SECTION 26 56 00

EXTERIOR LIGHTING
05/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Contractor may substitute compatible Japan Industrial Standard (JIS) or Japan Luminaires Association (JIL) for non-Japanese standards, as approved by the Contracting Officer's representative.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2023) National Electrical Safety Code

JAPANESE STANDARDS ASSOCIATION (JSA)

JIS A 5373	(2016) Precast Prestressed Concrete Products
JIS C 0365	(2007) Protection Against Electric Shock - Common Aspects for Installation and Equipment
JIS C 0920	(2003) Degrees Of Protection Provided By Enclosures (IP Code)
JIS C 5381-11	(2014; R 2019) Low-voltage surge protective devices -- Part 11: Surge protective devices connected to low-voltage power systems -- Requirements and test methods
JIS C 61000-3-2	(2019) Electromagnetic compatibility (EMC) -- Part 3-2: Limits -- Limits for harmonic current emissions
JIS C 8105-1	(2021) Luminaires - Part 1: General Requirements For Safety
JIS C 8105-2-3	(2011) Lighting-Part 2-3: Road and Street Lighting Fixtures Safety requirements
JIS C 8131	(2013) Luminaires for Road Lighting
JIS C 8152-2	(2019) Measurement method of white light emitting diode (LED) for lighting-Part 2: LED modules and LED light engines
JIS C 8152-3	(2013) Measurement method of white light emitting diode (LED) for lightingPart 3: Measurement of luminous flux maintenance rate

JIS C 8153	(2015) DC or AC supplied electronic control gear for LED modules -- Performance requirements
JIS C 8154	(2015) LED modules for general lighting -- Safety specifications
JIS C 8155	(2019) LED modules for general lighting -- Performance requirements
JIS C 8201-5-2	(2017) Low-Voltage Switchgear And Control Gear- Part 5-2: Control Circuit Devices And Switching Elements- Proximity Switches
JIS C 8201-4-3	(2010) Low-voltage switchgear and controlgear -- Part 4-3: Contactors and motor-starters -- AC semiconductor controllers and contactors for non-motor loads
JIS C 8369	(2020) Photoelectric Controls for Public Lighting
JIS C 8462-1	(2021) Boxes and enclosures for electrical accessories for household and similar fixed electrical installations -- Part 1: General requirements
JIS H 8641	(2021) Hot Dip Galvanized Coatings
JIS Z 2371	(2015) Methods of Salt Spray Testing
JIS Z 8113	(1998) Lighting vocabulary
JIS Z 9110	(2010; R 2011) General rules of recommended lighting levels
JIS Z 9111	(2022) Lighting for roads

1.2 RELATED REQUIREMENTS

Materials not considered to be luminaires or lighting equipment are specified in Section(s) [33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION] [33 71 01.00 40 OVERHEAD TRANSMISSION AND DISTRIBUTION] [33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION]. Luminaires and accessories installed in interior of buildings are specified in Section [26 51 00 INTERIOR LIGHTING] [26 51 00.00 40 INTERIOR LIGHTING].

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings shall be as defined in JIS Z 8113.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality

Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Photometric Plan; G[, [_____]]

LED Luminaire Warranty;

SD-02 Shop Drawings

Luminaire Drawings

Poles

SD-03 Product Data

[[LED,]Luminaires; G[, [_____]]

] Luminaire Light Sources; G[, [_____]]

Luminaire[Power Supply Units (Drivers)]; G[, [_____]]

Lighting Contactor; G[, [_____]]

Time Switch; G[, [_____]]

Lighting Control Relay Panel; G[, [_____]]

Motion Sensor; G[, [_____]]

Photocell; G[, [_____]]

Concrete Poles; G[, [_____]]

Aluminum Poles; G[, [_____]]

Steel Poles; G[, [_____]]

Fiberglass Poles; G[, [_____]]

Obstruction Marker Luminaires; G[, [_____]]

SD-06 Test Reports

Operating Test

Submit operating test results as stated in paragraph entitled "Field Quality Control."

SD-10 Operation and Maintenance Data

Operational Service

Submit documentation that includes contact information, summary of

procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

1.5.1.1 Luminaire Drawings

Include dimensions, effective projected area (EPA), accessories, and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio, aiming diagram, and[computerized] candlepower distribution data shall accompany shop drawings.

[1.5.1.2 Poles

Include dimensions, wind load determined in accordance with JIS C 8105-2-3, pole deflection, pole class, and other applicable information.[For concrete poles, include: section and details to indicate quantities and position of prestressing steel, spiral steel, inserts, and through holes; initial prestressing steel tension; and concrete strengths at release and at 28 days.]

]1.5.2 Photometric Plan

For LED luminaires, include computer-generated photometric analysis of the "designed to" values for the "end of useful life" of the luminaire installation using a light loss factor of 0.7. For LED and all other types of luminaires, the submittal shall include the following:

Horizontal illuminance measurements at finished grade, taken at a maximum of every 3050 mm.

Vertical illuminance measurements at 1500 mm above finished grade.

Minimum and maximum lux levels.

Average maintained lux level.

Maximum to minimum ratio for horizontal illuminance only.

1.5.3 Design Data for Luminaires

a. Provide distribution data according to IES classification type as defined in JIS Z 9110.

b. Shielding as defined by JIS Z 9111 or glare rating for the installed position as defined by JIS Z 9110.

c. Provide wind loading calculations for luminaires mounted on poles. Weight and effective projected area (EPA) of luminaires and mounting brackets shall not exceed maximum rating of pole as installed in particular wind zone area.

1.5.4 LED Luminaire - Test Report

Submit test report on manufacturer's standard production model luminaire. Submittal shall include all photometric and electrical measurements, as

well as all other pertinent data per JIS C 8152-2.

1.5.5 LED Light Source - Test Report

Submit report on manufacturer's standard production LED package, array, or module. Submittal shall include:

a. Testing agency, report number, date, type of equipment, and LED light source being tested.

b. All data required by JIS C 8152-3.

1.5.5.1 Test Laboratories

Test laboratories for the JIS C 8152-2 and JIS C 8152-3 test reports shall be:

A manufacturer's in-house lab that meets the following criteria:

1. Manufacturer has been regularly engaged in the design and production of high intensity discharge roadway and area luminaires and the manufacturer's lab has been successfully certifying these fixtures for a minimum of 15 years.

2. Annual equipment calibration including photometer calibration in accordance with applicable stanards.

[1.5.6 Tests for Fiberglass Poles

a. Ultraviolet resistance tests: Perform using a UV-B light source having a 313 nanometer wavelength, operated at 54 degrees C, cycling the light source on for 4 hours and off for 4 hours for a total test period of 1500 hours minimum with the following results:

Fiber exposure:	None
Crazing:	None
Checking:	None
Chalking:	None
Color:	May dull slightly

b. Flexural strength and deflection test: Test loading shall be as a cantilever beam with pole butt as fixed end and a force simulating wind load at the free end.

]1.5.7 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of applicable codes and standards unless more stringent requirements are specified or indicated.

1.5.8 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.8.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if the manufacturer has been regularly engaged in the design and production of high intensity discharge roadway and area luminaires for a minimum of 15 years. Products shall have been in satisfactory commercial or industrial use for 15 years prior to bid opening. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 15-year period.

1.5.8.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

[1.6 DELIVERY, STORAGE, AND HANDLING OF POLES

[1.6.1 Concrete Poles

Do not store poles on ground. Support poles so they are at least 305 mm above ground level and growing vegetation.

][1.6.2 [Fiberglass] [Aluminum] [Steel] Poles

Do not store poles on ground. Support poles so they are at least 305 mm above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

]]1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

[1.7.1 LED Luminaire Warranty

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

a. Provide a written five year on-site replacement warranty for material,

fixture finish, and workmanship. On-site replacement includes transportation, removal, and installation of new products.

1. Finish warranty shall include warranty against failure and against substantial deterioration such as blistering, cracking, peeling, chalking, or fading.

2. Material warranty shall include:

(a) All power supply units (drivers).

(b) Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective or non-starting.

b. Warranty period must begin on date of beneficial occupancy. Contractor shall provide the Contracting Officer signed warranty certificates prior to final payment.

]1.8 OPERATIONAL SERVICE

Coordinate with manufacturer for [maintenance agreement] [take-back program]. Collect information from the manufacturer about [maintenance agreement] [green lease] options, and submit to Contracting Officer. Services shall reclaim materials for recycling and/or reuse. Services shall not deposit materials in landfills or burn reclaimed materials. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be luminaires, equipment or accessories are specified in[Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION,][Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION,][and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.] Luminaires and associated equipment and accessories for interior applications are specified in Section 26 51 00 INTERIOR LIGHTING.

2.2 [LED,] LUMINAIRES

JIS C 61000-3-2, JIS C 8154 and JIS C 8155. Provide luminaires as indicated in luminaire schedule and XL plates or details on project plans. Provide luminaires complete with light sources of quantity, type, and wattage indicated. All luminaires of the same type shall be provided by the same manufacturer.

2.2.1 General Requirements

a.[LED luminaire housings shall be die cast or extruded aluminum.][Housings for luminaires other than LED shall be die cast, extruded, or fabricated aluminum. Fabricated aluminum housings shall have all seams and corners internally welded to resist weathering, moisture and dust.]

[b. LED luminaires shall be rated for operation within an ambient temperature range of minus 30 degrees C to[40 degrees C][50 degrees C].

] c. Luminaires shall be listed for wet locations per JIS C 8105-1.[Optical compartment for LED luminaires shall be sealed and rated a minimum of IP65.]

[d. LED luminaires shall produce a minimum efficacy as shown in the following table, tested per JIS C 8152-2. Theoretical models of initial raw LED lumens per watt are not acceptable.

Application	Luminaire Efficacy in Lumens per Watt
Exterior Pole/Arm-Mounted Area and Roadway Luminaires	65
Exterior Pole/Arm-Mounted Decorative Luminaires	65
Exterior Wall-Mounted Area Luminaires	60
Bollards	35
Parking Garage Luminaires	70

] e. Luminaires shall have lighting distribution and field angle classifications as indicated in luminaire schedule on project plans per JIS Z 9110.

f. Housing finish shall be baked-on enamel, anodized, or baked-on powder coat paint. Finish shall be capable of surviving JIS Z 2371 salt fog environment testing for 2500 hours minimum without blistering or peeling.

g. Luminaires shall not exceed the following JIS Z 9110 Glare ratings:

1. Maximum Glare (G) rating shall be determined by lighting zone in which luminaire is placed.

h. Luminaires shall be fully assembled and electrically tested prior to shipment from factory.

i. The finish color shall be as indicated in the luminaire schedule or detail on the project plans.

[j. Luminaire arm bolts shall be 304 stainless steel or zinc-plated steel.

] k. Luminaire lenses shall be constructed of[clear][frosted] tempered glass or UV-resistant acrylic.[Provide polycarbonate vandal-resistant lenses as indicated.]

[l. The wiring compartment on pole-mounted, street and area luminaires must be accessible without the use of hand tools to manipulate small screws, bolts, or hardware.

] m. Incorporate modular electrical connections, and construct luminaires to allow replacement of all or any part of the optics, heat sinks, power supply units, ballasts, surge suppressors and other electrical

components using only a simple tool, such as a manual or cordless electric screwdriver.

n. Luminaires shall have a nameplate bearing the manufacturer's name, address, model number, date of manufacture, and serial number securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable.

[o. Roadway and area luminaires shall have an integral tilt adjustment of plus or minus 5 degrees to allow the unit to be leveled in accordance with JIS C 8105-2-3.

] p. Luminaire must pass vibration testing in accordance with JIS C 8105-2-3 and JIS C 8131.

q. All factory electrical connections shall be made using crimp, locking, or latching style connectors. Twist-style wire nuts are not acceptable.

2.2.2 Luminaire Light Sources

[2.2.2.1 LED Light Sources

a. Correlated Color Temperature (CCT) shall be in accordance with JIS C 8155:

[Nominal CCT: 4000 degrees K: 3985 plus or minus 275 degrees K

] b. Color Rendering Index (CRI) shall be:

Greater than or equal to [70] [_____] for 4000 degrees K light sources.

c. Color Consistency:

]2.2.3 Luminaire[Power Supply Units (Drivers)]

[2.2.3.1 LED Power Supply Units (Drivers)

JIS C 8153. LED Power Supply Units (Drivers) shall meet the following requirements:

a. Minimum efficiency shall be 85 percent.

b. Shall be rated to operate between ambient temperatures of minus 30 degrees C and 40 degrees C[50 degrees C].

c. Shall be designed to operate on the voltage system to which they are connected, typically ranging from 120 V to 480 V or 100V to 430V nominal.

d. Operating frequency shall be: 50 or 60 Hz.

e. Power Factor (PF) shall be greater than or equal to 0.90.

f. Total Harmonic Distortion (THD) current shall be less than or equal to 20 percent.

g. Shall be RoHS-compliant.

h. Shall be mounted integral to luminaire. Remote mounting of power supply is not allowed.

[i. Shall be dimmable, and compatible with a standard dimming control circuit of 0 - 10V or other approved dimming system.

] j. Shall be equipped with over-temperature protection circuit that turns light source off until normal operating temperature is achieved.

]2.2.4 LED Luminaire Surge Protection

Provide surge protection integral to luminaire as defined by JIS C 5381-11

[2.3 OBSTRUCTION MARKER LUMINAIRES

Provide obstruction marker luminaires for facilities as required by the FAA and in accordance with Section 26 56 20 AIRFIELD AND HELIPORT LIGHTING AND VISUAL NAVIGATION AIDS.

]2.4 EXTERIOR LUMINAIRE CONTROLS

[Provide a control system interface within each luminaire that is compatible with the energy management or control system used by the utility department in charge of the project area for control of site lighting.]

[2.4.1 Photocell

JIS C 8369. Photocells shall be hermetically sealed,[cadmium sulfide][silicon diode] light sensor type, rated at [_____] watts, [_____] volts, 50/60 Hz with single-pole, [single][double]-throw contacts. Photocell shall be designed to fail to the ON position. Housing shall be constructed of [polycarbonate] [die cast aluminum] [UV stabilized polypropylene], rated to operate within a temperature range of minus 40 to 70 degrees C.[Photocell shall have a 13 mm threaded base for mounting to a junction box or conduit. Provide[fixed][swivel] base type housing.][Photocell shall be twist-lock receptacle type=. Provide with solid brass prongs and voltage markings and color coding on exterior of housing.] Photocell shall turn on at 10-30 lux and turn off at 30 to 150 lux. A time delay shall prevent accidental switching from transient light sources.[Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition.][Provide photocell with metal oxide varistor (MOV) type surge protection.][Photocell to be designed for 20-year service to match life expectancy of long-life LED fixtures and exceeds 15,000 operations at full load. Provide photocell with zero-cross technology to withstand severe in-rush current and extend relay life.]

][2.4.2 Timeswitch

[Timeswitch shall be electromechanical type with a[24 hour][7 day] [astronomic] dial[that changes on/off settings according to seasonal variations of sunset and sunrise]. Switch shall be powered by an enclosed synchronous motor with a maximum 3 watt operating rating. Timeswitch contacts shall be rated for [40][_____] amps at 120-277 or 100-230 VAC resistive load in a [SPST][DPST][SPDT][DPST][normally open (NO)][

normally closed (NC)] configuration. Switch shall have an automatic spring mechanism to maintain accurate time for up to 16 hours during a power failure.[Provide switch with function that allows automatic control to be skipped on certain selected days of the week.][Provide switch with manual bypass or remote override control.]

][Timeswitch shall be an electronic type with a[24 hour][7 day] [astronomic] programming function [that changes on/off settings according to seasonal variations of sunset and sunrise], providing a total of [56][_____] on/off set points. Digital clock display format shall be[AM/PM 12 hour][24 hour] type. Provide power outage backup for switch utilizing a[capacitor][alkaline batteries][lithium battery] which provides coverage for a minimum of [7 days][3 years][8 years]. Timeswitch shall provide control to [1][2][4][_____] channels or loads. Contacts shall be rated for [30] [_____] amps at 120-277 or 100-230 VAC resistive load in a [SPST][DPST][SPDT][DPST] [normally open (NO)][normally closed (NC)] configuration. [Provide switch with [function that allows automatic control to be skipped on certain selected days of the week][manual bypass or remote override control][daylight savings time automatic adjustment][EEPROM memory module][momentary function for output contacts][ability for photosensor input]].

] Timeswitch shall be housed in a surface-mounted, lockable [indoor][weatherproof][ ] IP rated enclosure constructed of painted steel or plastic polymer conforming to JIS C 8462-1.

][2.4.3 Lighting Contactor

JIS C 8201-4-3. Provide a [mechanically][electrically]-held lighting contactor [housed in a [indoor][weatherproof][ ] IP rated enclosure conforming to JIS C 8462-1]. Contactor shall have [2][4][6][_____] poles, configured as [normally open (NO)][normally closed (NC)]. Contacts shall be rated [600] [_____] volts, [30][_____] amperes for a resistive load. Coil operating voltage shall be [24][105][120][210][240][277][_____] volts. Contactor shall have silver cadmium oxide double-break contacts [and coil clearing contacts for mechanically held contactors] and shall require no arcing contacts. [Provide contactor with hand-off-automatic [on-off] selector switch.] [Provide contactor as specified above along with [disconnect switch][circuit breaker] in integral [indoor][weatherproof][ ] IP rated enclosure with flange-mounted handle to satisfy requirement for a "combination lighting contactor" when specified.]

][2.4.4 Lighting Control Relay Panel

Panel shall consist of a single [indoor][weatherproof][ ] IP rated [flush][surface]-mounted enclosure with two separate interior sections; one for Class 1 (branch circuit) and one for Class 2 (low voltage) wiring. Provide panel with [8][16][32][_____] relays. Panel shall be designed as [a stand alone][an automated control system interface] type. The Class 1 section shall contain the load side of all relays and the incoming branch circuit wiring. The Class 2 section shall contain the control power transformer (24 volt output), relays, relay control modules, and control wiring[, and native BACnet[LONworks] field-programmable application controller for panels connected to the facility automated control system]. Panel enclosure shall be constructed of [16][14] gauge cold-rolled steel with baked-on enamel finish.

Relays shall be [1][2]-pole, rated at 20 amperes [210][300][420][440][480] VAC with rated life of 120,000 mechanical operations minimum.

Relay control module shall be 24 volt, electronic type and control up to 16 separate relays (16 channel) or programmed groups of relays. Provide with inputs for signals from devices such as photocells, timeclocks, and motion sensors. [Relay control module with integral timeclock function shall be 24 volt, electronic type with LCD display and control up to 8 separate relays (8 channel)].

][2.4.5 Motion Sensor

JIS C 8201-5-2. Provide [passive infrared][microwave][dual technology passive infrared/microwave] type sensors with [270][_____] degree coverage, time delay that can be adjusted from 15 seconds to 15 minutes, and "fail to ON position" default state. Sensors shall be located to achieve coverage of areas as indicated on project plans. Coverage patterns shall be derated as recommended by manufacturer based on mounting height of sensor and any obstructions such as trees. Do not use gross rated coverage in manufacturer's product literature. Sensors installed integral to the luminaire must be provided by the luminaire manufacturer. Sensors shall have an integral light level sensor that does not allow luminaires to operate during daylight hours and shall be designed to operate on a voltage of [105 VAC][210 VAC][120/277 VAC][24 VDC]. [Provide sensors to operate in conjunction with bi-level controllers that lower LED luminaires to a 50 percent output.] Sensor shall be [equipped with a threaded base for mounting to a weatherproof junction box][mounted directly to luminaire].

][2.5 POLES

Provide poles designed for wind loading of [161][_____] km/hr determined in accordance with JIS C 8105-2-3 while supporting luminaires and all other appurtenances indicated. The effective projected areas of luminaires and appurtenances used in calculations shall be specific for the actual products provided on each pole. Poles shall be[embedded][anchor]-base type designed for use with[underground][overhead] supply conductors.[Poles[, other than wood poles,] shall have oval-shaped handhole having a minimum clear opening of 65 by 130 mm. Handhole cover shall be secured by stainless steel captive screws.][Metal poles shall have an internal grounding connection accessible from the handhole near the bottom of each pole.] Scratched, stained, chipped, or dented poles shall not be installed.

[2.5.1 Concrete Poles

Provide concrete poles conforming to JIS A 5373. Cross-sectional shape shall be[round][or][multi-sided]. Provide poles designed for wind loading of [100][ ] meters per hour determined in accordance with JIS C 8105-2-3 while supporting luminaires and all other appurtenances indicated. The effective projected areas of luminaires and appurtenances used in calculations shall be specific for the actual products provided on each pole.

2.5.1.1 Steel Reinforcing

Prestressed concrete pole shafts shall be reinforced with steel prestressing members. Design shall provide internal longitudinal loading

by either pretensioning or post tensioning of longitudinal reinforcing members.

2.5.1.2 Tensioned Reinforcing

Primary reinforcement steel used for a prestressed concrete pole shaft shall be tensioned between 60 to 70 percent of its ultimate strength. The amount of reinforcement shall be such that when reinforcement is tensioned to 70 percent of its ultimate strength, the total resultant tensile force does not exceed the minimum section compressive strength of the concrete.

2.5.1.3 Coating and Sleeves for Reinforcing Members

Where minimum internal coverage cannot be maintained next to required core openings, such as handhole and wiring inlet, reinforcing shall be protected with a vaporproof noncorrosive sleeve over the length without the 13 mm concrete coverage. Each steel reinforcing member which is to be post-tensioned shall have a nonmigrating slipper coating applied prior to the addition of concrete to ensure uniformity of stress throughout the length of such member.

2.5.1.4 Strength Requirement

As an exception to the requirements of JIS A 5373, poles shall be naturally cured to achieve a 28-day compressive strength of 48.23 MPa. Poles shall not be subjected to severe temperature changes during the curing period.

2.5.1.5 Shaft Preparation

Completed prestressed concrete pole shaft shall have a hard, smooth, nonporous surface that is resistant to soil acids, road salts, and attacks of water and frost, and shall be clean, smooth, and free of surface voids and internal honeycombing. Poles shall not be installed for at least 15 days after manufacture.

][2.5.2 Aluminum Poles

Provide aluminum poles manufactured of corrosion resistant aluminum alloys conforming to JIS C 8105-2-3for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys and Alloy 356-T4 (3,5) for cast alloys. Poles shall be seamless extruded or spun seamless type with minimum 4.8 mm wall thickness. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Tops of shafts shall be fitted with a round or tapered cover. Base shall be anchor bolt mounted, made of cast aluminum alloy and shall be machined to receive the lower end of shaft. Joint between shaft and base shall be welded. Base cover shall be cast aluminum alloy. Hardware, except anchor bolts, shall be either anodized aluminum alloy or stainless steel.[Aluminum poles and brackets for [walkway][_____] lighting shall have a[uniform satin][dark anodic bronze][_____] finish to match fixtures and shall not be painted.] Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

][2.5.3 Steel Poles

JIS C 8105-2-3. Provide steel poles having minimum 11-gage steel with

minimum yield/strength of 331 MPa and[hot-dipped galvanized in accordance with JIS H 8641][iron-oxide primed] factory finish. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Pole shall be[direct set][anchor bolt mounted] type. Poles shall have tapered tubular members, either round in cross section or polygonal.[Pole shafts shall be one piece. Poles shall be welded construction with no bolts, rivets, or other means of fastening except as specifically approved.] Pole markings shall be approximately 900 to 1270 mm above grade and shall include manufacturer, year of manufacture, top and bottom diameters, and length.[Base covers for steel poles shall be structural quality hot-rolled carbon steel plate having a minimum yield of 248 MPa.]

][2.5.4 Fiberglass Poles

Designed specifically for supporting luminaires and having factory-formed cable entrance and handhole. Resin color shall be[dark bronze][as indicated][_____], and pigment shall provide uniform coloration throughout entire wall thickness. Finish surface shall be pigmented polyurethane having a minimum dry film thickness of 0.038 mm. Polyurethane may be omitted if the surface layer of the pole is inherently ultraviolet inhibited. Minimum fiberglass content shall be 65 percent with resin and pigment comprising the other 35 percent material content.

]][2.6 BRACKETS AND SUPPORTS

JIS C 8105-2-3, as applicable. Pole brackets shall be not less than 31.75 mm[galvanized steel pipe][aluminum] secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaires provided, and brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted street lights shall correctly position luminaire no lower than mounting height indicated. Mount brackets not less than 7320 mm above street. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminaire head.

][2.7 POLE FOUNDATIONS

Anchor bolts shall be steel rod having a minimum yield strength of 344.5 MPa; the top 305 mm of the rod shall be galvanized. Concrete shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

]2.8 EQUIPMENT IDENTIFICATION

2.8.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.8.2 Labels

Provide labeled luminaires in accordance with JIS C 8105-1 requirements. Luminaires shall be clearly marked for operation of specific light sources and ballasts according to proper light source type. The following light source characteristics shall be noted in the format "Use Only _____":

a. Correlated color temperature (CCT) and color rendering index (CRI) for

all luminaires.

Markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place.

2.9 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of JIS C 0920 corrosion-resistance test.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, JIS C 0365 and to the requirements specified herein.

[3.1.1 Concrete Poles

Install concrete poles per JIS A 5373. Poles shall be [embedded] [anchor]-base type designed for use with [underground] [overhead] supply conductors. Install according to pole manufacturer's instructions.

][3.1.2 Fiberglass Poles

Install fiberglass poles designed specifically for supporting luminaires and having factory-formed cable entrance and handhole. Install according to pole manufacturer's instructions and applicable standards.

][3.1.3 [Aluminum][Steel] Poles

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 1.57 rad at the bottom end. Provide ornamental covers to match pole and galvanized nuts and washers for anchor bolts. Concrete for anchor bases, polyvinyl chloride (PVC) conduit ells, and ground rods shall be as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.[After installation, paint exposed surfaces of steel poles with two finish coats of[exterior oil paint of a color as indicated][aluminum paint]. Install according to pole manufacturer's instructions. Alterations to poles after fabrication will void manufacturer's warranty and shall not be allowed.]

]3.1.4 Pole Setting

[Depth shall be as indicated.][Poles in straight runs shall be in a straight line. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 150 mm maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.]

[3.1.5 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations.[Mount switch on

or beside each luminaire when switch is provided in cast weatherproof aluminum housing with swivel arm.][Set adjustable window slide for [_____] lux photocell turn-on.]

]3.1.6 GROUNDING

Ground noncurrent-carrying parts of equipment including[metal poles,] luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.1.7 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test after 100 hours of burn-in time to show that the equipment operates in accordance with the requirements of this section.

-- End of Section --