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 3. Install base covers unless otherwise indicated.
 4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
1. Dig holes large enough to permit use of tampers in the full depth of hole.
 2. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.
- F. Embedded Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
1. Make holes 6 inches in diameter larger than pole diameter.
 2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days, and finish in a dome above finished grade.
 3. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through concrete dome. Arrange to drain condensation from interior of pole.
 4. Cure concrete a minimum of 72 hours before performing work on pole.
- G. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.
- H. Raise and set poles using web fabric slings (not chain or cable).

3.5 BOLLARD LUMINAIRE INSTALLATION

- A. Align units for optimum directional alignment of light distribution.
- B. Install on concrete base with top 4 inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.6 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

- A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.7 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.8 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
1. Install grounding electrode for each pole unless otherwise indicated.

2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 1. Install grounding electrode for each pole.
 2. Install grounding conductor and conductor protector.
 3. Ground metallic components of pole accessories and foundations.

3.9 COORDINATION

- A. Give ample notice of special openings required for placing equipment in building; avoid cutting completed work.
- B. Furnish materials and labor for work under this Section in ample time, and in sufficient quantities so work may be installed in proper sequence to avoid unnecessary cutting of floors and walls.

3.10 ACCESSIBILITY

- A. Install equipment such as junction and pull boxes, fixture housings, transformers, ballasts, switches and controls, and other apparatus that must be reached periodically for operation and maintenance, easily accessible

3.11 ADJUSTMENTS

- A. Perform final focusing and adjustment, in presence of the Client of adjustable fixtures as required.

3.12 CLEANING

- A. Immediately prior to occupancy, clean reflector cones, reflectors aperture plates, lenses, louvers, lamps and decorative elements. Destaticize lenses after cleaning, install free of finger and dirt marks. Lamp shall also be clean and free of dust upon completion.

3.13 FIELD QUALITY CONTROL

- A. Tests: Upon completion of installation of lighting fixtures, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- B. Replacement Lamps: At the time of substantial completion and prior to field tests, replace lamps in interior lighting fixtures which are observed to be noticeably dimmed after Contractor's use and testing.
- C. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 1. Verify operation of photoelectric controls.
- D. Illumination Tests:
 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
 - a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting Installations."
 - b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
 - c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
 - d. IESNA LM-64, "Photometric Measurements of Parking Areas."

e. IESNA LM-72, "Directional Positioning of Photometric Data."

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

END OF SECTION

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