# SECTION 26 50 00

# LIGHTING

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Lighting fixtures.

B. Fixture mounting hardware.

C. Lamps.

D. Emergency Lighting.

E. Lighting control equipment.

F. Source quality control.

G. Standard fixtures.

H. Appendix 1 Summary Table of Illumination Level Requirements

### 1.02 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures.

B. Section 01 33 23 – Shop Drawings, Product Data, and Samples.

C. Lighting Control Panel board (addressable panels) are specified is section 26 09 26.

### 1.03 MEASUREMENT AND PAYMENT

A. General: Lighting, as specified herein, will not be measured separately for payment but will be paid for as part of the Contract lump-sum price for Electrical Work as indicated in the Bid Schedule of the Bid Form.

### 1.04 REFERENCES

A. American National Standards Institute (ANSI):

| | | |
|---|---|---|
| 1. | ANSI C62.41 | IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits |
| 2. | ANSI C78 Series | Incandescent Lamps/Electric Discharge Lamps (Fluorescent), Electric Discharge Lamps (Mercury), High Intensity Discharge Lamps/Fluorescent Lamp Auxiliaries |
| 3. | ANSI C81 Series | Electric Lamp Bases and Holders |

| | | |
|---|---|---|
| 4. | ANSI C82.4 | Ballasts for High Intensity Discharge and Low Pressure Sodium Lamps |

B. American Society for Testing and Materials (ASTM):

| | | |
|---|---|---|
| 1. | ASTM A123/A123M | Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| 2. | ASTM A167 | Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| 3. | ASTM A366/A366M | Specification for Steel Sheet, Carbon, Cold-Rolled, Commercial Quality |

C. Federal Specifications (FS):

| | | |
|---|---|---|
| 1. | TT-P-641 | Type II Zinc Dust Primer for Steel or Galvanized Metal Surfaces |

D. Illuminating Engineering Society of North America (IES):

1. IES Lighting Handbook, Reference and Application

E. National Fire Protection Association (NFPA):

| | | |
|---|---|---|
| 1. | NFPA 101 | Code for Safety to Life from Fire in Buildings and Structures |

F. Porcelain Enamel Institute (PEI):

| | | |
|---|---|---|
| 1. | PEI S-100 | Specification for Architectural Porcelain Enamel on Steel for Exterior Use |
| 2. | PEI LS-105 | Specification for Architectural Porcelain Enamel on Aluminum for Exterior Use |

G. Underwriters Laboratories Inc. (UL):

| | | |
|---|---|---|
| 1. | UL 94 | Tests for Flammability of Plastic Materials for Parts in Devices and Appliances |
| 2. | UL 496 | Edison-Base Lampholders |
| 3. | UL 508 | Industrial Control Equipment |
| 4. | UL 542 | Fluorsescent Lamp Starters |
| 5. | UL 595 | Marine-Type Electric Lighting Fixtures |

| | | |
|---|---|---|
| 6. | UL 773 | Plug-In, Locking Type Photocontrols for Use with Area Lighting |
| 7. | UL 1029 | High-Intensity-Discharge Lamp Ballasts |
| 8. | UL 1570 | Fluorescent Lighting Fixtures |
| 9. | UL 1571 | Incandescent Lighting Fixtures |
| 10. | UL 1572 | High Intensity Discharge Lighting Fixtures |
| 11. | UL 8750 | The Standard for Safety of Light Emitting Diode (LED) Equipment for use in Lighting Products. |

## 1.05 REGULATORY REQUIREMENTS

A. Refer to Section 20 70 26 - Common Materials and Methods for Electrical Systems, for requirements.

## 1.06 SUBMITTALS

A. General: Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 - Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Product Data Luminaire Manual: Submit light fixture manual which provides product data indicating fixture construction, photometric performance, installation, and maintenance requirements. Include the following information and exhibits:

1. The Manual shall be complete with cover, title page, and table of contents. The cover and title page shall identify the document, project, client, contract name, number and date of issuance. The table of contents shall provide at a glance the overall document scope and structure and, as a minimum, a heading for each fixture type with each grouping prefaced by a "general information" report sheet.

2. The Manual shall include drawings and illustrations of sufficient detail to show the following:

    a. Fixture housing, hardware, and finishes;

    b. Lighting controlling elements;

    c. Electrical components, including lampholders, ballast, and provision for conduit entry; and

    d. Support details including foundation. Indicate weight of fixture, complete with lamps.

3. The Manual shall include procedures for installation of the complete lighting unit in its final service location. Provide templates for mounting of light poles. Provide dimensions to locations of openings and parts interfacing with remote systems, such as pole bases, mounting hardware, auxiliary electrical equipment, lighting control equipment, and lamps.

4. The Manual shall include operation and maintenance requirements in accordance with Section 01 78 23 - Operation and Maintenance Data, and the following information:

   a. Materials and components clearly indicated in the parts list;

   b. Re-lamping methods;

   c. Special tools required; and

   d. Frequency of inspection, tightening, or other service recommended for preventative maintenance.

5. The Manual shall include calculations indicating capability of light poles with light fixtures installed to withstand wind load requirements. Proper selection of anchor bolts shall be included in the computation.

C. Test Reports: Submit certified test reports of factory and field tests performed, in accordance with applicable referenced standards and Specification requirements.

D. Samples: Submit one complete light fixture or luminaire for each type required. Each sample requires the Engineer's approval and shall become the property of the District. Approved samples will become the Engineer's control samples.

## 1.07 DELIVERY, HANDLING, AND STORAGE

A. Handle and transport products in a manner that prevents damage.

B. Wrap and package products to avoid damage.

C. Indelibly mark each carton with minimum 1/2 inch high letters containing the following information:

1. Fixture, lamp, or component type.

2. Quantity.

3. Manufacturer's name and product number.

D. Store products in a clean, dry, and secure storage area pending installation.

## 1.08 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 this 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.

## PART 2 -PRODUCTS

### 2.01 LIGHT EMITTING DIODE (LED) LIGHTING

This specification covers the requirements to provide Light Emitting Diode (LED) lighting fixtures. The use of any other lighting fixture is subject to BART Engineer's approval.

A. LED Lighting Fixture

1. LED Fixture requirements are as described below:

   a. Definition: The LED Fixture shall consist of LED Luminaire, detachable LED Driver, and mounting hardware.

   b. Each fixture shall have its own LED driver. LED drivers shall be placed within LED Fixture, unless otherwise specified.

   c. Input voltage: 120 to 277VAC (±10%), 60HZ

   d. Efficacy: Shall be as indicated by the Engineer

   e. NEMA Rating: Shall be as indicated by the Engineer

   f. Brightness and glare: Lighting systems shall be free from distracting and uncomfortable glare; care shall be exercised to prevent specular reflections on signage, direct glare from exposed lamps, high brightness areas of individual fixtures, and reflections in glazing or other specular surfaces.

   g. Warranty: Minimum 5 years

   h. Cooling System: Shall consist of a heat with no fans, pumps, or liquids and shall be resistant to debris buildup that does not degrade heat dissipation performance.

B. LED Luminaire

2. Luminaire requirements are as described below:

   a. Definition: Luminaire Assembly is the LED assembly without LED driver.

   b. Correlated Color Temperature (CCT) shall be 3500K indoor, 4000K outdoor.

   c. Color Rendering Index (CRI) shall be≥85.

d. A minimum of 80,000 operating hours before reaching the L70 lumen output degradations point without catastrophic failure.

e. Difficult Access: 100,000 operating hours with remote driver if practical.

f. Conform with UL 8750

g. Compliance to FCC CFR Section 15.

C. LED Driver General requirements:

3. LED Driver general requirements as described below:

a. Input voltage: 120VAC to 277VAC (±10%)

b. Frequency: 60Hz

c. Operating temperature: -40ºC to +50ºC.

d. Minimum efficiency: 85%

e. Driver shall be dimmable.

f. Self-protected, including: surge protection & short circuit protection.

g. Compliance to FCC CFR Section 15.

h. A minimum of 50,000 operating hours.

i. Driver must have a Power Factor (PF) of ≥0.90.

j. Connectivity: wired Powerline Carrier (PLC) and/or wireless controller.

k. Regulatory compliance minimum UL recognized for the class. The driver shall be field replaceable with quick disconnect.

D. LED Dimmable Driver

4. LED Dimmable Driver requirements are as described below:

a. (Fail-Safe) 0-10V dimming standard. Lamps dimmable from 100% to 1 % of maximum light output.

b. Withstand up to a 1000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.

c. No visible change in light output with a variation of ± 10 % line voltage input.

d. Driver shall provide step-free, continuous dimming from 100% to 1%. Driver shall respond similarly when rising from 0% to 100%.

e. LED dimming driver shall provide continuous step-free, flicker free dimming over the operating range.

## 2.02 (LEGACY) FLUORESCENT AND HIGH INTENSITY DISCHARGE – LIGHTING FIXTURES

A. Requirements:

1. Provide lighting fixtures, complete and ready for service, in accordance with UL 1570, UL 1571, and UL 1572. Fixtures shall be of the number, type, material, finish, electrical components, and characteristics, and shall be provided with the necessary hardware and auxiliary equipment, as indicated. Light fixtures provided with provisions for raceways shall be UL-listed for this use. Comply also with applicable requirements and guidelines of the IES Lighting Handbook.

2. Mark fixtures clearly with manufacturer's name and catalog number, voltage, acceptable lamp type, maximum wattage, and label for intended use.

3. Fixtures shall be UL listed for the location and application indicated.

B. Materials:

1. Thicknesses, gages, and tempers of products shall be as indicated, and as recommended by the manufacturer for the specific finish, proper forming operations, and structural requirements.

2. Reflector material shall be prefinished, copper-free aluminum alloy, minimum thickness 0.032 inch, Architectural Type 1 with Class M1 anodic coating providing 83 percent reflectivity.

3. Acrylic for lenses and diffusers shall be manufactured from virgin-acrylic extrusion or injection molding pellets.

4. Polycarbonate for lenses shall be manufactured from high temperature resin designed for use with HID lamps.

5. Glass for lenses shall be of tempered borosilicate pressed or spun glass, minimum 0.13 inch thick.

6. Stainless steel shall be Type 304 conforming to ASTM A167.

C. Finishes:

1. Provide lighting fixtures completely factory-finished in colors to match the Engineer's control samples.

2. Do not start finishing operations until fabrication and forming operations have been completed.

3. Aluminum to be anodized shall be given the Aluminum Association's Architectural Class 1 anodic coating.

   a. Anodize aluminum in accordance with procedures established by alloy manufacturer to achieve color within specified range.

   b. Apply a clear organic protective coating to exposed aluminum surfaces that may experience prolonged contact with caustic material such as concrete and plaster.

4. Minimum cleaning of metal before painting shall be a five-stage phosphatizing system consisting of alkali cleaner, hot water rinse, zinc phosphatizing solution with toner, water rinse at room temperature, and chromic acid rinse for neutralizing.

5. Interior fixtures with surfaces not exceeding 150 degrees F shall be statically charged and painted two coats minimum of acrylic gloss enamel to a minimum total dry film thickness (DFT) of 2.5 mils.

6. Interior fixtures with surfaces exceeding a temperature of 150 degrees F, but not exceeding 300 degrees F, shall be statically charged and painted with silicone-alkyd enamel, two coats minimum to a total DFT of 2.5 mils.

7. Provide fixtures specified to be painted with one coat of epoxy-polyamide at a minimum DFT of 2 mils and one coat of aliphatic urethane to a minimum DFT of 2 mils. Interior reflective surfaces specified to be painted shall be as for interior fixtures.

8. Finish fixtures specified to be porcelain enameled, or painted fixtures with reflectors specified to be porcelain enameled, shall receive porcelain-enamel coating in accordance with the requirements of PEI S-100 or PEI LS-105.

9. Reflective surfaces not specified to be specular shall be gloss white, guaranteed nonyellowing, with a reflectance rating of not less than 88 percent.

10. Provide galvanized coating, where indicated, hot-dip galvanized according to ASTM A123. Where painting of the galvanized surface is indicated, pre-treat the surface with a spray of zinc chromate-vinyl butyryl wash primer at least 0.05 mil thick; apply an 80 percent zinc dust, 20 percent zinc oxide, alkyd resin primer conforming to FS TT-P-641; and then apply a single-component, Type II, modified acrylic or polyurethane top coat.

D. Electrical Components:

1. Lampholders:

   a. Provide lampholders and sockets in accordance with ANSI C78 and C81 and of the class and style recommended by the lamp manufacturer for the specific lamp required for each fixture design and rated for 660 W, 600 V, or as indicated.

   b. Fasten lampholders and sockets rigidly and securely to the mounting surface with the necessary provisions to prevent lampholder from turning and to be front removable without dismantling any part of the fixture.

c. Locate lampholders and sockets correctly in the lighting fixtures to place each specified lamp in proper position with relation to the fixture design and to ensure proper distribution of light. Clearly mark lampholders and sockets to indicate manufacturer, lamp type, voltage, and appropriate listings.

d. Provide incandescent and high intensity discharge lampholders of glazed porcelain body with nonferrous metal components of heavy-duty design, vibration resistant. Edison-based lampholders shall be in accordance with UL 496.

1) Provide phenolic body, double contact, bayonet sockets rated 75 W, 125 V, for special compact fluorescent and low wattage incandescent lamps such as the 20 W T6-1/2.

2) Provide position oriented mogul base sockets for metal halide lamps that are to be operated in the universal burning position.

e. Provide fluorescent lampholders of white urea, spring loaded with silver-plated contacts of the pedestal or button type, in accordance with UL 542.

1) Rapid start lamps shall use medium bipin spring-loaded lampholders of the tombstone or butt configuration.

2) Miniature fluorescent pre-heat and circline lamps shall use special lampholders as recommended by the individual lamp manufacturer.

2. Ballasts:

a. Ballasts shall be only electronic type with pf correction circuit (higher than 0.9)

b. Mount each ballast securely inside the fixture so as to obtain the necessary heat dissipation. High intensity discharge ballast shall comply with UL 1029 and ANSI C82.4.

c. Pulse start metal halide lamps shall be operated by a linear reactor type ballast with ignitor or a constant wattage auto-transformer (CWA) type ballast to provide the required nominal 4kV (3kV to 5kV) pulse to start.

d. High intensity discharge lighting fixtures shall have a non-time delay automatically switched quartz standby light. The restrike/quartz light will turn on when power is restored and turns off when the HID lamp restrikes. During the period of restriking restrike/quartz light shall meet minimum 1 foot candle specifications.

e. Ballast for fluorescent lamps shall be of Instant Start 265 mA, 60 Hz, electronic type, and shall meet the following requirements:

1) Operate lamps at a frequency of 20 kHz or higher without visible flicker.

2) Comply with ANSI standards.

3) Be UL listed Class P for indoor or Type 1for outdoor applications.

4) Have total harmonic distortion of less than 10 percent at 277 V.

5) Have current crest factor conform to ANSI standards.

6) Have an audible noise rating of Class A or better.

7) Contain no Polychlorinated Biphenyls (PCB) material.

8) Comply with ANSI C62.41, Category A, for transient protection.

9) Have inherent thermal protection.

10) Provide constant light output with input voltage fluctuation of plus or minus 5 percent.

11) Provide instant-start for parallel wiring connection of lamps. Allow remaining lamps to maintain full output, in the event of lamp failure on multiple lamp fixtures.

12) Comply with the requirements of Federal Communications Commission, Part 18 (RFI and EMI).

13) Provide reliable lamp starting at 0 degrees F for fixtures located outdoors and at 50 degrees F for fixtures located indoors.

3. Fixture Wiring:

a. Provide fixture wires of stranded tinned-copper construction, not smaller in wire size than 16 AWG. Provide insulation of silicone rubber type SF-2, 200 degrees C rated. Mark conductor size, temperature rating, voltage, and manufacturer clearly on the insulation of each conductor.

b. Provide wires between lampholders and associated operating and starting equipment with the same ampacity rating as leads from the ballast. Wiring within the fixtures shall comply with the California Electrical Code.

c. Tape wires at points of abrasion. Do not permit splices within fixtures other than as required to connect lampholders and ballast. Provide wireways and wiring channels with rounded edges or bushed holes wherever conductors pass through. Install insulated bushings at points of entrance and exit of wiring.

4. Fixture Grounding:

a. Unless otherwise specified, provide the housing of each ballasted lighting fixture with a separate, factory-installed grounding device.

b. A separate grounding conductor shall be attached to the grounding device on each fixture housing and connected to the ground lug terminal in the hand hole of the light pole.

c. Fluorescent fixtures connected end-to-end shall have a common ground conductor between them to provide a continuous ground path.

d. Provide only galvanized rigid conduit (GRC) and accessories, except in underground or concrete encased duct banks.

e. Light poles shall be grounded by use of a separate grounding conductor connected at one end to the grounding lug in the hand hole of each pole, and the other end connected to the grounding bus in the lighting distribution panel.

E. Fixture Hardware:

1. Latch and release mechanism, hinges, pins, and other retaining parts of fixtures; screws, bolts, or other assembly and mounting parts shall be manufactured of Type 304 or Type 316 stainless steel. Provide springs of heavy-duty stainless steel. Provide self-retaining type retaining hardware.

2. Light transmitting panels shall be held in the frames in a neat, rattle-free manner that will provide proper tolerance for normal expansion and contraction.

3. Fabricate internal brackets from ASTM A366/A366M sheet steel, zinc-coated after fabrication, or finished extruded aluminum.

4. Gaskets, sealants, and adhesives shall be formed from silicone rubber.

5. Provide bolts, nuts, washers, screws, nails, rivets, and other fastenings necessary for proper installation or assembly of work. When exposed to the atmosphere, items shall be made of 300 series stainless steel. Fastenings within the housing shall be hot-dip galvanized steel. Nuts shall have captive externally-footed lockwashers.

6. Junction boxes suitable for the intended location and wiring requirements shall be provided with four 3/4 inch threaded and plugged conduit entries.

## 2.03 FIXTURE MOUNTING HARDWARE

A. Requirements:

1. Provide fixtures with brackets, straps, canopies and stems, poles, and miscellaneous hardware suitable for the mounting method specified. Pendant mounted fixtures shall have seismic resistant swivel mountings.

2. When exposed to public view, fabricate and finish hardware in material matching the fixture body.

3. Canopies, holders, and similar parts shall be drawn or spun in one piece with a minimum 0.026 inch finished thickness.

4. Tubing used for stems shall be seamless drawn with a minimum of 1/16-inch wall thickness of size and length as indicated. Stems shall be provided for pendant- mounted fixtures of length as required for the specified mounting height with swivel hangers or ball aligners.

B. Light poles:

1. Provide the type, configuration, and dimensions indicated. The pole shall resist wind loads in accordance with the California Building Code, with Basic Wind Speed of 80 mph, Exposure C, Importance Factor 1.0. Maximum deflection of pole shall be five percent when fully loaded. Furnish poles as indicated with handhole and flush cover with tamper proof screw and grounding stud, luminaire mounting tenon/bracket, base cover and mounting hardware including anchor bolts, nuts, washers, and baseplate to permit accurate alignment and installation of pole and luminaire as indicated. Light pole anchor bolt covers shall have tamper proof screw.

2. Light pole ladder and safety cable shall conform to CCR Title 8, CAL/OSHA, Section 3277(m), Ladder Safety Devices.

## 2.04 LAMPS

A. Requirements: Provide each lighting fixture with the number, type, and wattage of lamps as indicated. Lamps used in the illumination system shall be of standard manufacture, readily available, and of the highest efficiency and life consistent with other requirements of the illumination system. Each type of lamp shall be provided by a single manufacturer.

B. Compact Fluorescent Lamps: Screw-in energy efficient type with universal burning position and integral electronic ballast with high power factor greater than 0.90. Lamps shall have a rated minimum average life of 10,000 hours, minimum 82 Color Rendering Index (CRI) and minimum 2700 degress Correlated Color Temperature (CCT).

C. Fluorescent Lamps:

1. Energy-efficient T8, rapid start fluorescent lamp rated 265 mA, wattage rating as indicated. Lamps for T8 fluorescent lighting shall have reduced mercury contents that meet U.S. Environmental Protection Agency (EPA) Toxic Characteristic Leaching Procedure (TCLP) test for non-hazardous fluorescent light waste pursuant to 22 CCR Section 66260.200 (e). The soluble concentrations of the inorganic constituents as measured by the Toxicity Characteristic Leaching Procedure (TCLP) pursuant to Title 22, California Code of Regulations (22 CCR), Section 66261.24(a), shall be below the established regulatory thresholds.

2. Lamps shall have a rated minimum average life of 30,000 hours, minimum 78 Color Rendering Index (CRI), and minimum 4000 K Correlated Color Temperature (CCT).

Lamps for signage shall have a rated minimum 4000 degrees K Correlated Color Temperature (CCT).

D. Metal Halide Lamps: Clear or coated as indicated, suitable for all operating positions. 175 W or smaller lamps shall be for operating in any burning position. Over 175 W lamps shall be provided with position oriented mogul base. Photometric characteristics shall provide maximum luminous output while operating in the horizontal position with color temperature of 3700 degrees K and CRI of 70.

E. LED (Light Emitting Diode): See Section 2.01

## 2.05 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 plus or minus ten percent of rated voltage at 60 Hz.

B. All new lighting panels shall be addressable and remotely controllable, except Emergency lighting panels. Addressable panels will also provide status of breakers and contactors to SCADA. See Section 26 09 26, Lighting Control Panel boards.

C. Photocell General Requirements:

1. Conform with UL 773, UL 916.

2. Provide operation in temperature range of 0°C to 50°C.

3. Provide dusk-to-dawn operation, with adjustments from 2 to 50 foot candles with a ten-second time delay to preclude false switching.

4. Provide weatherproof and tamperproof equipment.

D. Installation:

1. Indoor photocells:

a. Indoor photocell shall be mounted above existing lighting fixtures and central to the area illuminated by the electrical lighting that will be controlled. The photocell shall be mounted such that only reflected light enters; no direct light is permitted to enter the photocell.

2. Outdoor photocells:

a. Outdoor photocells shall be mounted in an area exposed to full daylight and not shadowed or directly exposed to nighttime illumination. Photocells must be mounted horizontally, facing north, with hooded portion facing upward.

E. Occupancy Sensor:

Occupancy Sensor general requirements are as described below:

1. Conform to NEMA WD7.

2. Provide operation in temperature range of 0°C to 50°C.

3. Provide Adjustable Time Delay, 1-30min (1min. increments).

4. Occupancy sensors shall be of type Passive infrared (PIR) or dual-technology PIR/Ultrasonic.

5. Utilize multiple segmented lens with internal grooves to eliminate dust and residue build-up.

6. Occupancy sensors shall have a 360 degree coverage pattern for both PIR and dual-technology detection.

Wired Occupancy Sensor:

Wired Occupancy Sensor requirements are as described below:

1. Connects directly to compatible ballast/driver without need of power pack or other interface.

2. Turn off or reduces lighting automatically through time delay when a room or area is vacated by last person to occupy space.

3. Occupancy sensor shall have self-adjusted sensitivity and timing to ensure optimal lighting control.

4. Furnished with field-adjustable controls for time delay and sensitivity to override any self-adjusting features.

5. Settings and learned parameters shall be saved in non-volatile memory and not lost should power be interrupted and subsequently restored.

Wireless Occupancy Sensor:

Wireless Occupancy Sensor requirements are as described below:

1. Operational life of 10 years without the need to replace batteries when installed per manufacturer’s recommendation.

2. Communicates directly to compatible RF receiving devices through use of a radio frequency communications link or through wireless gateway.

3. Provides a visible method of indication to verify that motion is being detected during testing and that the unit is communicating to compatible RF or wireless gateway receiving devices.

## 2.06 EMERGENCY LIGHTING

A. Emergency lighting system shall be arranged to provide the required illumination automatically in the event of interruption of normal light, such as failure of utility opening of a circuit breaker or fuse, or any manual opening(s), including accidental switch off of the controlling normal lighting system.

B. Emergency lighting shall be 1/3 of total lighting.

C. For tunnels and Transbay Tube all lighting shall be emergency lighting.

D. Emergency lighting shall be connected through UPS.

E. The batteries will provide sufficient power to maintain the nominal voltage of the inverter for a period of 90 minute minimum.

F. All exit signs.

G. Mandatory locations for luminaries must be provided for the following:

(Note: Near means within 5 feet)

1. At each exit door.
2. All safety exit signs.
3. Outside and near each final exit door.
4. Near stairs so that each tread receives direct light.
5. At each change of direction.
6. Near each first aid post.
7. Near any change of floor level.
8. At each intersection of corridors.
9. At each piece of fire fighting equipment and call point.
10. In Electrical and Mechanical rooms.
11. At Escalator such that top and bottom steps/landings are adequately illuminated.

H. Raceway

1. New Raceway in Existing and New Facility.

    a. Normal and Emergency lighting circuits must be in separate conduits.

2. Existing Raceway in Existing Facility.

   a. Normal and Emergency lighting circuits can be mixed in the same conduit with special permission from BART Engineering.

## 2.07 SOURCE QUALITY CONTROL

A. The lighting fixture to be tested shall be typical of the unit it represents, clean and free from mechanical defects, equipped with the proper fittings, and with the lamp of the size and type in the position recommended for service operation.

B. Test UL-listed material, equipment, and components in accordance with UL standards. Test material, equipment, and components not covered by UL standards in accordance with nationally recognized standards. Provide material, equipment, and components bearing a label tag or certification of such inspection.

C. Perform and report tests for photometric performance in accordance with the approved methods outlined by the IES Lighting Handbook for photometric testing, and include data on candlepower, distribution, zonal lumens, maximum luminance values, and luminaire efficiency, including complete coefficients of utilization tables to indicate compliance with performance requirements.

D. Test data shall be reported on 8-1/2 inch by 11-inch sheets and shall be certified by a nationally recognized independent testing laboratory.

## 2.08 STANDARD FIXTURES

A. Tunnel Fixtures: Provide fixtures that are UL listed for wet locations, and that include the following features, appurtenances, and accessories:

1. Housing shall be 0.125 inch extruded aluminum with anodized finish. Housing upper portion shall have an integral continuous clevis on each side, accommodating a slide grip hanger assembly, eliminating all mounting hole requirements.

2. End caps shall be 0.150 thick cast aluminum with service entry hubs on each end for 1/2-inch conduit. End caps and hub assembly shall be firmly held against the extruded housing and lens by a cast aluminum bracket on each end.

3. Reflector/ballast cover shall be of 0.05 inch aluminum and chain hinged for ease of access with baked-on white enamel finish

4. Provide gasket continuous along the length of lens/housing intersection with one piece 0.250 inch close celled neoprene gasket. Gasket the entire inner wall of each end cap with 0.250 inch close celled neoprene gasket.

5. Provide wall-mounting bracket for 45 degree mounting tilt. Bracket shall be galvanized plate steel and moveable along the entire length of fixture housing. Two brackets per fixture are required.

6. Diffuser shall be of 0.125 acrylic with internal prisms for low brightness and smooth external surface for minimizing dirt collection.

7. Provide electronic ballast for single fluorescent rapid start lamp at 277 V.

8. Tunnel lighting fixtures and mounting devices shall be designed to withstand air pressure waves ranging from plus 80 psf to minus 80 psf repetitively with each passing train.

9. Lamp shall be energy-efficient T8, rapid start fluorescent lamp rated 265 mA, wattage rating as indicated. Lamps for T8 fluorescent lighting shall have reduced mercury contents as specified in this section. Lamps shall have a rated minimum average life of 30,000 hours, minimum 78 Color Rendering Index (CRI) and minimum 4100 degrees K Correlated Color Temperature (CCT).

B. Emergency Trip Station Blue Light: Provide fixtures that are UL listed for wet locations, and that include the following features, appurtenances, and accessories:

1. Provide housing and outlet box of glass reinforced (30 percent) polyester material conforming to UL 94V-0. Polyester housing and box shall be non-fading, permanent gray color, ultraviolet resistant.

2. Provide blue enclosing globe of heat-resistant glass with integral male threads for mounting into housing.

3. Boxes shall be four-way tapped for 3/4-inch conduit. Plugs shall be of same polyester material. Provide box with mounting ears.

4. The blue light shall be composed of two ultra-bright, long lasting LED lamps and shall be visible at any point within 250 feet from its designated mounting location.

5. The blue light LED lamp shall provide a minimum of 200 lumens output.

6. The blue light shall flash at a minimum rate of 78 flashes per minute.

7. The blue light shall be housed in vandal-resistant, impact resistant polycarbonate retractor housing lens resistant UV-fade.

8. The light LEDs shall be connectorized and field-replaceable.

C. Operator's Access Aisle Fixture: Provide fixtures that are UL listed for wet locations, and that include the following features, appurtenances, and accessories:

1. Provide one piece housing of die cast aluminum with integral cooling fins over the optical chamber and electrical compartments and double thick gussets on the support arm-mounting end. Housing shall form a half-cylinder shape with 55 degree front face plane providing a recess to allow a flush single-latch detail. All hardware shall be stainless steel.

2. Provide lens frame and cam-latch of die cast aluminum and mate with 1 inch minimum depth around the gasket flange. Provide integral cast hinges with stainless steel pins that allow removal, without tools, from the housing. Cam-latch shall provide positive locking and sealing of the optical chamber.

3. Provide clear tempered glass lens 3/16-inch thick with one piece molded perimeter gasket seal retained by eight stainless steel clips.

4. Provide reflector assembly of specular alzak aluminum mounted in an aluminum frame attaching to fixture housing as a one piece module. Reflector module shall be field rotatable in 90 degree increments.

5. Provide factory pre-wired electrical module components on a single plate with a socket to a quick-disconnect plug and include a wire seal through the barrier wall. Attach module to housing with no-tool hinges and latches, accessible by opening the lens frame only.

6. Support arm shall be one piece extruded aluminum, fully radiussed internal bolt guides top and bottom and circular cut for specified round pole. Provide luminaire to pole attachment by internal draw bolts and include a pole reinforcement plate with wire strain relief.

7. Provide finish housing, lens frame, latch and support arm with thermoset polyester powder coat paint in natural aluminum color. Components shall be thoroughly cleaned and primed with protective chromate conversion coating prior to powder coating. Powder coating shall be 2.5 mils nominal thickness.

8. Provide metal halide lamp, 277 V ac.

D. Cross Passage Yellow Light: Fixture shall be identical to emergency trip blue light fixture except equipped with yellow enclosing globe. Enclosing globe shall be of heat-resistant glass with integral male threads for mounting into housing.

E. Wet Standpipe Valve White Light: White light shall be xenon strobe type, 120VAC, 1000 effective candela. The base shall be comprised of corrosion-resistant, anodized aluminum, with integrated power supply. Enclosing case shall be of heat-resistant, Fresnel lens, and clear-type.

## PART 3 - EXECUTION

### 3.01 INSTALLATION OF LIGHTING FIXTURES

A. Install lighting fixtures as indicated and in accordance with the manufacturer's installation instructions and recommendations, complete with lamps, hangers, brackets, poles, fittings, and accessories, ready for operation.

B. Align, mount, and level lighting fixtures uniformly.

C. Avoid interference with, and provide clearance for, the equipment. Where the indicated locations for the lighting fixtures conflict with the locations for other equipment, change the

locations for the lighting fixtures by the minimum distances necessary and as approved by the Engineer.

D. For suspended lighting fixtures, provide the indicated mounting height clearances between the bottoms of the fixtures and the finished floors.

E. Anchor lighting fixture supports to the structural slab or to structural members as indicated. Supports shall maintain the fixture positions after cleaning and re-lamping. Provide supports for seismic loading in accordance with applicable requirements of the California Building Code and the California Electrical Code.

F. Surface-mounted lighting fixtures shall be bracketed rigidly from the mounting surfaces. Provide 1/4-inch clearance between surfaces when the fixture is flat- mounted against concrete surfaces. Install fixtures with a non-cumulative dimensional alignment tolerance of 1/16-inch when mounted in continuous runs with one inch spacing between individual fixtures. Nipples carrying wires between fixtures shall be watertight.

G. Where aluminum is placed in contact with dissimilar materials, except galvanized steel, zinc, or stainless steel, treat contact surfaces as follows:

1. When in contact with dissimilar metals, apply a prime coat of zinc chromate primer followed by two coats of aluminum and masonry paint.

2. When in contact with concrete, masonry, and plaster, apply zinc chromate primer, bituminous paint, aluminum and masonry paint, or pressure-sensitive tape to aluminum contact surfaces.

3. When in contact with wood or other absorptive materials, apply two coats of aluminum house paint to such materials, and protect aluminum contact surfaces with bituminous paint.

H. Welding:

1. Locate welds in assemblies to be anodized so as to conceal visible discoloration in the heat-affected zone.

2. Where weld metal will be exposed after anodizing, select filler alloys to closely match composition of base metal. Follow manufacturer's recommendations for such filler alloys.

I. Provide pendant fixtures with stem swivel hangers to assure a plumb installation with a minimum 45-degree swing from horizontal in all directions. Where 45-degree movement of fixture is not possible due to field conditions, provide, in addition to above, cross bracing of aircraft cable to restrict movement in direction of potential contact. Tubing shall be not less than 3/16-inch diameter. Motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation. For heavy pendant-mounted fixtures, where support is to be independent of the outlet box, provide stem swivel hangers with fixture studs.

J. Install fixtures to be pole-mounted in accordance with the manufacturer's installation instructions.

K. Provide required lamps in each pole-mounted lighting fixture as soon as fixtures are properly installed.

## 3.02 INSTALLATION OF BALLASTS

A. Install ballasts, other than those mounted integrally within luminaries, in such a manner that the ballast is protected from weather, moisture, and other atmospheric conditions, and in ambient temperatures that will not cause the temperature of the ballast housing hot-spot to exceed UL requirements.

B. Voltage drop to lamp, due to remote ballast mounting, shall not exceed one percent of the nominal lamp voltage. Provide secondary ballast conductors with 1 kV insulation. When more than one ballast is mounted at one location, the minimum spacing between ballasts shall be 6 inches in a horizontal direction and 12 inches in a vertical direction. Mount ballast components securely in such a manner as to obtain the necessary heat dissipation.

## 3.03 INSTALLATION OF LIGHT POLES

A. Install light poles as indicated and in accordance with the manufacturer's installation instructions and recommendations. Light poles shall be grounded as indicated on the Contract Drawings.

## 3.04 CONCRETE BASES

A. Provide necessary templates and anchor kits before starting work, and coordinate installation of anchors in concrete with the work specified under Division 3 - Concrete.

## 3.05 FIELD QUALITY CONTROL

A. Inspect luminaries, lamps, and associated hardware before and after installation to ensure that they are of the quality and type specified and indicated, and are free of defects and damage.

B. Deliver luminaries and lighting equipment to the project site complete with related items, completely wired and assembled.

C. Whenever practicable, test lighting systems at the same time that the distribution panelboard or switchboard is tested.

D. Replace lamps that fail within 90 days after final acceptance without additional cost to the District.

F. Test light poles for continuity to the grounding system.

# APPENDIX 1

# SUMMARY TABLE OF ILLUMINATION LEVEL REQUIREMENTS

| Room/Area | Average footcandle | Light Type | Controls |
|---|---|---|---|
| **ABOVE GROUND STATIONS** | | | |
| Concourse | 30 | LED | Dimmable, Powerline carrier technology |
| Edge of platform | 30 | LED | Photocell and Powerline carrier technology |
| Platform for queuing, waiting area | 20 | LED | Photocell and Powerline carrier technology |
| Platform | 20 | LED | Photocell and Powerline carrier technology |
| **UNDERGROUND STATIONS** | | | |
| Concourse | 30 | LED | Dimmable, Powerline carrier technology |
| Edge of platform | 30 | LED | Dimmable, Powerline carrier technology |
| Platform for queuing, waiting area | 30 | LED | Dimmable, Powerline carrier technology |
| Platform | 30 | LED | Dimmable, Powerline carrier technology |
| **ALL STATIONS** | | | |
| Fare gates | 50 | LED | Dimmable, Powerline carrier technology (same as surrounding space) |
| Vending machine area | 50 | LED | Dimmable, to reduce contrast with surrounding environment, powerline carrier technology (same as surrounding space) |
| Exterior patron waiting area | 10 | LED | Dimmable to reduce contrast during daytime and evening hours with photocell control, powerline carrier technology |
| Concessions | 40 | LED | Dimmable, Powerline carrier technology to match surrounding environment. If concessions area is enclosed, then a separate manual switch is recommended for the tenant. |
| Station's agent booth | 60 | LED | Dimmable with local switch |

| | | | |
|---|---|---|---|
| Pedestrian tunnels | 30 | LED | Dimmable, Powerline carrier technology |
| Pedestrian overpass | 10 | LED | Dimmable, Powerline carrier technology |
| Escalator landing and Elevator lobbies | 10-20 depending on surrounding area, no lower than 10 | LED | Same as surrounding space |
| Elevator Car | 5 | LED | Manual Switch |
| Escalators, stairways, and passageways | 10-20 depending on surrounding area | LED | Same as surrounding space |
| Public restrooms | 15 | LED | Manual switch |
| Staff rooms, break rooms, and staff restrooms | 30 | LED | Motion detector with local manual switch |
| Equipment rooms, train control rooms, train control huts, IT and server rooms | 60 | LED | Bi-level local manual switching |
| Storage and stockrooms | 15 | LED | Motion detector with local manual switch |
| Janitorial rooms | 20 | LED | Motion detector with local manual switch |
| Elevator machine rooms | 50 | LED | Bi-level local manual switching |
| Underplatform utility chases | 15 | LED | Local manual switch |
| Elevator and Escalator pits | 15 | LED | Local manual switch |
| PG&E and utility vault and pits | 15 | LED | Local manual switch |
| Substation, main electrical rooms, power house, and fan rooms | 50 | LED | Bi-level local manual switching |
| Electrical, generator, fuel rooms, UPS, battery, and mechanical rooms | 30 | LED | Bi-level local manual switching |
| Bike locker area | 10 minimum, average shall match surrounding area | LED | Same as surrounding space |
| Station entrances and exits | 10 | LED | Same as surrounding space with photocell controls |

**ENCLOSED PARKING STRUCTURES**

| Room/Area | Average footcandle | Light Type | Controls |
|---|---|---|---|
| Traffic lanes | 10 | LED | Dimmable, powerline carrier technology |
| Entrance and exit areas for vehicles | 50 | LED | |
| Parking stalls | 10 | LED | |
| Photo voltaic parking stalls under canopy | 10 | LED | |
| Stairs, escalators, and elevator landings | 10-20 depending on surrounding space | LED | |
| Pedestrian walkways | 10 | LED | |

**OPEN SITE AREAS**

| Area | Average footcandle | Light Type | Controls |
|---|---|---|---|
| Open parking areas and lots | 2 | LED | Photocell and Powerline carrier technology or wireless control |
| Loading, unloading, kiss-and-ride areas, and pedestrian walkways | 5 | LED | |

**POLICE ZONE FACILITY**

| Room/Area | Average footcandle | Light Type | Controls |
|---|---|---|---|
| Main lobby | 20 | LED | Motion detector with dimming and manual switch |
| Record/dispatch room | 45 | LED | Motion detector with dimming and manual switch |
| Sally port | 30 | LED | Local manual switch |
| Secure interview area | 40 | LED | Motion detector with dimming and manual switch |
| Offices and open area workstation | 60 | LED | Motion detector with dimming and manual switch |
| Training/squad room | 60 | LED | Motion detector with dimming and manual switch |
| Exercise/locker/restrooms | 30 | LED | Motion detector with dimming and manual switch |

**REVENUE VEHICLE YARD AND SHOPS**

| Room/Area | Average footcandle | Light Type | Controls |
|---|---|---|---|
| Offices and conference rooms, staff training, and classrooms | 60 | LED | Motion detector with dimmable local manual switch |
| Secondary repair shop (including electrical repair and electro/mechanical repair shop | 50 | LED | Bi-level local manual switching |
| Primary repair shop and major component repair shop | 50 | LED | Bi-level local manual switching |
| Passageways and hallways | 20 | LED | Motion detector with local manual switch |
| Electrical and mechanical rooms | 30 | LED | Bi-level local manual switching |
| Working vault and pit areas | 100 | LED | Local manual switch |
| Wheel truing areas and pits, car lift areas | 100 | LED | Local manual switch |
| Break room | 30 | LED | Motion detector with dimmable local manual switch |
| Lockers and restrooms | 30 | LED | Motion detector with local manual switch |
| Janitorial rooms | 20 | LED | Motion detector with local manual switch |
| Storage rooms | 15 | LED | Motion detector with local manual switch |
| Perimeter lighting | 2 | LED | Photocell |
| Yard | 2 | LED | Powerline carrier technology |
| Parking lot areas | 2 | LED | Photocell with powerline carrier technology |
| Watch tower control room | 30 | LED | Dimmable with local manual switch |
| **TRAIN WASHER** | | | |
| General area | 20 | LED | Powerline carrier technology |
| Inside building structure | 30 | LED | Powerline carrier technology |
| Outside vicinity of gauges and meters | 30 | LED | Powerline carrier technology |

**TUNNEL**

| Area | Average footcandle | Light Type | Controls |
|---|---|---|---|
| Pedestrian walkway | 2 (absolute minimum) | LED | Power-line carrier technology |
| Switches, transformers, telephone stations, or similar | 5 | LED | Power-line carrier technology with local manual switch |
| Trackway (centerline) | 0.25 | LED | Power-line carrier technology |
| Line storage, turnaround, tail track | 5 | LED | Power-line carrier technology |
| Line maintenance and pit lighting | 5 | LED | Local manual switch |

**END OF SECTION 26 50 00**