

SECTION 26 51 00

INTERIOR LIGHTING
05/16

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), Japan Luminaires Association (JIL) 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 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 7617-1 (2017) Double-capped fluorescent lamps --
Part 1: Safety specifications

JIS C 7620-1 (2017) Self-ballasted fluorescent lamps
for general lighting service -- Part 1:
Safety specifications

JIS C 8105-1 (2021) Luminaires - Part 1: General
Requirements For Safety

JIS C 8105-2-22 (2014) Luminaires - Part 2-22: Particular
Requirements - Luminaires For Emergency
Lighting

JIS C 8117 (2008) AC supplied electronic ballasts for
fluorescent lamps

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 lighting-Part 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 8201-4-1	(2023) Low-voltage switchgear and controlgear -- Part 4-1: Contactors and motor-starters: Electromechanical contactors and motor-starters
JIS C 8201-5-1	(2022) Low-Voltage Switchgear And Control Gear - Part 5-1: Control Circuit Devices And Switching Elements - Electromechanical Control Circuit Devices
JIS C 8286	(2021) Electrical accessories -- Cord sets and interconnection cord sets
JIS C 8304	(2009; R 2019) Small switches for indoor use
JIS C 8462-1	(2021) Boxes and enclosures for electrical accessories for household and similar fixed electrical installations -- Part 1: General requirements
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 5381-12	(2021) Low-voltage surge protective devices -- Part 12: Surge protective devices connected to low-voltage power distribution systems -- Selection and application principles
JIS C 5402-20-2	(2005) Electromechanical components for electronic equipment -- Basic testing procedures and measuring methods -- Part 20-2: Test 20b -- Flammability tests -- Fireproofness
JIS C 60079-0	(2010; R 2020) Explosive atmospheres -- Part 0: Equipment -- General requirements
JIS C 61000-3-2	(2019) Electromagnetic compatibility (EMC) -- Part 3-2: Limits -- Limits for harmonic current emissions
JIS C 9730-2-7	(2019) Automatic electrical controls -- Part 2-7: Particular requirements for timers and time switches
JIS G 3141	(2021) Cold-reduced carbon steel sheet and strip

JIS G 3302	(2022) Hot Dip Zinc Coated Steel Sheet and Strip
JIS G 3547	(2015) Cold-rolled stainless steel plate, sheet and strip
JIS G 4309	(2013) Stainless Steel Wires
JIS H 8610	(1999) Electroplated-Coatings of Zinc on Iron or Steel
JIS Z 8113	(1998) Lighting vocabulary
JIS Z 9110	(2010; R 2011) General rules of recommended lighting levels
JIS Z 9112	(2019) Classification of fluorescent lamps by chromacity and colour rendering property

JAPAN LIGHTING MANUFACTURERS ASSOCIATION (JLMA)

JIL 4003	Fluorescent Lighting Fixtures with Electronic Ballast
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2021; TIA 21-1) Life Safety Code
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UNDERWRITERS LABORATORIES (UL)

UL 2043	(2013) Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces
UL 924	(2016; Reprint May 2018) UL Standard for Safety Emergency Lighting and Power Equipment
UL 94	(2023; Seventh Edition) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.2 RELATED REQUIREMENTS

Materials not considered to be luminaires or luminaire accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Luminaires and accessories mounted on exterior surfaces of buildings are specified in Section 26 56 00 EXTERIOR LIGHTING.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, must 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. Data, drawings, and reports must employ the terminology, classifications and methods prescribed by the JIS Z 9110 as applicable, for the lighting system specified. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Occupancy/Vacancy Sensor Coverage Layout;

SD-03 Product Data

Luminaires; G[, [____]]

Light Sources; G[, [____]]

Drivers, Ballasts and Generators; G[, [____]]

LED Luminaire Warranty;

Vacancy Sensors; G[, [____]]

Dimming Controllers (Dimmers); G[, [____]]

Lighting Contactor; G[, [____]]

Timeswitch; G[, [____]]

Power Hook Luminaire Hangers; G[, [____]]

Exit Signs; G[, [____]]

Emergency Lighting Unit (EBU); G[, [____]]

LED Emergency Drivers; G[, [____]]

Fluorescent Emergency Ballasts; G[, [____]]

Occupancy Sensors; G[, [____]]

Ambient Light Level Sensor ; G[, [____]]

Lighting Control Panel; G[, [____]]

SD-06 Test Reports

Occupancy/Vacancy Sensor Verification Tests;

Energy Efficiency;

1.5 QUALITY CONTROL

1.5.1 Luminaire Drawings

Include dimensions, accessories, and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio, aiming diagram, and computerized candlepower distribution data must accompany shop drawings.

1.5.2 Occupancy/Vacancy Sensor Coverage Layout

Provide floor plans showing coverage layouts of all devices using manufacturer's product information.

1.5.3 Luminaire Design Data

Provide long term lumen maintenance projections for each LED luminaire in accordance with JIS C 8152-3. Data used for projections must be obtained from testing in accordance with JIS C 8152-3 Appendix B.

1.5.4 LED Luminaire - Test Report

Submit test report on manufacturer's standard production model luminaire.

1.5.5 LED Light Source - Test Report

Submit test report on manufacturer's standard production LED light source (package, array or module). Include all applicable and required data, as outlined under "8 Report on Test Results" in JIS C 8152-3.

1.5.6 Photometric Plan

1.5.6.1 Computer-generated Photometric Plans

Computer-generated photometric plans for each space are required to verify proposed luminaires and locations meet the required performance criteria of the design using the applicable light loss factor (LLF).

Target illumination levels are provided for each Interior Application. Depending on the application and the recommendations provided by the IES, values are given as one of the following:

- a. Minimum: No values anywhere on the calculation grid may be less than this value, within a 10 percent margin of error.
- b. Minimum Average: An average, taken over the entire task area for the application, may not be less than this value, within a 10 percent margin of error.
- c. Maximum: No values anywhere on the calculation grid may be greater than this value, within a 10 percent margin of error.
- d. Maximum Average: An average, taken over the entire task area for the application, may not be greater than this value, within a 10 percent margin of error.
- e. Uniformity: Unless otherwise noted, uniformity is calculated as a ratio of the average calculated illuminance over the minimum calculated illuminance of the calculation grid.

1.5.6.2 Schematic Photometric Plan Calculations

Schematic photometric plan calculations must include:

- a. Horizontal illuminance measurements at workplane or other designated height above finished floor, taken at a maximum of every 305 mm across the task area.
- b. Average maintained illuminance level.
- c. Minimum and maximum maintained illuminance levels.
- d. Lighting power density (Watts per square meter).
- e. LLF. Recommended LLF is 0.81 for LED luminaires but LLF varies based on environment and application.

1.5.6.3 Final Photometric Plan Calculations

Final photometric plan calculations must include:

- a. Horizontal illuminance measurements at workplane or other designated height above finished floor, taken at a maximum of every 305 mm across the task area.
- b. Where applicable, vertical illuminance measurements at designated surface, taken at a maximum of every 305 mm across task area.
- c. Minimum and maximum maintained illuminance levels.
- d. Average maintained illuminance level.
- e. Average to minimum and maximum to minimum ratios for horizontal illuminance.
- f. Lighting power density (Watts per square meter).
- g. LLF. Recommended LLF is 0.81 for LED luminaires but LLF varies based on environment and application.

1.5.7 Occupancy/Vacancy Sensor Verification Tests

Submit test report outlining post-installation coverage and operation of sensors.

1.5.8 Test Laboratories

Test laboratories for JIS C 8152-2 and JIS C 8152-3 test reports must be a Japan Accredited Laboratory for solid-state lighting testing as part of the Energy-Efficient Lighting Products laboratory accreditation program for both LM-79 and LM-80 or JIS C 8152-2 and JIS C 8152-3 testing

1.5.9 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word "must" 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 must be in accordance with the mandatory and advisory provisions of applicable codes and standards, unless more stringent requirements are specified or indicated.

1.5.10 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 must have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the two-year period. Where two or more items of the same class of equipment are required, these items must 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.

1.5.10.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.10.2 Material and Equipment Manufacturing Date

Products manufactured more than six months prior to date of delivery to site must not be used, unless specified otherwise.

1.5.10.3 Energy Efficiency

Submit data indicating lumens per watt efficacy and color rendering index of light source.

1.6 WARRANTY

Support all equipment items 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.

1.6.1 LED Luminaire Warranty

- a. Provide a written 5 year on-site replacement warranty for material, fixture finish, and workmanship. On-site replacement includes transportation, removal, and installation of new products.
 - (1) Include finish warranty to include failure and substantial deterioration such as blistering, cracking, peeling, chalking, or fading.
 - (2) Material warranty must include:
 - (a) All 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. Provide the Contracting Officer with signed warranty certificates prior to final payment.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be luminaires, luminaire controls, or associated equipment are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Luminaires, luminaire controls, and associated equipment for exterior applications are specified in Section 26 56 00 EXTERIOR LIGHTING.

2.2 LUMINAIRES

JIS C 8105-1, JIS C 61000-3-2 JIS C 8154 and JIS C 8155. Provide luminaires as indicated in luminaire schedule and NL plates or details on project plans. Provide luminaires complete with light sources of quantity, type, and wattage indicated. Provide all luminaires of the same type by the same manufacturer. Luminaires must be specifically designed for use with the driver, ballast or generator and light source provided.

2.2.1 LED Luminaires

Provide luminaires complete with power supplies (drivers) and light sources. Provide design information including lumen output and design life in luminaire schedule on project plans for LED luminaires. LED luminaires must meet the minimum requirements in the following table:

<u>LUMINAIRE TYPE</u>	<u>MINIMUM LUMINAIRE EFFICACY (LE)</u>	<u>MINIMUM COLOR RENDERING INDEX (CRI)</u>
LED TROFFER - 300 x 1200 600 x 600 600 x 1200	90 LPW	80
LED Downlight	50 LPW	90
LED Track or Accent	40 LPW	80
LED Low Bay/High Bay	80 LPW	70
LED Linear Ambient	80 LPW	80

LED luminaires must also meet the following minimum requirements:

- a. Luminaires must have a minimum 5 year manufacturer's warranty.
- b. Luminaires must have a minimum [_____] lumen maintenance value of [_____] hours as calculated by JIS C 8152-3, with data obtained per JIS C 8152-3 requirements.
- c. Luminaire drive current value must be identical to that provided by test data for luminaire in question.
- d. Luminaires must be tested to JIS C 8152-2 and JIS C 8152-3, with the results provided as required in the Submittals paragraph of this

specification.

2.2.2 Fluorescent Luminaires

JIS C 8105-1 and JIL 4003. Provide linear and compact fluorescent luminaires complete with housing, ballast and light source. All fluorescent luminaires must be equipped with electronic ballasts.

2.2.3 Induction Luminaires

JIS C 8105-1. Provide induction luminaires complete with housing, generator and light source.

2.2.4 Luminaires for Hazardous Locations

In addition to requirements stated herein, provide [LED,][fluorescent,][HID,][induction] luminaires for hazardous locations which conform to JIS C 60079-0 or which have Factory Mutual certification for the class and division indicated.

2.3 DRIVERS, BALLASTS and GENERATORS

2.3.1 LED Drivers

JIS C 8153, JIS C 8154 and JIS C 8155. LED drivers must be electronic, constant-current type and comply with the following requirements:

- a. Output power (watts) and luminous flux (lumens) as shown in luminaire schedule for each luminaire type to meet minimum luminaire efficacy (LE) value provided.
- b. Power Factor (PF) greater than or equal to 0.9 over the full dimming range when provided.
- c. Current draw Total Harmonic Distortion (THD) of less than 20 percent.
- d. Class A sound rating.
- e. Operable at input voltage of [120][240][120-277][105][210] volts at [50][60] hertz.
- f. Minimum 5 year manufacturer's warranty.
- g. RoHS compliant.
- h. Integral thermal protection that reduces or eliminates the output power if case temperature exceeds a value detrimental to the driver.
- i. UL listed for dry or damp locations typical of interior installations.
- j. [Non-dimmable], [step-dimmable to 50 percent output], or fully-dimmable using 0-10V control as indicated in luminaire schedule.

2.3.2 Fluorescent Electronic Ballasts

JIS C 8117. Fluorescent ballasts must not contain any magnetic core and coil components, and must meet the following requirements:

- a. Provide with protection as recommended by JIS C 5381-11 and

JIS C 5381-12.

b. Be designed for the wattage and type of light source provided in the luminaire specified, and have circuit diagrams and light source connection information printed on the exterior of the ballast housing.

c. Have a full replacement warranty of five years from date of manufacture.

[d. Provide all fluorescent ballasts as highest-efficiency type.
]

2.3.2.1 T8 Programmed[Instant]-Start Fluorescent Ballasts

Provide programmed[instant]-start T8 electronic fluorescent ballasts with the following characteristics:

a. Total harmonic distortion (THD): Must be [20 percent][_____ percent] (maximum).

b. Input wattage at [120/277][105][210] volts.

[c. Where indicated on project drawings, provide multi-light source luminaires with two or more ballasts to accomplish the switching scenario indicated.
]

[d. A single ballast may be used to serve multiple luminaires if they are continuously mounted and factory manufactured for that installation with an integral wireway.

]2.3.2.2 T5 (long twin tube) and T5HO Fluorescent Ballasts

a. Total harmonic distortion (THD): Not greater than[25 percent when operating one light source,][15 percent when operating two light sources,][and][20 percent when operating three light sources].

b. Input wattage shall be per Annex B, JIS C 8117

[c. Provide three[and four] light source luminaires with two ballasts per luminaire where multilevel switching is indicated.
]

[d. A single ballast may be used to serve multiple fixtures if they are continuously mounted and factory manufactured for that installation with an integral wireway.

]2.3.2.3 Compact Fluorescent Ballasts

Provide programmed-start ballasts for compact fluorescent luminaires.

2.3.2.4 Fluorescent Electronic Dimming Ballasts

Provide fluorescent electronic dimming ballasts with the following characteristics:

a. Comply with JIS C 8117 and JIL 4003, unless specified otherwise. Provide ballast as recommended by JIS C 5381-11 and JIS C 5381-12. Provide dimming capability range from 100 to 5 percent (minimum range) of light output, flicker free. Ballast must start lamp at any preset light output setting without first having to go to full light output.

Provide ballasts designed for the wattage of the light sources used in the indicated application. Provide ballasts designed to operate on the voltage system to which they are connected.

- a. Ballast must be capable of starting and maintaining operation at a minimum of minus 17 degrees C unless otherwise indicated.
- b. Ballasts for T-5 and smaller light sources must have protection circuits as required by JIS C 7617-1 and JIS C 7620-1 as applicable.

2.3.2.4.1 T-8 Lamp Ballast

Input wattage shall be per Annex B, JIS C 8117

2.3.3 Induction Generators

Generator must be connected, and operate in conjunction with an inductive power coupler or coil(s). Provide solid-state, high-frequency (200 kHz - 2.67 MHz) type, with power factor greater than 0.95, Class A sound rating, maximum input current THD of 15 percent, operating voltage of [105-210][120-240][120-277]V, and a minimum starting temperature of minus 30 degrees F. Provide generator dimmable to a minimum of 50 percent light output.

2.4 LIGHT SOURCES

JIS C 8155. Provide type and wattage as indicated in luminaire schedule on project plans.

2.4.1 LED Light Sources

- a. Correlated Color Temperature (CCT) of [3000]3500[4000][_____] degrees K.
- b. Minimum Color Rendering Index (CRI) value of 80.
- c. High power, white light output utilizing phosphor conversion (PC) process[or mixed system of colored LEDs, typically red, green and blue (RGB)].
- d. RoHS compliant.

[2.4.1.1 LED Retrofit T8 Tubes

Provide linear T8 tubular LED light sources to replace fluorescent light sources in renovation or energy conservation projects. Provide only where entire luminaires are not being replaced. Light sources must be compatible with existing instant-start or programmed-start ballasts and have the following requirements:

- a. Correlated Color Temperature (CCT) of [3000]3500[4000] degrees K.
- b. Total Harmonic Distortion (THD) less than 20 percent, with Power Factor (PF) greater than 90 percent.
- c. Minimum lumen per watt efficacy greater than 120.
- d. Minimum beam angle of 180 degrees.

- e. Minimum 5 year warranty.
- f. Minimum Color Rendering Index (CRI) of 80.

2.4.2 Fluorescent Light Sources

JIS Z 9112. Fluorescent light sources must be low-mercury, energy-savings type and be compliant with the most current TCLP test procedure at the time of manufacture.

2.4.2.1 Linear Fluorescent Light Sources

JIS C 7617-1. Provide linear fluorescent light sources with minimum CRI of 85[_____] and CCT of 3500[_____] degrees K.

2.4.2.1.1 T8 Linear Fluorescent Light Sources

Provide T8 light sources with medium bi-pin base, rated [_____] watts (maximum), [_____] initial lumens (minimum), and with an average rated life of 30,000[_____] hours using a average three hour burn time and programmed-start ballast.

2.4.2.1.2 T5HO (High-Output) Linear Fluorescent Light Sources

Provide T5HO light sources with miniature bi-pin base, rated [_____] watts (maximum), [_____] initial lumens (minimum), and with an average rated life of 30,000[_____] hours using a average three hour burn time and programmed start ballast.

2.4.2.2 Compact Fluorescent (CFL) Light Sources

JIS C 7620-1. Provide compact fluorescent (CFL) light sources with minimum CRI of 82[_____] and CCT of 3500[_____] degrees K.

2.4.3 Induction Light Sources

Provide induction light sources consisting of an electrodeless, inductively-coupled, phosphor-coated fluorescent envelope, with an average rated life of 100,000 hours minimum rated using three hours operation per start. Light sources must be compliant with the most current TCLP test procedure at the time of manufacture.

2.5 LIGHTING CONTROLS

Provide lighting controls and associated equipment in accordance with drawings and applicable energy codes. [Provide network certification for all networked lighting control systems and devices per requirements of Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS.]

2.5.1 Toggle Switches

Provide line-voltage toggle switches as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.5.2 Dimming Controllers (Dimmers)

JIS C 8304. [120/277][105/210] V[0-10 V] dimmers must provide flicker-free, continuously variable light output throughout the dimming range. Provide radio frequency interference suppression integral to

device. Provide dimmers utilizing [pulse width modulation (PWM)][constant current reduction (CCR) technology]. Provide device with a vertical slider, paddle, rotary button, or toggle (with adjacent vertical slider) type control, with finish to match switches and outlets in same area. Provide back box in wall with sufficient depth to accommodate body of switch and wiring. Devices must be capable of operating at their full rated capacity regardless of being single or ganged-mounted, and be compatible with three-way and four-way switching scenarios. Dimmers must be capable of controlling [two-wire][three-wire][0-10 volt] fluorescent ballasts or LED drivers. Ensure compatibility of dimmer with separate power packs when utilized for lighting control. Dimmers and the ballasts or drivers they control, must be provided from the same manufacturer, or tested and certified as compatible for use together.

2.5.3 Sensors for Lighting Control

UL 94, JIS C 5402-20-2 and JIS C 8201-5-1.

2.5.3.1 Occupancy Sensors

Provide occupancy sensors with coverage patterns as indicated on project plans. Provide no less quantity of sensors as shown on plans, but add additional sensors when required to fulfill coverage requirement for the specific model sensor provided. Sensor must be provided with an adaptive learning function that automatically sets sensor in optimum calibration in a set period of time after installation and a non-volatile memory that saves settings after a power outage. Provide sensors designed for ceiling, wall or wall-box installation as indicated. Operating voltage must be [105][120][210][240][277] volts.[Operating voltage must be 24V in conjunction with a control system or separate power pack which interacts with luminaire being controlled.] Provide housing of high-impact, injection-molded thermoplastic with a multi-segmented lens for PIR and dual technology sensors. Sensor operation requires movement to activate luminaires controlled, and turns luminaires off after a set time of inactivity.[Provide integral photocell mounted in occupancy sensor housing when indicated.]

2.5.3.1.1 Passive Infrared (PIR) Sensors

Provide ceiling or wall-mounted PIR sensors meeting the following requirements:

- a. Temperature compensated, dual element sensor and a multi-element fresnel lens (Poly IR4 material).
- b. Technology to optimize automatic time delay to fit occupant usage patterns.
- c. No minimum load requirement for line voltage sensors and be capable of switching from zero to 800 W at [105][120] VAC, 50/60 Hz and from zero to 1200 W at [210][240][277] VAC, 50/60 Hz. Control voltage sensors must not exceed a maximum load requirement of 20 mA at 24VDC.
- d. Time delay of five to 30 minutes in increments of five minutes with a walk through and test mode set by DIP switch.
- e. LED indicator that remains active during occupancy.
- f. Built-in light level sensor that is operational from 0.8 to 18 lux.

- g. Coverage pattern tested to applicable standards.
- h. Standard five year warranty.
- i. No leakage current to load when in the off mode.

2.5.3.1.2 Ultrasonic Sensors

Provide ceiling-mounted ultrasonic sensors meeting the following requirements:

- a. Operate at an ultrasonic frequency of [_____]kHz.
- b. LED on exterior of device to indicate occupant detection.
- c. Adjustable time delay period of 15 seconds to 15 minutes [____].
- d. Minimum five year warranty.
- [e. Provide with isolated relay for integrating control of HVAC or other automated systems.

]2.5.3.1.3 Dual Technology Sensors

Provide dual technology sensors that meet the requirements for PIR sensors and ultrasonic sensors indicated above. If either the passive infrared or ultrasonic sensing registers occupancy, the luminaires must remain on.

2.5.3.1.4 High/Low-Bay Sensors

Provide occupancy sensors specifically designed for high/low-bay mounting application using passive infrared (PIR) technology, with the following characteristics:

- a. Input voltage of [120][240][120/277][105][210] volts, at [50][60] hertz.
- b. High-impact, injection-molded thermoplastic housing with interchangeable lenses for 360 degree open area coverage or narrow rectangular, warehouse aisle coverage.
- c. Utilize zero-crossing circuitry to prevent damage from high inrush current and to promote long life operation.
- d. Be designed to mount directly to or adjacent to high or low-bay luminaires.

2.5.3.1.5 Power Packs for Sensors

UL 2043 Power packs used to provide power to one or more lighting control sensors must meet the following requirements:

- a. Input voltage - [105][210][120][240][120-277] VAC; output voltage - 24 VDC at 225 mA.
- b. Plenum-rated, high-impact thermoplastic enclosure.
- c. Utilizes zero-crossing circuitry to prevent damage from inrush current.

d. Maximum load rating of [_____] amps for electronic[_____] lighting loads.

e. RoHS compliant.

2.5.3.2 Vacancy Sensors

Provide vacancy sensors as indicated above under paragraph OCCUPANCY SENSORS, but with requirement of a manual operation to activate luminaires controlled. Provide automatic operation to turn luminaires off after a set period of inactivity.

2.5.4 [Lighting Contactor

JIS C 8201-4-1. Provide an electrically[mechanically]-held lighting contactor housed in a [indoor][weatherproof][] rated IP enclosure conforming to JIS C 8462-1. Provide contactor with one[_____] normally-open(NO)[normally closed(NC)], single[double] pole contacts, rated 600 volts, 30 amps. Provide coil operating voltage of [24][120][277][480][105][210][240][400][_____] volts.]

[2.5.5 Timeswitch

JIS C 9730-2-7. [Provide electromechanical type timeswitch with a [24 hour][7 day][astronomic] dial [that changes on/off settings according to seasonal variations of sunset and sunrise]. Provide power to switch from integral synchronous motor with a maximum three watt rating. Rate contacts at 40 amps at [105][210][120][240][120-277] volts for general purpose loads. Provide contacts in a SPST[DPST][SPDT], [normally-open (NO)][normally-closed (NC)] configuration. [Provide switch with an automatic spring mechanism to maintain accurate time for up to 16 hours.] [Provide switch with function that allows automatic control to be skipped on certain selected days of the week.][Provide switch with manual bypass[remote override] control function.]]

[Provide electronic type timeswitch 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. Provide [12 hour AM/PM][24 hour] type digital clock display format. Provide power outage back-up for switch for a minimum of [seven][_____] days. Provide switch capable of controlling a minimum of [1][2][4][_____] channels or loads. Rate contacts at [30][_____] amps at [105][210][120][240][120/277] volts for general purpose loads. Provide contacts in a SPST[DPST][SPDT], [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 adjustment][additional memory module][momentary function for output contacts][ability for photosensor input].]]

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

]2.5.6 Lighting Control Panel

Provide an electronic, programmable lighting control panel, capable of providing lighting control with input from internal programming, digital

switches, time clocks, and other low-voltage control devices.

Enclose panel hardware in a surface[flush]-mounted, [indoor][weatherproof] rated IP enclosure in accordance with JIS C 0920, painted, steel enclosure, with hinged, lockable access door and ventilation openings. Internal low-voltage compartment must be separated from line-voltage compartment of enclosure with only low-voltage compartment accessible upon opening of door.[Provide additional remote cabinets that communicate back to main control panel.]

Input voltage - [105][210][120/277] V, [50][60] Hz, with internal 24 VDC power supply.

Provide 8[16][32][_____] single-pole latching[return to close] relays rated at [20][30] amps, [120][277][105][210] volts.[Provide provision for relays to close upon power failure that meets UL 924 and JIS C 8105-2-22.]

Relay control module must operate at 24 VDC and be rated to control a minimum of 8[16][32][_____] relays.

2.5.7 Local Area Lighting Controller

Provide controller designed for single area or room with the following requirements:

- a. [105][120][210][240][277] volt input, designed for fluorescent or LED lighting loads.
- b. 2[_____] zone, with 1[2][_____] relay[s] rated 20 amps[each].
- c. Provide daylight harvesting capability with full-range dimming control.
- d. Inputs for occupancy sensor, photocell, and low-voltage wall switch.
- [e. Provide capability for receptacle load control.
-]f. Provide full 'OFF' function with input from external time clock input.

]2.6 EXIT AND EMERGENCY LIGHTING EQUIPMENT

UL 924, JIS C 8105-2-22 and NFPA 101 compliant.

2.6.1 Exit Signs

Provide exit signs consuming a maximum of five watts total.

2.6.1.1 LED Self-Powered Exit Signs

Provide in [UV-stable, thermo-plastic][painted, die-cast aluminum][painted steel] housing with [UL damp label][UL wet label][using clear polycarbonate housing], configured for ceiling[wall][end] mounting. [Provide edge-lit type with clear acrylic, edge-lit face and aluminum trim having clear aluminum[white][chrome][brass][_____] finish.] Provide 150 mm high, 19 mm stroke red[green][_____] lettering on face of sign. Provide chevrons on either side of lettering to indicate direction. Provide single[double] face. Equip with automatic power failure device, test switch, and pilot light, and fully automatic high/low trickle charger in a self-contained power pack. Battery must be sealed, maintenance free

nickel-cadmium type, and must operate unattended for a period of not less than five years. Emergency run time must be a minimum of 1 1/2 hours. LEDs must have a minimum rated life of 10 years. [Provide self-diagnostic circuitry integral to emergency LED driver.]

2.6.1.2 LED Remote-Powered Exit Signs

Provide as indicated above for self-powered type, but without battery and charger. Exit sign must contain provision for [105][210][120][240][120/277] VAC or 6-48 VDC input from remote source.

2.6.2 Emergency Lighting Unit (EBU)

Provide in [UV-stable, thermo-plastic][painted, die-cast aluminum][painted steel] housing with [UL damp label][UL wet label][IP rated enclosure in accordance with JIS C 0920] as indicated. Emergency lighting units must be rated for 12 volts, except units having no remote-mounted lamps and having no more than two unit-mounted light sources may be rated six volts. Equip units with brown-out sensitive circuit to activate battery when input voltage falls to 75 percent of normal. Equip with two[_____] LED, automatic power failure device, test switch, and pilot light, and fully automatic high/low trickle charger in a self-contained power pack. Battery must be sealed, maintenance free [lead-calcium][nickel-cadmium][_____] type, and must operate unattended for a period of not less than five years. Emergency run time must be a minimum of 1 1/2 hours. LEDs must have a minimum rated life of 10 years. [Provide self-diagnostic circuitry integral to emergency LED driver.]

2.6.3 LED Emergency Drivers

Provide LED emergency driver with automatic power failure detection, test switch and LED indicator (or combination switch/indicator) located on luminaire exterior, and fully-automatic solid-state charger, battery and inverter integral to a self-contained housing. [Provide self-diagnostic function integral to emergency driver.]Integral nickel-cadmium[lead-calcium][_____] battery is required to supply a minimum of 90 minutes of emergency power at [5][7][10][_____] watts, [10-50][_____] VDC[compatible with LED forward voltage requirements], constant output. Driver must be RoHS compliant, rated for installation in plenum-rated spaces and damp locations, and be warranted for a minimum of five years.[Provide central lighting inverter(s) to supply a minimum of 90 minutes of emergency power.]

2.6.4 Fluorescent Emergency Ballasts

Provide each 'system' with an automatic power failure device, test switch operable from the exterior of the luminaire (or remotely), a pilot light visible from the exterior of the luminaire, and fully automatic solid-state charger, battery, and inverter integral to a self-contained housing. [Provide self-diagnostic function integral to emergency ballast.] Integral [nickel-cadmium][lead-calcium][_____] battery is required to supply a minimum of 90 minutes of emergency power to one[two][_____] light source[s] within luminaire at a minimum of [500][700][1200][_____] lumens output[each]. Provide open-circuit protection and time-delay function to counteract 'end-of-life' circuitry in normal power ballast from interfering with emergency ballast operation. Ballast must be RoHS compliant, rated for installation in plenum-rated spaces and damp locations, and be warranted for a minimum of five years.[Provide central lighting inverter(s) to supply a minimum of 90

minutes of emergency power.]

[2.6.5 Self-Diagnostic Circuitry for LED and Fluorescent Emergency Drivers/Ballasts

Provide emergency lighting unit with fully-automatic, integral self-testing/diagnostic electronic circuitry. Circuitry must provide for a one minute diagnostic test every 28 days, and a 30 minute diagnostic test every six months, minimum. Any malfunction of the unit must be indicated by LED(s) visible from the exterior of the luminaire. A manual test switch must also be provided to perform a diagnostic test at any given time.

]2.6.6 Central Emergency Lighting System

Provide integrally-housed emergency system rated at [_____] VA/watts, [105][120][210][240][277] volts (input and output), for a minimum period of 90 minutes. Output frequency must be a pure sine wave at [50][60] hertz, with maximum 5 percent total harmonic distortion. Provide system with minimum short circuit rating required for protection against available fault current.

2.6.6.1 System Operation

During normal power operation, system charges batteries as needed and allows normal power to pass through to load. Upon loss of normal power, system automatically transfers to emergency mode without interruption of connected loads. Internal batteries provide a minimum of 90 minutes of emergency power at this time. Upon normal power being restored, system switches back to normal power mode and fully charges batteries within UL-approved time period.

2.6.6.2 Battery Charger

Solid state, monitored, three step float charging type, keeping batteries in a fully charged state. Provide circuitry to prevent deep discharge of batteries in prolonged power outage conditions.

2.6.6.3 Batteries

Provide sealed, lead calcium type, designed to operated unattended without maintenance, for a minimum of 10 years.

2.6.6.4 Enclosure

Provide system in [indoor][weatherproof][] rated IP enclosure in accordance with JIS C 0920 painted steel[aluminum] enclosure with exterior-mounted "push-to-test" button and LED indicator.

2.6.6.5 Accessories

Provide [_____] single pole, [_____] ampere output circuit breakers. [Voltmeter and ammmeter for battery[load].]

2.7 LUMINAIRE SUPPORT HARDWARE

2.7.1 Wire

JIS G 3547; Galvanized, soft tempered steel, minimum 2.7 mm in diameter,

or galvanized, braided steel, minimum 2 mm in diameter.

2.7.2 Wire for Humid Spaces

JIS G 4309; Annealed stainless steel, minimum 2.7 mm in diameter.

Annealed nickel-copper alloy, minimum 2.7 mm in diameter.

2.7.3 Threaded Rods

Threaded steel rods, 4.76 mm diameter, zinc or cadmium coated.

2.7.4 Straps

Galvanized steel, 25 by 4.76 mm, conforming to JIS G 3302, with a light commercial zinc coating or JIS G 3141 with an electrodeposited zinc coating conforming to JIS H 8610.

2.8 POWER HOOK LUMINAIRE HANGERS

JIS C 8105-1. Provide an assembly consisting of through-wired power hook housing, interlocking plug and receptacle, power cord, and luminaire support loop. Power hook housing must be cast aluminum having two 19 mm threaded hubs. Support hook must have safety screw. Fixture support loop must be cast aluminum with provisions for accepting 19 mm threaded stems. Power cord must include 410 mm of 3 conductor 1.2 mm Type SO cord or power cord per JIS C 8286. Assembly must be rated [105][120] volts or [210][277] volts, 15 amperes.

2.9 EQUIPMENT IDENTIFICATION

2.9.1 Manufacturer's Nameplate

Each item of equipment must 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.

2.9.2 Labels

Provide labeled luminaires in accordance with JIS C 8105-1 requirements. All luminaires must be clearly marked for operation of specific light sources and ballasts, generators or drivers. Note the following light source characteristics in the format "Use Only ____":

- a. Light source diameter code (T-5, T-8), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
- b. Start type (programmed start, instant start) for fluorescent and compact fluorescent luminaires.
- c. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

All markings related to light source type must be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when light sources are in place. Ballasts, generators or drivers must have clear markings indicating multi-level outputs and indicate

proper terminals for the various outputs.

2.10 FACTORY APPLIED FINISH

Provide all luminaires and lighting equipment with factory-applied painting system that as a minimum, meets requirements of JIS C 0920 corrosion-resistance test.

2.11 RECESS- AND FLUSH-MOUNTED LUMINAIRES

Provide access to lamp and ballast from bottom of luminaire. Provide trim [and lenses] for the exposed surface of flush-mounted luminaires as indicated on project drawings and specifications.

2.12 SUSPENDED LUMINAIRES

Provide hangers capable of supporting twice the combined weight of luminaires supported by hangers. Provide with swivel hangers to ensure a plumb installation. Provide cadmium-plated steel with a swivel-ball tapped for the conduit size indicated. Hangers must allow fixtures to swing within an angle of 0.79 rad. Brace pendants 1219 mm or longer to limit swinging. Single-unit suspended luminaires must have twin-stem hangers. Multiple-unit or continuous row luminaires must have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Provide rods in minimum 4.57 mm diameter.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations must conform to IEEE C2 and JIS C 0365 and to the requirements specified herein. Install luminaires and lighting controls to meet the requirements of applicable codes and standards. To encourage consistency and uniformity, install luminaires of the same manufacture and model number when residing in the same facility or building.

3.1.1 Light Sources

When light sources are not provided as an integral part of the luminaire, deliver light sources of the type, wattage, lumen output, color temperature, color rendering index, and voltage rating indicated to the project site and install just prior to project completion, if not already installed in the luminaires from the factory.

3.1.2 Luminaires

Set luminaires plumb, square, and level with ceiling and walls, in alignment with adjacent luminaires and secure in accordance with manufacturers' directions and approved drawings. Installation must meet requirements of applicable codes and standards. Mounting heights specified or indicated must be to the bottom of the luminaire for ceiling-mounted luminaires and to center of luminaire for wall-mounted luminaires. Obtain approval of the exact mounting height on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Recessed and semi-recessed luminaires must be independently supported from the building structure by a minimum of four wires, straps or rods per luminaire and located near each corner of the luminaire. Ceiling grid

clips are not allowed as an alternative to independently supported luminaires. Round luminaires or luminaires smaller in size than the ceiling grid must be independently supported from the building structure by a minimum of four wires, straps or rods per luminaire, spaced approximately equidistant around. Do not support luminaires by acoustical tile ceiling panels. Where luminaires of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support each independently and provide at least two 19 mm metal channels spanning, and secured to, the ceiling tees for centering and aligning the luminaire. Provide wires, straps, or rods for luminaire support in this section. Luminaires installed in suspended ceilings must also comply with the requirements of Section 09 51 00 ACOUSTICAL CEILINGS.

3.1.3 Suspended Luminaires

Provide suspended luminaires with 0.79 rad swivel hangers so that they hang plumb and level. Locate so that there are no obstructions within the 0.79 rad range in all directions. The stem, canopy and luminaire must be capable of 0.79 rad swing. Pendants, rods, or chains 1.2 meters or longer excluding luminaire must be braced to prevent swaying using three cables at 2.09 rad separation. Suspended luminaires in continuous rows must have internal wireway systems for end to end wiring and must be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Utilize aligning splines on extruded aluminum luminaires to assure minimal hairline joints. Support steel luminaires to prevent "oil-canning" effects. Luminaire finishes must be free of scratches, nicks, dents, and warps, and must match the color and gloss specified. Match supporting pendants with supported luminaire. Aircraft cable must be stainless steel. Canopies must be finished to match the ceiling and must be low profile unless otherwise shown. Maximum distance between suspension points must be 3.1 meters or as recommended by the manufacturer, whichever is less.

3.1.4 Ballasts, Generators and Power Supplies

Typically, provide ballasts, generators, and power supplies (drivers) integral to luminaire as constructed by the manufacturer.

3.1.5 Exit Signs and Emergency Lighting Units

Wire exit signs and emergency lighting units ahead of the local switch, to the normal lighting circuit located in the same room or area.

[3.1.5.1 Exit Signs

Connect exit signs on separate circuits and serve from [an emergency panel][a separate circuit breaker][a fused disconnect switch]. Provide only one source of control, which would be [the circuit breaker in the emergency panel][the separate circuit breaker][the fused disconnect switch]. Paint source of control red and provide lockout capability.

]3.1.5.2 Emergency Lighting from Central Emergency System

Connect emergency lighting from a central emergency system as indicated on the project drawings.

]3.1.6 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations.

3.1.7 Occupancy/Vacancy Sensors

Provide testing of sensor coverage in all spaces where sensors are placed. This should be done only after all furnishings (carpet, furniture, workstations, etc.) have been installed. Provide quantity of sensor units indicated as a minimum. Provide additional units to give full coverage over controlled area. Full coverage must provide hand and arm motion detection for office and administration type areas and walking motion for industrial areas, warehouses, storage rooms and hallways. Locate the sensor(s) as indicated and in accordance with the manufacturer's recommendations to maximize energy savings and to avoid nuisance activation and deactivation due to sudden temperature or airflow changes and usage.

3.1.8 Daylight or Ambient Light Level Sensor

Locate sensor as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for 300 luxor for the indicated light level measured at the work plane for that particular area.

3.2 FIELD APPLIED PAINTING

Paint lighting equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Provide painting as specified in Section 09 90 00 PAINTS AND COATINGS.

-- End of Section --