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USACE / NAVFAC / AFCEA / NASA UFGS-26 51 00.00 40 (November 2008)  
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Preparing Activity: NASA Superseding  
UFGS-26 51 13.08 40 (July 2007)

## UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2009

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### SECTION TABLE OF CONTENTS

#### DIVISION 26 - ELECTRICAL

#### SECTION 26 51 00.00 40

#### INTERIOR LIGHTING

11/08

#### PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
- 1.3 DEFINITIONS
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
  - 1.5.1 Fluorescent Electronic Ballasts
  - 1.5.2 Lighting Fixtures, Complete With Lamps and Ballasts
  - 1.5.3 Regulatory Requirements
  - 1.5.4 Standard Products
    - 1.5.4.1 Alternative Qualifications
    - 1.5.4.2 Material and Equipment Manufacturing Date
    - 1.5.4.3 Energy Efficiency
- 1.6 WARRANTY
  - 1.6.1 Electronic Ballast Warranty
- 1.7 OPERATIONAL SERVICE
- 1.8 SUSTAINABLE DESIGN REQUIREMENTS
  - 1.8.1 Local/Regional Materials
  - 1.8.2 Environmental Data

#### PART 2 PRODUCTS

- 2.1 PRODUCT STANDARDS
- 2.2 FLUORESCENT LIGHTING FIXTURES
  - 2.2.1 Fluorescent Lamp Electronic Ballasts
    - 2.2.1.1 T-8 Lamp Ballast
    - 2.2.1.2 F17T8 Lamp Ballast
    - 2.2.1.3 T-5 Long Twin Tube Lamp Ballast
    - 2.2.1.4 F96T8 Lamp Ballast
  - 2.2.2 Fluorescent Lamp Electronic Dimming Ballast
    - 2.2.2.1 T-8 Lamp Ballast
  - 2.2.3 Dimming Ballast Controls
  - 2.2.4 Light Level Sensor
  - 2.2.5 Fluorescent Electromagnetic Ballasts
    - 2.2.5.1 Electromagnetic Energy-Saving Ballasts

- 2.2.5.2 Electromagnetic Ballasts for Compact Fluorescent Lamps
- 2.2.5.3 Electromagnetic Low Temperature Ballasts
- 2.2.5.4 Electromagnetic Ballasts for T-5 Long Twin Tube Lamps
- 2.2.6 Fluorescent Lamps
- 2.2.7 Compact Fluorescent Fixtures
  - 2.2.7.1 Bare Bulb Retrofits
  - 2.2.7.2 Reflector Type Bulb Retrofits
- 2.2.8 Open-Tube Fluorescent Fixtures
- 2.2.9 Air Handling Fixtures
- 2.2.10 Electromagnetic Interference Filters
- 2.3 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES
  - 2.3.1 HID Ballasts
  - 2.3.2 High-Pressure Sodium (HPS) Lamps
    - 2.3.2.1 Standby HPS Lamps
    - 2.3.2.2 Luminaire Efficiency Rating (LER)
  - 2.3.3 Low-Pressure Sodium Lamps
  - 2.3.4 Metal-Halide Lamps
    - 2.3.4.1 Luminaire Efficiency Rating (LER)
- 2.4 INCANDESCENT LIGHTING FIXTURES
  - 2.4.1 Incandescent Lamps
- 2.5 RECESS- AND FLUSH-MOUNTED FIXTURES
- 2.6 SUSPENDED FIXTURES
- 2.7 FIXTURES FOR HAZARDOUS LOCATIONS
- 2.8 POWER HOOK FIXTURE HANGERS
- 2.9 AUXILIARY INSTANT-ON SYSTEM
- 2.10 SUPPORT HANGERS FOR LIGHTING FIXTURES IN SUSPENDED CEILINGS
  - 2.10.1 Wires
  - 2.10.2 Wires, for Humid Spaces
  - 2.10.3 Straps
  - 2.10.4 Rods
- 2.11 EQUIPMENT IDENTIFICATION
  - 2.11.1 Manufacturer's Nameplate
  - 2.11.2 Labels
- 2.12 FACTORY APPLIED FINISH
- 2.13 COMMERCIAL INCANDESCENT LIGHTING FIXTURES
  - 2.13.1 Surface-Mounted Fixtures
  - 2.13.2 Recessed Fixtures
  - 2.13.3 Pendant-Mounted Fixtures
- 2.14 INDUSTRIAL INCANDESCENT LIGHTING FIXTURES
- 2.15 ENCLOSED AND GASKETED VAPOR-TIGHT FIXTURES
- 2.16 INCANDESCENT LAMPS
- 2.17 LOWERING DEVICES FOR HIGH-BAY LIGHTING FIXTURES

## PART 3 EXECUTION

- 3.1 INSTALLATION
  - 3.1.1 Lamps
  - 3.1.2 Lighting Fixtures
  - 3.1.3 Suspended Fixtures
  - 3.1.4 Ballasts
    - 3.1.4.1 Remote Ballasts
    - 3.1.4.2 Electronic Dimming Ballasts
- 3.2 FIELD APPLIED PAINTING
- 3.3 FIELD QUALITY CONTROL
  - 3.3.1 Electronic Dimming Ballast
- 3.4 FIELD TESTING

-- End of Section Table of Contents --

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### SECTION 26 51 00.00 40

#### INTERIOR LIGHTING 11/08

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NOTE: This guide specification covers requirements for interior lighting installations. Requirements for materials and procedures for special or unusual design should be added as necessary to fit specific projects.

Emergency lighting and exit signs are covered in UFGS Section 26 52 00.00 40 EMERGENCY LIGHTING.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments and suggestion on this specification are welcome and should be directed to the technical proponent of the specification. A listing of the technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

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NOTE: In compliance with Executive Order 12902 and FAR section 23.704 which directs federal agencies to purchase products in the upper 25 percent of energy efficiency, the following products specified in this section meet or exceed the U.S. Department of Energy, Federal Energy Management Program (DOE/FEMP) Product Energy Efficiency Recommendations (PEER) for the Recommended energy efficiency levels.

This specification contains products recommended by FEMP. The following recommendations are currently on the FEMP site on the internet. Additional

recommendations may be added or existing  
recommendations updated at any time.

FEMP LT-1	(1998) How to Buy Energy Efficient Fluorescent Tube Lamps
FEMP LT-2	(1998) How to Buy Energy-Efficient Fluorescent Ballasts
FEMP LT-3	(1998) How to Buy Energy-Efficient Fluorescent Luminaires
FEMP LT-4	(1998) How to Buy Energy-Efficient Exit Signs
FEMP LT-5	(1999) How to Buy Energy-Efficient Compact Fluorescent Light Bulbs
FEMP LT-6	(1999) How to Buy Energy-Efficient Industrial HID Luminaires
FEMP LT-7	(2000) How to Buy Energy-Efficient Commercial Downlight Luminaires
FEMP LT-8	(2000; Draft) How to Select Lighting Controls For Offices and Public Buildings

Be aware that PEER is based on certain  
cost-effectiveness assumptions. Where energy prices  
and hours of use differ from those assumed in the  
PEER, recalculate cost effectiveness using the  
ratios given in the PEER.

For additional information on PEER, contact FEMP at  
800-363-3732. To view the latest information about  
buying energy efficient products on-line go to the  
FEMP home page at:  
<http://www.eren.doe.gov/femp/procurements>.

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NOTE: TO DOWNLOAD UFGS GRAPHICS

Go to <http://www.wbdg.org/ccb/NAVGRAPH/graphtoc.pdf>.

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NOTE: This section contains the following sketches  
(Graphics) and are available in metric (SI) and U.S.  
Customary (IP) system dimensions. Sketch titles and  
style numbers are unchanged for both types. The  
metric values indicated are a conversion of the IP  
system dimensions.

Do not include list of sketches, or sketches  
themselves, in project specifications. Use lighting  
fixture sketches as details on drawings whenever  
possible. If special features are required for a

project, do not modify sketches, but indicate these changes on notes in fixture schedule. The "NL" style numbers and dates should remain on the drawing details.

<u>SKETCH NUMBER</u>	<u>TITLE</u>
NL-1	Surface Mounted Wrap-Around Luminaire for Premium Office/Classroom Type Spaces
NL-2	Surface Mounted Wrap-Around Luminaire for Standard Office Type Spaces and Other Type Spaces
NL-3	Fluorescent Troffer Luminaire Lens Type
NL-4	Wall-Mounted Fluorescent
NL-5	Wall-Mounted Indirect Fluorescent With Wood Shielding
NL-6	Industrial Fluorescent
NL-7	Strip Fluorescent
NL-8	Wet/Damp Location Luminaries
NL-9	Parabolic Troffers - 610 mm x 610 mm and 610 mm x 1220 mm 2 x 2 and 2 x 4
NL-10	Parabolic Troffer - 305 mm x 1220 mm 1 x 4
NL-11	Surface, Pendant or Bracket-Mounted Parabolic Luminaire
NL-12	Steel Sided Surface Fluorescent
NL-13	Round Surface Fluorescent
NL-14	Surface Mounted 1-Lamp Vandal Resistant Luminaire
NL-15	Arm Mounted Outdoor Sign Luminaire
NL-16	Decorative/Specialty 1-Lamp Luminaire
NL-17	Recessed Round, Lens Type Compact Fluorescent
NL-18	Recessed Round, Open Bottom Multigroove Compact Fluorescent
NL-19	Recessed Round, Open Bottom Compact Fluorescent
NL-20	Round-Surface, Pendant, or Wall Mount Compact Fluorescent - Interior/Exterior
NL-21	Fluorescent Troffer With Plastic Parabolic Cube Louvers
NL-22	High Bay Open/Enclosed Industrial HID
NL-23	Low Bay Industrial HID
NL-24	Pendant/Wall Mount - Indirect HID
NL-25	Exterior Commercial Wall Mount HID
NL-26	Exterior Compact Fluorescent and Low Pressure Sodium-Wall Mount
NL-27	Recessed Round Regressed Lens Type HID
NL-28	Handball and Racquetball Court Luminaire
NL-29	Architectural Style Security/Area Luminaire
NL-30	Warehouse HID Aisle Luminaire
NL-31	Surface Mounted Commercial HID
NL-32	Recessed Commercial HID
NL-33 thru 39	Reserved for Future HID Luminaries
NL-40	Step Light/Night Light
NL-41	Adjustable Incandescent Interior Spotlight
NL-42	Semi-Recessed Baffle Downlight
NL-43	Open Recessed Baffle Downlight
NL-44	Adjustable Semi-Recessed Spotlight
NL-45	Exterior Luminaries
NL-46	Ceiling-Mounted Vandal-Resistant Luminaire
NL-47	Wall-Mounted Vandal-Resistant Luminaire
NL-48	Fluorescent Exit Sign
NL-49	Explosion-Proof Luminaire

SKETCH NUMBER

TITLE

NL-50	Obstruction Light
NL-51	Emergency Lighting Unit
NL-52	Lens Type Emergency Lighting Unit
NL-53	Cylinder Type Emergency Lighting Unit
NL-54	Remote Fixtures for Use With Battery Unit
NL-55	Not Used
NL-56	Recessed Shower Light
NL-57	Recessed Downlight - Incandescent/Fluorescent
NL-58 and 59	Reserved for Future Luminaires
NL-60	Industrial Fluorescent - Hazardous Location
NL-61	Light Emitting Diode Exit Sign
NL-62 thru 98	Reserved for Future Luminaires
NL-99	Sample Lighting Fixture Schedule

NOTE: Do not include this index in project specification.

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NOTE: Show the following information on project drawings:

1. Type, style, mounting, and lamp arrangement
2. Location of fixtures
3. Wattage, voltage, and frequency rating required
4. Type of reflector, diffuser required
5. Glass/plastic lens
6. Accessories required, such as photocell, time switches, sensors, and auxiliary lamps
7. Mounting height above floor or grade to bottom of fixture
8. Where wire for humid areas, rods, or straps are used (if more than one type of hanger is used)
9. Reflecting or nonreflecting surface finish
10. Shielding required
11. Referenced sketch
12. NEMA distribution type (when applicable).
13. Occupancy sensor location, mounting, and sensor detection type.

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NOTE: Demolition work that involves disposal of fluorescent and HID lamps and ballasts will require the use of Section 02 84 16 HANDLING OF LIGHTING

**BALLASTS AND LAMPS CONTAINING PCBs AND MERCURY.**

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**PART 1 GENERAL**

**1.1 REFERENCES**

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**NOTE:** This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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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.

**ASTM INTERNATIONAL (ASTM)**

<b>ASTM A 1008/A 1008M</b>	(2008a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
<b>ASTM A 123/A 123M</b>	(2008) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
<b>ASTM A 368</b>	(1995a; R 2004) Standard Specification for Stainless Steel Wire Strand
<b>ASTM A 467/A 467M</b>	(2007) Standard Specification for Machine Coil and Chain
<b>ASTM A 47/A 47M</b>	(1999; R 2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
<b>ASTM A 580/A 580M</b>	(2008) Standard Specification for Stainless Steel Wire
<b>ASTM A 641/A 641M</b>	(2003) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

ASTM A 653/A 653M	(2008) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 164	(2003; R 2008) Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B 26/B 26M	(2005) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B 633	(2007) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products

#### CALIFORNIA ENERGY COMMISSION (CEC)

CEC Title 24	(1978; R 2005) California's Energy Efficiency Standards for Residential and Nonresidential Buildings
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#### ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA HB-9	(2000; Errata 2004; Errata 2005) IES Lighting Handbook
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#### INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; Errata 2007; INT 2008) National Electrical Safety Code
IEEE C62.41.1	(2002) IEEE Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE Std 100	(2000) The Authoritative Dictionary of IEEE Standards Terms

#### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ANSLG C78.41	(2006) Guidelines for Low-Pressure Sodium Lamps
NEMA ANSLG C78.42	(2007) Standard for High-Pressure Sodium Lamps
NEMA C78.1381	(1998) Electric Lamps - 250-Watt, 70 Watt,



M85 Metal-Halide Lamps

NEMA C78.43	(2007) Standard for Electric Lamps - Single-Ended Metal-Halide Lamps
NEMA C78.81	(2005) Electric Lamps - Double-capped Fluorescent Lamps Dimensional and Electrical Characteristics
NEMA C78.901	(2005) Electric Lamps - Single Base Fluorescent Lamps Dimensional and Electrical Characteristics
NEMA C82.1	(2004) Electric Lamp Ballasts - Line Frequency Fluorescent Lamp Ballasts
NEMA C82.11	(2002) High-Frequency Fluorescent Lamp Ballasts
NEMA C82.2	(2002) Methods of Measurement of Fluorescent Lamp Ballasts
NEMA C82.4	(2002) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
NEMA LL 1	(1997; R 2002) Procedures for Linear Fluorescent Lamp Sample Preparation and the TCLP Extraction

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007; AMD 1 2008) National Electrical Code - 2008 Edition
NFPA 90A	(2008) Standard for the Installation of Air Conditioning and Ventilating Systems

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System
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UNDERWRITERS LABORATORIES (UL)

UL 1029	(1994; Rev thru Dec 2007) Standard for Safety High-Intensity-Discharge Lamp Ballasts
UL 1598	(2008; Rev thru Nov 2008) Luminaires
UL 595	(1985; Rev thru Sep 1991) Marine-Type Electric Lighting Fixtures
UL 844	(2006; Rev thru Nov 2008) Standard for Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 935	(2001; Rev thru Dec 2007) Standard for

## Fluorescent-Lamp Ballasts

### [1.2 RELATED REQUIREMENTS

Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.]

### 1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Std 100.
- b. Average life is the time after which 50 percent has failed and 50 percent has survived under normal conditions.
- c. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.

### 1.4 SUBMITTALS

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NOTE: Limit submittals to those necessary for adequate quality control. The importance of an item in the project is one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Recommended codes for Army projects are "RE" for Resident Engineer approval, "ED" for Engineering approval, and "AE" for Architect-Engineer approval. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the

Government. Submit the following in accordance with Section 01 33 00  
SUBMITTAL PROCEDURES:

Employ the terminology, classifications, and methods prescribed by the  
IESNA HB-9, as applicable, for the lighting system specified in data,  
drawings, and reports.

#### SD-02 Shop Drawings

Submit Fabrication Drawings for the following items consisting of  
fabrication and assembly details to be performed in the factory.

Commercial Incandescent Lighting Fixtures

Industrial Incandescent Lighting Fixtures

Enclosed and Gasketed Vapor-Tight Fixtures

Incandescent Lamps

Lowering Devices

Submit Installation Drawings for the incandescent lighting  
fixtures in accordance with the paragraph entitled,  
"Installation," of this section.

#### SD-03 Product Data

Fluorescent lighting fixtures [; G] [; G, [\_\_\_\_]]

Fluorescent electronic ballasts [; G] [; G, [\_\_\_\_]]

Fluorescent electromagnetic ballasts [; G] [; G, [\_\_\_\_]]

Fluorescent lamps [; G] [; G, [\_\_\_\_]]

High-intensity-discharge (HID) lighting fixtures [; G] [; G, [\_\_\_\_]]

HID ballasts [; G] [; G, [\_\_\_\_]]

High-pressure sodium (HPS) lamps [; G] [; G, [\_\_\_\_]]

Low-pressure sodium lamps [; G] [; G, [\_\_\_\_]]

Metal-halide lamps [; G] [; G, [\_\_\_\_]]

Incandescent lighting fixtures [; G] [; G, [\_\_\_\_]]

Incandescent lamps [; G] [; G, [\_\_\_\_]]

Power hook fixture hangers [; G] [; G, [\_\_\_\_]]

Electronic dimming ballast [; G] [; G, [\_\_\_\_]]

Dimming ballast controls [; G] [; G, [\_\_\_\_]]

Light Level Sensor [; G] [; G, [\_\_\_\_]]

[ Local/Regional Materials

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

[ [Environmental Data](#)]

#### [Energy Efficiency](#)

Submit Equipment and Performance Data for incandescent lighting fixtures in accordance with paragraph entitled, "Related Requirements," of this section.

Submit Manufacturer's catalog data for the following items:

[Commercial Incandescent Lighting Fixtures](#)

[Industrial Incandescent Lighting Fixtures](#)

[Enclosed and Gasketed Vapor-Tight Fixtures](#)

[Incandescent Lamps](#)

[Lowering Devices](#)

#### [SD-04 Samples](#)

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NOTE: Samples involve additional shipping cost.  
Use only for special fixtures on a project. If  
samples are not essential to the specific  
application, delete them.  
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[Lighting fixtures](#), complete with lamps and ballasts[; [G](#)][; [G](#),  
[\[\\_\\_\\_\\_\\_\]](#)]

#### [SD-06 Test Reports](#)

##### [Operating test](#)

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

Submit Test reports for [Operational Tests](#) on incandescent lighting fixtures in accordance with the paragraph entitled, "Field Testing," of this section.

#### [SD-10 Operation and Maintenance Data](#)

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NOTE: Require O&M manuals for lighting control  
systems that use low voltage control circuits.  
Example: Light level sensors used with dimming  
ballast, or occupancy sensors used with power packs.  
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## Lighting Control System, Data Package 5

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein, showing all light fixtures, control modules, control zones, occupancy sensors, light level sensors, power packs, dimming ballasts, schematic diagrams and all interconnecting control wire, conduit, and associated hardware.

### Operational Service

Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

## 1.5 QUALITY ASSURANCE

### 1.5.1 Fluorescent Electronic Ballasts

Submit ballast catalog data as required in the paragraph entitled "Fluorescent Lamp Electronic Ballasts" contained herein. As an option, submit the fluorescent fixture manufacturer's electronic ballast specification information in lieu of the actual ballast manufacturer's catalog data. Include published specifications and sketches, which cover the information required by the paragraph entitled "Fluorescent Lamp Electronic Ballasts" herein. This information may be supplemented by catalog data if required, containing a list of vendors with vendor part numbers.

### 1.5.2 Lighting Fixtures, Complete With Lamps and Ballasts

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**NOTE: Delete this paragraph if samples are not required.**

**Delete bracketed options if samples are required for all fixture types. Choose bracketed options only if samples of some fixtures are required. Indicate in the fixture schedule on the drawings which fixture types require samples or specify using the last bracketed sentence.**

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Submit one sample of each fixture type[ indicated] for inspection, review, and approval. Retain the sample for comparison against the remainder of the fixtures. The sample may be used in the final fixture installation.[ Provide samples for the following fixture types indicated on the drawings: [\_\_\_\_].]

### 1.5.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory 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. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

#### 1.5.4 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, which have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period includes applications of equipment and materials under similar circumstances and of similar size, on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, provide 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.

##### 1.5.4.1 Alternative Qualifications

Products having less than a 2-year field service record are 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.

##### 1.5.4.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than 3 years prior to date of delivery to site, unless specified otherwise.

##### 1.5.4.3 Energy Efficiency

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NOTE: Meet Energy Star requirements for all  
lighting per EO 13123.  
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NOTE: The Energy Policy Act of 2005 requires new  
buildings to use 30 percent less energy than the  
ASHRAE 90.1 level. Efficient lighting equipment  
contributes to the following LEED credits: EA  
Prerequisite 2; EA1.  
\*\*\*\*\*

Comply with National Energy Policy Act and Energy Star requirements for lighting products. [Submit documentation for Energy Star qualifications for equipment provided under this section. ]Submit data indicating lumens per watt efficiency and color rendition index of light source.

#### 1.6 WARRANTY

Support the equipment items with 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 Electronic Ballast Warranty

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NOTE: The warranty clause in this section has been  
approved by a Level 1 Contracting Officer, and may

be used without further approval or request for waiver.

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Furnish the electronic ballast manufacturer's warranty, for not less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage is not to exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. State in the warranty that the manufacturer agrees to exchange a malfunctioning ballast and promptly ship the replacement to the using Government facility, said replacement ballast being identical to, or an improvement upon, the original design of the malfunctioning ballast.

#### 1.7 OPERATIONAL SERVICE

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NOTE: Maintenance agreements are standard practice in the building industry. Take-back programs refer to programs in which the product manufacturer "takes-back" scrap material and/or packaging associated with its product. Under a green lease, when the customer no longer requires the use of the particular product or requires an updated model, the manufacturer is obligated to reclaim it and refurbish it or disassemble it for recycling as appropriate. Using one of these manufacturer's services contributes to the following LEED credit: MR2.

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Coordinate with manufacturer for [maintenance agreement] [take-back program] for services which reclaim materials for recycling and/or reuse. Collect information from the manufacturer about [maintenance agreement] [green lease] options, and submit to Contracting Officer. Placement into landfills or burning of reclaimed materials is not allowed. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, seek out local recyclers to reclaim the materials.

#### 1.8 SUSTAINABLE DESIGN REQUIREMENTS

##### 1.8.1 Local/Regional Materials

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NOTE: Using local materials can help minimize transportation impacts, including fossil fuel consumption, air pollution, and labor.

Note: This is optional for Army projects.

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[ Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [800] [\_\_\_\_\_] kilometer [500] [\_\_\_\_\_] mile radius from the project site, if available from a minimum of three sources.]

##### 1.8.2 Environmental Data

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NOTE: ASTM E 2129 provides for detailed documentation of the sustainability aspects of products used in the project. This level of detail may be useful to the Contractor, Government, building occupants, or the public in assessing the sustainability of these products.

NOTE: This is optional for Army projects.

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[Submit Table 1 of ASTM E 2129 for the following products: [\_\_\_\_].]

## PART 2 PRODUCTS

### 2.1 PRODUCT STANDARDS

Provide incandescent lighting fixtures conforming to UL 1598. Provide fixtures in hazardous areas conforming to UL 844.

Furnish lighting fixtures completely assembled with wiring and mounting devices and ready for installation at the locations noted. Design and equip recessed fixtures in suspended ceilings for installation in the type of ceiling in which the fixture is to be installed. Design fixtures to be supported independent of the ceiling. Equip fixtures with the lamps required.

### 2.2 FLUORESCENT LIGHTING FIXTURES

\*\*\*\*\*

NOTE: For projects within the United States and its possessions, do not specify hard metric recessed lighting fixtures as the only option.

\*\*\*\*\*

Provide fluorescent fixtures, conforming to UL 1598 with electronic ballasts [unless specifically indicated otherwise].

#### 2.2.1 Fluorescent Lamp Electronic Ballasts

\*\*\*\*\*

NOTE: Electronic ballasts may have system compatibility problems when installed in certain environments. The problems mainly concern the radiated and conducted EMI due to the relatively high switching frequencies inherent in electronic ballasts and possibly due to utilization of the same power source for lighting and other equipment. Shielding technologies today can prevent interference with surroundings, and therefore this is rarely an issue. Environments where electronic ballasts have the potential for EMI are:

1. Libraries or other facilities which utilize magnetic detectors to prevent theft or inventory control. However, it has been reported that electronic ballasts have no impact on the magnetic detectors if the separation distance is greater than 3050 to 4575 mm 10 to 15 feet. This includes distances in all directions through floors,



ceilings, and walls.

2. Facilities using high frequency power line carrier (PLC) control systems, such as a central clock system. These PLC systems usually have a 50,000 Hz to 200 kHz carrier frequency which may be affected by the harmonics generated by the electronic ballasts.

3. Areas where sensitive electronic equipment is installed such as hospital critical care units, other areas utilizing sensitive electronic equipment based life support systems, and electronic testing facilities.

With proper design considerations, electronic ballasts should provide satisfactory performance even in these and other sensitive areas. The designer must consider fixture location, fixture performance characteristics, manufacturers' recommendations, environmental constraints, etc. in the lighting design. Edit this specification as required to solve specific design problems.

\*\*\*\*\*

Provide electronic ballasts, meeting as a minimum, the following characteristics:

- a. Provide ballasts complying with **UL 935**, **NEMA C82.11**, **NFPA 70**, and **CEC Title 24** unless specified otherwise. Provide 100 percent electronic high frequency type ballasts with no magnetic core and coil components, which provide transient immunity as recommended by **IEEE C62.41.1** and **IEEE C62.41.2**. Design ballast for the wattage of the lamps used in the indicated application. Design ballasts to operate on the voltage system to which they are connected.
- b. A power factor of 0.95 (minimum).
- c. Operates at a frequency of 20,000 Hertz (minimum), and is compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.
- d. Light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ensure ballasts have 10 percent flicker (maximum) using any compatible lamp.
- e. A ballast factor between 0.85 (minimum) and 1.00 (maximum). Current crest factor - 1.7 (maximum).
- f. UL listed Class P with a sound rating of "A."
- g. Include circuit diagrams and lamp connections displayed on the ballast.

\*\*\*\*\*

**NOTE:** Choose the bracketed option and require programmed start ballasts for Army and Air Force projects.

For Navy projects, provide instant start ballasts for areas not subject to frequent switching (i.e., more than once every three hours). Provide programmed start ballasts for areas subject to frequent switching, including all areas controlled by occupancy sensors. Identify fixtures requiring each type on the drawings.

\*\*\*\*\*

- h. [Provide instant start ballasts unless otherwise indicated, with programmed start where indicated. Provide instant start ballasts which operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed.][ Provide programmed start ballast unless otherwise indicated.][ Programmed start ballasts may operate lamps in a series circuit configuration. Provide series/parallel wiring for programmed start ballasts where available.]
- i. Provide programmed start ballasts for compact fluorescent fixtures.
- j. Provide ballasts for T-5 and smaller lamps with end-of-life protection circuits as required by **NEMA C78.81** and **NEMA C78.901** as applicable.

\*\*\*\*\*

**NOTE: A source of light other than fluorescent is recommended for areas subject to temperatures below -17 degrees C, 0 degrees F.**

\*\*\*\*\*

- k. Provide ballasts capable of starting and maintaining operation at a minimum of **-17 degrees C 0 degrees F** unless otherwise indicated.
- l. Provide electronic ballasts with a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

#### 2.2.1.1 T-8 Lamp Ballast

\*\*\*\*\*

**NOTE: Total harmonic distortion of 20 percent is acceptable for most applications.**

\*\*\*\*\*

- a. Total harmonic distortion (THD): [20 percent][[\_\_\_\_] percent] (maximum).
- b. Input wattage.
  - [1. 32 watts (maximum) when operating one F32T8 lamp]
  - [2. 62 watts (maximum) when operating two F32T8 lamps]
  - [3. 92 watts (maximum) when operating three F32T8 lamps]
  - [4. 114 watts (maximum) when operating four F32T8 lamps]

\*\*\*\*\*

**NOTE: Multilevel switching for light control is recommended for some locations, such as classrooms**

and conference rooms where multilevel switching is desired.

\*\*\*\*\*

c. Ballast efficacy factor.

- [1. 2.54 (minimum) when operating one F32T8 lamp]
- [2. 1.44 (minimum) when operating two F32T8 lamps]
- [3. 0.93 (minimum) when operating three F32T8 lamps]
- [4. 0.73 (minimum) when operating four F32T8 lamps]

- [d. Provide three[ and four] lamp fixtures with two ballasts per fixture where multilevel switching is indicated.]

\*\*\*\*\*

**NOTE: To avoid potential maintenance problems, use following bracketed option only when requested by the activity.**

\*\*\*\*\*

- [e. 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.]

2.2.1.2 F17T8 Lamp Ballast

Provide F17T8 ballasts with:

- a. Total harmonic distortion (THD): 25 percent (maximum).
- b. Input wattage:
  - 1. 34 watts (maximum) when operating two F17T8 lamps.

2.2.1.3 T-5 Long Twin Tube Lamp Ballast

- a. Total harmonic distortion (THD): No greater than[ 25 percent when operating one lamp,][ 15 percent when operating two lamps,][ and][ 20 percent when operating three lamps].
- b. Input wattage:
  - [1. 45 watts (maximum) when operating one F40 T-5 lamps]
  - [2. 74 watts (maximum) when operating two F40 T-5 lamps]
  - [3. 105 watts (maximum) when operating three F40 T-5 lamps]

\*\*\*\*\*

**NOTE: Multilevel switching for light control is recommended for some locations, such as classrooms and conference rooms where multilevel switching is desired.**

\*\*\*\*\*

- [c. Provide three[ and four] lamp fixtures with two ballasts per fixture

where multilevel switching is indicated.]

\*\*\*\*\*  
NOTE: To avoid potential maintenance problems, use following bracketed option only when requested by the activity. Also, serving multiple fixtures from a single ballast may alter the minimum starting and operating temperature for the fixture. Design accordingly.  
\*\*\*\*\*

- [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.]

#### 2.2.1.4 F96T8 Lamp Ballast

- a. Total harmonic distortion (THD): No greater than[ 30 percent when operating one lamp][ and][ 20 percent when operating two lamps].
- b. Input wattage:
- [1. 56 watts (maximum) when operating one F96T8 lamps]
- [2. 102 watts (maximum) when operating two F96T8 lamps]

\*\*\*\*\*  
NOTE: To avoid potential maintenance problems, use following bracketed option only when requested by the activity. Also, serving multiple fixtures from a single ballast may alter the minimum starting and operating temperature for the fixture. Design accordingly.  
\*\*\*\*\*

- [c. 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.]

#### 2.2.2 Fluorescent Lamp [Electronic Dimming Ballast](#)

\*\*\*\*\*  
NOTE: Electronic dimming ballast may have the same system compatibility problems as normal light output electronic ballast when installed in certain environments. The problems mainly concern the radiated and conducted EMI due to the relatively high switching frequencies inherent in electronic ballast and possibly due to utilization of the same power source for lighting and other equipment. Environments where electronic ballast have the potential for EMI are listed in the criteria note for electronic ballast.

Electronic dimming ballasts as specified in the following paragraph, are for general workplace dimming and daylight harvesting for energy conservation. For architectural dimming applications with very low light levels, 100 percent

to 1 percent, the specifier must review all parameters of this paragraph and ensure competitive sources.

Electronic dimming ballasts can be controlled by a number of devices: manual dimmers, occupancy sensors, light level sensor, photosensors, and timers, or with energy management systems. All control types are not specified here and the specifier must ensure system compatibility between ballast and controls.

If dimming ballast and non-dimming ballast are used in the same area, designer and specifier may need to coordinate the ballast factors at full light output.

\*\*\*\*\*

Provide electronic ballasts meeting as a minimum, the following characteristics:

- a. Compliance with NEMA C82.11, UL 935, and NFPA 70, unless specified otherwise. Provide transient immunity as recommended by IEEE C62.41.1 and IEEE C62.41.2. Ballast dimming capability range - from 100 to 5 percent (minimum range) of light output, flicker free, and starts lamp at any preset light output setting without first having to go to full light output. Design ballast for the wattage of the lamps used in the indicated application. Design ballasts to operate on the voltage system to which they are connected.
- b. Power factor of 0.95 (minimum) at full light output, and 0.90 (minimum) over the entire dimming range.
- c. Operates at a frequency of 20,000 Hertz (minimum), and is compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.
- d. Ballast factor at full light output is between 0.85 (minimum) and 1.00 (maximum). Current crest factor is 1.7 (maximum).
- e. UL listed Class P with a sound rating of "A".
- f. includes circuit diagrams and lamp connections displayed on the ballast.
- g. Provide programmed start ballasts. Ballast may operate lamps in a series circuit configuration. Provide series/parallel wiring for programmed start ballasts where available.
- h. Provide programmed start ballasts for compact fluorescent fixtures.

\*\*\*\*\*

NOTE: A source of light other than fluorescent is recommended for areas subject to temperatures below -17 degrees C, 0 degrees F.

\*\*\*\*\*

- i. Ballast is capable of starting and maintaining operation at a minimum of 17 degrees C 0 degrees F unless otherwise indicated.

- j. Total harmonic distortion (THD): 20 percent (maximum) over the entire dimming range.
- k. Provide ballasts for T-5 and smaller lamps with end-of-life protection circuits as required by NEMA C78.81 and NEMA C78.901 as applicable.

#### 2.2.2.1 T-8 Lamp Ballast

Input wattage, for indicated lamp quantity is:

- a. 35 watts (maximum) when operating one F32T8 lamp.
- b. 70 watts (maximum) when operating two F32T8 lamps.
- c. 104 watts (maximum) when operating three F32T8 lamps.

#### 2.2.3 Dimming Ballast Controls

Provide slide dimmer ballast controls with on/off control, compatible with the ballast, and capable of controlling the ballast light output over the full dimming range. Provide dimming ballast controls approved by the ballast manufacturer.

#### 2.2.4 Light Level Sensor

UL listed. Provide light level sensor capable of detecting changes in ambient lighting levels, and providing a dimming range of 20 percent to 100 percent, minimum, designed for use with dimming ballast and voltage system to which they are connected. Ensure sensor is capable of controlling 40 electronic dimming ballast, minimum. Provide adjustable light level sensor with a set level range from 10 to 100 foot candles 100 to 1000 lux, minimum. Provide sensor with a bypass function to electrically override sensor control.

#### [2.2.5 Fluorescent Electromagnetic Ballasts

\*\*\*\*\*

NOTE: Generally, electromagnetic ballasts should not be specified. Include this paragraph only for specific project requirements. Include this paragraph if any of the optional subparagraphs are used. Delete last two sentences when only compact fluorescent fixtures paragraph is used.

\*\*\*\*\*

UL 935. Provide high power factor type ballasts (0.9 minimum), [ unless indicated otherwise,] designed to operate on the voltage system to which they are connected, Class P and have sound rating "A"[ unless otherwise noted]. Design and construct fixtures and ballasts to limit the ballast case temperature to 90 degrees C 195 degrees F when installed in an ambient temperature of [40] [ ] degrees C [105] [ ] degrees F. Provide energy saving electromagnetic ballasts for T-8 and T-12 lamps. Provide three lamp fixtures with two ballasts per fixture.

#### 2.2.5.1 Electromagnetic Energy-Saving Ballasts

\*\*\*\*\*

NOTE: Energy-saving ballasts are generally not available for low temperature applications (below 10

degrees C 50 degrees F). Additionally, the combination of energy-saving ballasts and energy-saving lamps are not recommended below 15 degrees C 60 degrees F.

\*\*\*\*\*

\*\*\*\*\*

NOTE: Include last bracketed sentence and use 123 input wattage in lieu of 136, when required by the Post or Base or Activity involved.

\*\*\*\*\*

NEMA C82.1. Provide energy-saving fluorescent ballasts of the CBM certified full light output type[ except where fixtures are provided with low temperature ballasts], with an average input wattage of[ 40 or less when operating one 32-watt F32T8 lamp][ 45 or less when operating two 17 watt F17T8 lamps][ 72 or less when operating two 32 watt F32T8 lamps][ 109 or less when operating two 59-watt F96T8 lamps][ [\_\_\_\_\_] or less when operating [\_\_\_\_\_] lamps] tested in accordance with NEMA C82.2 methods.[ Provide ballasts which are compatible with energy-saving lamps.]

#### 2.2.5.2 Electromagnetic Ballasts for Compact Fluorescent Lamps

Provide electromagnetic ballasts for compact fluorescent lamps.

#### 2.2.5.3 Electromagnetic Low Temperature Ballasts

\*\*\*\*\*

NOTE: A source of light other than fluorescent is recommended for areas subject to temperatures below -17 degrees C, 0 degrees F. If fluorescent fixtures are required, low temperature ballasts should be indicated and specified where ambient temperatures may normally drop below 10 degrees C 50 degrees F if required by the design. Low temperature ballasts are not CBM certified and do not conform to NEMA C82.1.

\*\*\*\*\*

Provide fluorescent ballasts having a minimum starting temperature of[ minus 17 degrees C][ minus 28 degrees C][ zero degrees F][ minus 20 degrees F] for 800 milliamper, high output (HO) lamps in fixtures mounted[ in cold rooms,][ outdoors,][ in unheated buildings,][ and as indicated].

#### [2.2.5.4 Electromagnetic Ballasts for T-5 Long Twin Tube Lamps

Provide electromagnetic ballasts with an average input wattage of[ 49 or less when operating one][ 86 or less when operating two] 40-watt T-5 long twin tube lamps.

#### ]2.2.6 Fluorescent Lamps

\*\*\*\*\*

NOTE: T-8 lamps with CRI of 75 and color temperature of 3500 K are recommended for most applications.

Low mercury lamps must be specified on projects that use 1220 mm (4 foot) 4-foot lamps and are located in

the continental United States. For other locations or lamp types, the specifier must ensure availability of the low mercury lamps.

\*\*\*\*\*

- [a. Provide T-8 rapid start[ low mercury] lamps rated 32 watts (maximum), 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of [3500 K] [\_\_\_\_], with an average rated life of 20,000 hours.[ Provide low mercury lamps which have passed the EPA Toxicity Characteristic Leachate Procedure (TCLP) for mercury by using the lamp sample preparation procedure described in NEMA LL 1.]]
- [b. Provide T-8 rapid start lamp, 17 watt (maximum), nominal length of 610 mm 24 inches, 1300 initial lumens, CRI of 75 (minimum), color temperature of [3500 K] [\_\_\_\_], and an average rated life of 20,000 hours.]
- [c. Provide T-8 instant start lamp, 59 watts (maximum), nominal length of 2438 mm 96 inches, minimum CRI of 75, 5700 initial lumens, color temperature of [3500 K] [\_\_\_\_], and average rated life of 15,000 hours.]
- [d. Provide T-12 slim line lamps rated 60 watts (maximum), 5750 initial lumens (minimum), 12,000 hours average rated life.]
- [e. Provide T-5, long twin tube fluorescent lamp, 40 watts (maximum), [3500 K] [\_\_\_\_], 574 mm 22.6 inches maximum length, 20,000 hours average rated life, 3150 initial lumens, CRI of 80 (minimum), 2G11 Type base, 90 to 100 lumens/watt depending on wattage.]
- [f. Provide T-8, U shaped fluorescent lamp, 31 watts maximum, 2600 initial lumens (minimum), [3500 K] [\_\_\_\_], 75 CRI (minimum), 20,000 hours average rated life, [ 41.29 mm] [\_\_\_\_] mm ([\_\_\_\_] inch) [1.625] [\_\_\_\_] inch leg spacing.]
- [g. Provide compact fluorescent lamps: CRI 80, minimum, [3500 K] [\_\_\_\_], 10,000 hours average rated life, and as follows:
  - 1. T-4, twin tube, rated[ 5 watt, 250 initial lumens (minimum)][ 7 watts, 400 initial lumens (minimum),][ 9 watts, 600 initial lumens (minimum),][ and][ 13 watts, 825 initial lumens (minimum),][ as indicated].
  - 2. T-4, double twin tube, rated[ 13 watts, 900 initial lumens (minimum),][ 18 watts, 1200 initial lumens (minimum),][ and][ 26 watts, 1800 initial lumens (minimum),][ as indicated].]

Average rated life is based on 3 hours operating per start.

#### 2.2.7 Compact Fluorescent Fixtures

Provide compact fluorescent fixtures manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Providing assemblies designed to retrofit incandescent fixtures is prohibited except when specifically indicated for renovation of existing fixtures. Provide fixtures using lamps as indicated, with a minimum CRI of 80.

##### 2.2.7.1 Bare Bulb Retrofits

Replace 40-watt incandescent bulbs (495plus lumens) with 11- to 14-watt



compact fluorescent bulbs (45 plus lumens per watt). Replace 60-watt incandescent bulbs (900 plus lumens) with 15- to 19-watt compact fluorescent bulbs (60 plus lumens per watt). Replace 75-watt incandescent bulbs (1200 plus lumens) with 20- to 25-watt compact fluorescent bulbs (60 plus lumens per watt). Replace 100-watt incandescent bulbs (1750 plus lumens) with 29-watt or greater compact fluorescent bulbs (60 plus lumens per watt).

#### 2.2.7.2 Reflector Type Bulb Retrofits

Replace 50-watt incandescent bulbs (550 plus lumens) with 17- to 19-watt compact fluorescent bulbs (33 plus lumens per watt). Replace 60-watt incandescent bulbs (675 plus lumens) with 20- to 21-watt compact fluorescent bulbs (40 plus lumens per watt). Replace 75-watt incandescent bulbs (875 plus lumens) with 22-watt or greater compact fluorescent bulbs (40 plus lumens per watt).

#### 2.2.8 Open-Tube Fluorescent Fixtures

\*\*\*\*\*  
**NOTE: Select one of bracketed options where lamp breakage is detrimental, such as above food counters.**  
\*\*\*\*\*

Provide with self-locking sockets, or lamp retainers (two per lamp).[ Provide lamps with shatter resistant coating, non-yellowing, nominal thickness of 0.38 mm 15 mils, and with 97 percent (minimum) light transmission.][ Provide a clear polycarbonate protective sleeve with end caps, over lamp, with 95 percent (minimum) light transmission. Rate the sleeve to withstand the thermal profile of the lamp and ballast.]

#### 2.2.9 Air Handling Fixtures

Provide fixtures used as air handling registers conforming to the requirements of NFPA 90A.

#### [2.2.10 Electromagnetic Interference Filters

\*\*\*\*\*  
**NOTE: Use filters only when specifically required by activity. Filters available for mounting within lighting fixtures provide only basic interference suppression. For shielded enclosures and secure facilities, provide power line filters in the circuits serving the lighting.**  
\*\*\*\*\*

Provide in each fluorescent fixture mounted[ in shielded enclosures][ where indicated].[ Provide filters integral to the fixture assembly with one filter per ballast and suppress electromagnetic interference in the AM radio band from 500 to 1700 kHz.][ Provide filters in the circuit serving the lighting fixtures mounted where indicated and conforming to requirements of Section 26 35 46.00 20 RADIO FREQUENCY INTERFERENCE POWER LINE FILTERS.]

#### ]2.3 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES

UL 1598.[ Provide HID fixtures with tempered glass lenses when using metal-halide lamps.]

### 2.3.1 HID Ballasts

Provide HID ballasts conforming to UL 1029 and NEMA C82.4, with constant wattage autotransformer (CWA) or regulator, high power factor type (minimum 90 percent). Provide single-lamp ballasts which have a minimum starting temperature of minus 30 degrees C minus 22 degrees F. Provide ballasts:

- a. Designed to operate on the voltage system to which they are connected.
- b. Designed for installation in a normal ambient temperature of [40] [ ] degrees C [105] [ ] degrees F.
- c. Constructed so that open circuit operation will not reduce the average life.

Provide high-pressure sodium (HPS) ballasts with a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature is not to exceed 90 degrees C 195 degrees F in any mode.

### 2.3.2 High-Pressure Sodium (HPS) Lamps

NEMA ANSLG C78.42 wattage as indicated. 150 watt lamps, if required, are 55 volt type.

#### [2.3.2.1 Standby HPS Lamps

\*\*\*\*\*  
NOTE: Dual ARC tube HPS Lamps may, under certain  
conditions be used as auxiliary stand-by lighting  
when momentary power interruptions are anticipated.  
\*\*\*\*\*

Provide standby HPS lamps with two arc tubes and an average rated life of 40,000 hours (minimum), and hot restart instant lumen output of 8 percent, minimum, of total light output.

#### ]2.3.2.2 Luminaire Efficiency Rating (LER)

- a. Upward efficiency of 0 percent
  - [1. 150-399 watts: Minimum 58 LER for closed fixture; minimum 68 for open fixture]
  - [2. 400-999 watts: Minimum 63 LER for closed fixture; minimum 84 for open fixture]
- b. Upward efficiency of 1 percent-10 percent
  - [1. 150-399 watts: Minimum 64 LER for closed fixture; minimum 63 for open fixture]
  - [2. 400-999 watts: Minimum 82 LER for closed fixture; minimum 89 for open fixture]
  - [3. 1000 plus watts: Minimum 109 LER for open fixture]
- c. Upward efficiency of 11 percent to 20 percent

[1. 150-399 watts: Minimum 78 LER for open fixture]

[2. 400-999 watts: Minimum 94 for open fixture]

d. Upward efficiency greater than 20 percent

1. 150-399 watts: Minimum 75 LER for closed fixture; minimum 77 for open fixture

2.3.3 Low-Pressure Sodium Lamps

\*\*\*\*\*  
NOTE: Use low-pressure sodium where color rendition  
is not a factor, but high lamp efficiency is.  
\*\*\*\*\*

NEMA ANSLG C78.41.

2.3.4 Metal-Halide Lamps

\*\*\*\*\*  
NOTE: Metal-halide lamp safe operation requires  
lamps to be turned off at least 15 minutes per week  
or lamp may rupture near the end of its expected  
life. Lamp rupture may discharge glass and  
extremely hot quartz (greater than 900 degrees C)  
into the surrounding area. Therefore, designs for  
metal-halide lamps include weekly turnoff  
instructions when continuously operated, 24 hours  
per day, 7 days per week. Detail these instructions  
on the drawings for posting at the control  
locations. For indoor use, color rendition index  
(CRI) and color temperature (CCT) may need to be  
specified.  
\*\*\*\*\*

[a. Double-ended, 70 watt, conforming to NEMA C78.1381]

[b. Single-ended, wattage as indicated, conforming to NEMA C78.43]

2.3.4.1 Luminaire Efficiency Rating (LER)

a. Upward efficiency of 0 percent

[1. 150-399 watts: Minimum 41 LER for closed fixture]

[2. 400-999 watts: Minimum 53 LER for closed fixture; minimum 59 for open fixture]

[3. 1000 plus watts: Minimum 77 LER for closed fixture]

b. Upward efficiency of 1 percent-10 percent

[1. 150-399 watts: Minimum 56 LER for closed fixture]

[2. 400-999 watts: Minimum 62 LER for closed fixture; minimum 64 for open fixture]

[3. 1000 plus watts: Minimum 88 LER for open fixture]

c. Upward efficiency greater than 20 percent

[1. 150-399 watts: Minimum 62 LER for closed fixture; minimum 77 for open fixture]

[2. 400-999 watts: Minimum 65 LER for closed fixture]

2.4 INCANDESCENT LIGHTING FIXTURES

Use of incandescent lamps and fixtures is prohibited, unless specifically indicated otherwise. UL 1598.

2.4.1 Incandescent Lamps

Provide the number, type, and wattage indicated.

2.5 RECESS- AND FLUSH-MOUNTED FIXTURES

Provide type that can be relamped from the bottom, with access to ballast from the bottom, with trim for the exposed surface of flush-mounted fixtures as indicated.

2.6 SUSPENDED FIXTURES

\*\*\*\*\*  
NOTE: Coordinate pendant sway bracing details with the architect. The architect may prefer to provide pendant sway bracing details in locations where appearance is important. Specify shock absorbing hangers for fixtures in certain hazardous locations if indicated. Specify swivel hangers to satisfy antiterrorist/force protection requirements.  
\*\*\*\*\*

Provide hangers capable of supporting twice the combined weight of fixtures supported by hangers. Provide with swivel hangers to ensure a plumb installation, cadmium-plated steel with a swivel-ball tapped for the conduit size indicated.[ Provide shock-absorbing type hangers where indicated.] Provide hangers which allow fixtures to swing within an angle of 0.79 rad 45 degrees. Brace pendants 1219 mm 4 feet or longer[ provided in shops or hangers] to limit swinging. Provide single-unit suspended[ fluorescent] fixtures with twin-stem hangers. Provide multiple-unit or continuous row fluorescent fixtures with 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 with a minimum 4.57 mm 0.18 inch diameter.

[2.7 FIXTURES FOR HAZARDOUS LOCATIONS

In addition to requirements stated herein, provide[ fluorescent][ HID][ incandescent] fixtures for hazardous locations which conform to UL 844 or which have Factory Mutual certification for the class and division indicated.[ Provide fixtures also conforming to UL 595 for marine environments as indicated.]]

## 2.8 POWER HOOK FIXTURE HANGERS

Provide UL listed assembly including through-wired power hook housing, interlocking plug and receptacle, power cord, and fixture support loop. Provide power hook housing of cast aluminum having two 19 mm 3/4 inch threaded hubs, including support hook with safety screw. Provide fixture support loop of cast aluminum with provisions for accepting 19 mm 3/4 inch threaded fixture stems. Include with power cord 410 mm (16 inches) 16 inches of 3 conductor No. 16 Type SO cord. Provide complete assembly rated[ 120 volts or 277 volts, 15 amperes][ 480 volts, 20 amperes].

## 2.9 AUXILIARY INSTANT-ON SYSTEM

\*\*\*\*\*  
NOTE: Specify auxiliary quartz or compact fluorescent system for luminaires where extinguishing of HID lamps caused by momentary power interruptions is unacceptable for safety or security reasons, and inclusion of a central emergency system is beyond the project scope.  
\*\*\*\*\*

UL listed, automatically switched instant-on [\_\_\_\_\_] [150] [250] watt[ quartz][ compact fluorescent] lamp. [Quartz][Compact fluorescent] lamp is to come on when luminaire is initially energized and following a momentary power outage and remain on until HID lamp reaches approximately 60 percent light output. Design wiring for[ quartz][ compact fluorescent] lamp internal to the ballast and independent of the incoming line voltage to the ballast.[ Provide instant-on[ quartz][ compact fluorescent] system for each HID fixture.][ Provide instant-on[ quartz][ compact fluorescent] system as indicated.]

## 2.10 SUPPORT HANGERS FOR LIGHTING FIXTURES IN SUSPENDED CEILINGS

### 2.10.1 Wires

\*\*\*\*\*  
NOTE: Select zinc-coated steel wire for all locations except those listed in the note in the paragraph entitled "Wires, for Humid Spaces," below. When spacing of hanger wires exceeds 1219 mm 4 feet or when heavy lighting fixtures are supported, 8 or 10 gage wire should be specified.  
\*\*\*\*\*

ASTM A 641/A 641M, galvanized regular coating, soft temper, [2.68 mm] [[\_\_\_\_\_] mm ([\_\_\_\_\_] inches)] [0.1055][\_\_\_\_\_] inches in diameter ([12][\_\_\_\_\_] gage).

### [2.10.2 Wires, for Humid Spaces

\*\*\*\*\*  
NOTE: Select stainless steel or nickel copper alloy wire for facilities where high humidity can be expected such as large kitchens, dishwashing areas, etc. Select nickel copper alloy when hangers are used in an indoor pool environment. When spacing of hanger wires exceeds 1219 mm 4 feet or when heavy lighting fixtures are supported, 8 or 10

gage wire should be specified.

\*\*\*\*\*

[ASTM A 580/A 580M, composition 302 or 304, annealed stainless steel [2.68 mm] [[\_\_\_\_\_] mm ([\_\_\_\_\_] inches)] [0.1055] [\_\_\_\_\_] inches in diameter ([12] [\_\_\_\_\_] gage).]

[ASTM B 164, UNS NO4400, annealed nickel-copper alloy [2.68 mm] [[\_\_\_\_\_] mm ([\_\_\_\_\_] inches)] [0.1055] [\_\_\_\_\_] inches in diameter ([12] [\_\_\_\_\_] gage).]

#### ] 2.10.3 Straps

\*\*\*\*\*

NOTE: Normally wire hangers should be used. If the project is in an area subject to violent storms, steel strap or rod hangers should be specified. Check with area Engineering Office to determine if straps or rods are needed.

\*\*\*\*\*

Galvanized steel, 25 by 4.76 mm one by 3/16 inch, conforming to ASTM A 653/A 653M, with a light commercial zinc coating or ASTM A 1008/A 1008M with an electrodeposited zinc coating conforming to ASTM B 633, Type RS.

#### ] 2.10.4 Rods

\*\*\*\*\*

NOTE: Normally wire hangers should be used. If the project is in an area subject to violent storms, steel straps or rod hangers should be specified. Check with area Engineering Office to determine if straps or rods are needed.

\*\*\*\*\*

Threaded steel rods, 4.76 mm 3/16 inch diameter, zinc or cadmium coated.

### ] 2.11 EQUIPMENT IDENTIFICATION

#### 2.11.1 Manufacturer's Nameplate

Provide each item of equipment with 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.

#### 2.11.2 Labels

\*\*\*\*\*

NOTE: Labeling of lighting components is an inexpensive and effective method for helping facilities personnel properly operate and maintain the lighting systems. Provide easily readable labels when standing next to the equipment, and durable to match the life of the equipment to which they are attached. Refer to the FEMP guidelines for lighting at

[http://www.eere.energy.gov/femp/technologies/eep\\_lighting\\_guidance.cfm](http://www.eere.energy.gov/femp/technologies/eep_lighting_guidance.cfm).

\*\*\*\*\*

Provide labeled luminaires in accordance with **UL 1598** requirements. Clearly mark all for operation of specific lamps and ballasts according to proper lamp type. Note the following lamp characteristics in the format "Use Only [\_\_\_\_\_]":

- a. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
- b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
- c. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
- d. ANSI ballast type (M98, M57, etc.) for HID luminaires.
- e. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

Provide all markings related to lamp type clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Provide ballasts with clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

## 2.12 FACTORY APPLIED FINISH

\*\*\*\*\*  
**NOTE: This paragraph covers only the basic painting requirements for most electrical equipment. Include any special finishes for high or low temperatures and corrosive atmospheres.**  
\*\*\*\*\*

Provide electrical equipment with factory-applied painting systems which , as a minimum, meet the requirements of **NEMA 250** corrosion-resistance test.

## 2.13 COMMERCIAL INCANDESCENT LIGHTING FIXTURES

Commercial incandescent lighting fixtures include recessed, surface mounted, and pendant-mounted luminaires.

Provide [corrosion-resistant nonferrous metal] [sheet steel with corrosion-resistant finish] metal parts of fixtures. Do not use solder or self-threading sheet metal screws in the construction of the fixture enclosure.

Equip fixtures rated up to and including 300 watts with medium screw-base lampholders. Equip fixtures rated in excess of 300 watts but not more than 1,500 watts with mogul screw-base lampholders. Provide screw shells of lampholders which are electrically connected to the metal part of lighting fixtures or equipment grounding-circuit conductor.

### 2.13.1 Surface-Mounted Fixtures

Design the surface-mounted fixtures to be fastened to wall or ceiling flush-mounted outlet boxes. Do not subject combustible ceiling materials to temperatures in excess of **90 degrees C 195 degrees F**.

### 2.13.2 Recessed Fixtures

Design recessed fixtures in suspended ceilings for the type of ceiling construction in which the fixture is to be installed. Do not subject combustible ceiling materials to temperatures in excess of 90 degrees C 195 degrees F. Where recessed fixtures are supported on suspended ceilings, provide a minimum of four support rods per fixture with no support further than [150] [\_\_\_\_\_] millimeter [6] [\_\_\_\_\_] inches from the edge of the fixture. Do not support fixtures by acoustic panels.

### 2.13.3 Pendant-Mounted Fixtures

Equip pendant-mounted fixtures with stems, swivel ball-and-socket self-aligning hangers that allow a minimum of a [20] [\_\_\_\_\_] -degree angle swing, ceiling canopies, and fixture-hanging devices, made of seamless brass, aluminum, steel, corrosion-resistant steel tubing, or steel conduit not less than [15] [\_\_\_\_\_] millimeter [1/2] [\_\_\_\_\_] inch in diameter. Stem length, material, and finish are as noted.

## 2.14 INDUSTRIAL INCANDESCENT LIGHTING FIXTURES

Provide industrial incandescent lighting fixtures with industrial porcelain-enameled seamless dome reflectors with ventilated necks and hoods tapped for 15 millimeter 1/2 inch conduit for swivel suspension pendant mounting. Provide lampholders with medium or mogul bases as applicable, furnished with incandescent lamps having the wattage rating indicated, meeting the requirements of UL 1598. Provide easily detachable reflectors and sockets as a unit, without the use of tools, but arranged so that they cannot inadvertently come loose.

## 2.15 ENCLOSED AND GASKETED VAPOR-TIGHT FIXTURES

Provide enclosed and gasketed vapor-tight fixtures suitable for wet or damp locations consisting of a cast-aluminum body, cap or matching outlet box, porcelain lampholder, glass enclosing globe, cork gaskets, and cast-aluminum guards for wall, ceiling, or pendant mounting in accordance with UL 1598 and NFPA 70.

Furnish exposed cast aluminum outlet boxes for wall- and ceiling-mounted fixtures with four tapped hubs 90 degrees apart circumferentially, with three cast-aluminum threaded pipe plugs to fit the tapped holes. Provide boxes with ears or lugs for surface mounting to wall or ceiling. Provide body with mounting screws and gasket to ensure a vapor-tight joint between the body and outlet box.

Concealed outlet boxes for wall- and ceiling-mounted fixtures may be standard sheet metal boxes. Provide fixture body with mounting screws and gasket to ensure a vapor-tight joint between the body and outlet box.

Seal body and cap for pendant-mounted fixtures with a gasket at the joint. Provide cast aluminum cap with top hub tapped for 15 millimeter 1/2 inch tapered iron pipe threads.

Furnish cast aluminum exposed outlet boxes for pendant-mounted fixtures with the fixtures with four tapped hubs 90 degrees apart circumferentially, with three cast-aluminum threaded pipe plugs to fit the tapped holes. Supply boxes with ears or lugs for surface mounting to the ceiling. Provide cast aluminum outlet-box covers for concealed and exposed outlet



boxes with the center hub tapped for 15 millimeter 1/2 inch tapered iron pipe threads. Provide cover and outlet box with mounting screws and gasket to ensure a vapor-tight joint between the cover and outlet box. Also provide 15 millimeter 1/2 inch galvanized rigid steel conduit stem.

Provide clear nondiffusing heat-resistant glass enclosing globe molded in one piece into a cylindrical shape with a closed bowl-shaped bottom and an open molded top bead or thread. Make edges of the open end either ground or molded to a smooth, true surface that will ensure a vapor-tight joint when the globe is fastened to the gasketed body.

Provide a cast-aluminum guard of the same shape as the glass enclosing globe which is affixed to the fixture body with threads or setscrews.

## 2.16 INCANDESCENT LAMPS

Provide general-purpose lamps, [clear] [frosted inside]. Provide lamps with wattage ratings up to and including 300 watts with medium brass screw bases. Provide lamps with wattage ratings in excess of 300 watts with mogul brass screw bases.

Special-purpose lamps include PAR and R lamps. Provide PAR lamps with clear, molded, heat-resistant, hard-glass bulbs with parabolic, aluminized, inner-bulb wall reflector for spot- or flood-lighting applications. Provide R lamps with clear, soft, blown-glass bulbs with silver-deposited, inner-bulb wall reflector for spot or floodlighting applications. Design lamps for operation on 120 volts.

## 2.17 LOWERING DEVICES FOR HIGH-BAY LIGHTING FIXTURES

Provide lowering devices for high-bay lighting fixtures consisting of a hand-operated mechanism that will connect, disconnect, raise, and lower the lighting fixture and permit the servicing and maintenance of fixtures and equipment at floor level. Include with lowering device hangers, pulleys, beam clamps or suspension fittings, operating cable, hand chain, and cable and chain fittings.

Provide hanger consisting of a two-piece latching spring-loaded mechanism with an upper and lower separable contact assembly and stem and guide assembly, with cast-aluminum protective housings. Provide contacts for two-pole for single 2-wire circuits and four-pole for 3- and 4-wire circuits rated 15 amperes at 600 volts and 30 amperes at 250 volts ac.

Include with upper contact assembly an integrally mounted corner pulley with threaded hub for electrical-conduit connections and top flange with [lugs] [ears] for mounting.

Include with lower contact assembly fixture adapters and swivel end fittings for anchoring operating cable in the stem of the hanger, with adapters of hot-dip galvanized malleable iron.

Provide open face pulleys with cast-aluminum alloy housings and deep-grooved pulley wheels closely shrouded to prevent lines from becoming wedged between wheel and housing. Design pulleys to be straight through for top and bottom mounted operating cables and corner type as required. Hinge top mounted pulleys, with mounting lugs. Provide fixed bottom mounted pulleys, with mounting lugs. Bolt all pulleys to the supporting structure. Support horizontal runs of operating cable with pulleys located not more than [10700] [ ] millimeter [35] [ ]-feet apart.

Include with terminal fittings an enclosed lockbox with hub tapped for 20 millimeter 3/4 inch conduit, flared conduit end fitting, pulley wheel, locking hooks, and hinged cover with provisions for padlocking.

Provide cast-aluminum alloy lockbox and cover, with the flared conduit end fitting of hot-dip galvanized malleable iron.

Mount wall mounted lockbox not less than [1100] [ ] millimeter and not more than [1370] [ ] millimeter [43] [ ] inches and not more than [54] [ ] inches above the floor at the operating level. Provide pulley designed to permit horizontal pull operation of the lowering device at the operating level.

Provide 3 millimeter 1/8 inch diameter operating cable, 7 by 19 stranded, heat- and corrosion-resistant steel aircraft cable with link, cable loops, and serving sleeves. Perform cable with detachable fittings designed for connection to the terminal fittings, conforming to ASTM A 368.

Provide hand chains which are separate detachable hand lines to provide means for disconnecting, lowering, raising, and reconnecting fixtures after servicing and maintenance work has been completed. Provide hand chain equal in length to the mounting height of the fixture and equipped with a snap hook for connection to the terminal end of the operating cable, size 4, hot-dip galvanized steel, conforming to ASTM A 467/A 467M, Class MS machine, straight link, steel chain.

Provide cast-aluminum-alloy housings conforming to ASTM B 26/B 26M.

Provide malleable-iron fittings conforming to ASTM A 47/A 47M, and hot-dip galvanized coatings conforming to ASTM A 123/A 123M.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Ensure all electrical installations conform to IEEE C2, NFPA 70, and to the requirements specified herein.

#### 3.1.1 Lamps

\*\*\*\*\*  
NOTE: Indicate all lamp types and colors on the  
lighting fixture schedule.  
\*\*\*\*\*

Deliver lamps of the type, wattage, and voltage rating indicated to the project in the original cartons and installed just prior to project completion. Replace lamps installed and used for working light during construction prior to turnover to the Government if more than 15 percent of their rated life has been used. Test the lamps for proper operation prior to turn-over and replace if necessary with new lamps from the original manufacturer. Provide 10 percent spare lamps of each type from the original manufacturer.

#### 3.1.2 Lighting Fixtures

\*\*\*\*\*  
NOTE: Coordinate these requirements with  
\*\*\*\*\*

architectural plans and specifications. Ensure requirements for antiterrorism/force protection for fixtures in suspended ceilings are included in and coordinated with Section 09 51 00 ACOUSTICAL CEILINGS by referencing ASTM E 580 seismic requirements in that section.

Design lighting fixtures for facilities located in earthquake zones with additional supports and restraining devices as described in Army TI809-04, "Seismic Design for Buildings."

\*\*\*\*\*

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings, in conformance with the requirements of NFPA 70. Mounting heights specified or indicated are to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Independently support recessed and semi-recessed fixtures from the building structure by a minimum of four wires[ or straps][ or rods] per fixture and located near each corner of each fixture. Ceiling grid clips are not allowed as an alternative to independently supported light fixtures. Independently support round fixtures smaller in size than the ceiling grid from the building structure by a minimum of four wires[ or straps][ or rods] per fixture spaced approximately equidistant around the fixture. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently and provide at least two 19 mm 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the fixture. Provide wires[ or straps][ or rods] for lighting fixture support in this section. Lighting fixtures installed in suspended ceilings are to comply with the requirements of Section 09 51 00 ACOUSTICAL CEILINGS.

### 3.1.3 Suspended Fixtures

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**NOTE:** Coordinate pendant sway bracing details with the architect. The architect may prefer to provide pendant sway bracing details in locations where appearance is important.

\*\*\*\*\*

Provide suspended fixtures with 0.79 rad 45 degree swivel hangers so that they hang plumb and locate with no obstructions within the 0.79 rad 45 degree range in all directions. Provide the stem, canopy and fixture capable of a 0.79 rad 45 degree swing. Brace pendants, rods, or chains 1.2 meters 4 feet or longer excluding fixture, to prevent swaying, using three cables at 2.09 rad 120 degree separation. Provide suspended fixtures in continuous rows with internal wireway systems for end to end wiring and properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Use aligning splines on extruded aluminum fixtures to assure hairline joints. Support steel fixtures to prevent "oil-canning" effects. Provide fixture finishes free of scratches, nicks, dents, and warps, and matching the color and gloss specified.

Provide pendants finished to match Provide stainless steel air craft cable. Provide canopies finished to match the ceiling and low profile unless otherwise shown. Ensure maximum distance between suspension points is 3.1 meters 10 feet or as recommended by the manufacturer, whichever is less.

#### [3.1.4 Ballasts

##### [3.1.4.1 Remote Ballasts

Mount remote type ballasts or transformers, where indicated, in a well ventilated, easily accessible location, within the maximum operating distance from the lamp, as designated by the manufacturer.

##### ] [3.1.4.2 Electronic Dimming Ballasts

Provide all electronic dimming ballasts, controlled by the same controller, from the same manufacturer. Season or burn all fluorescent lamps on electronic dimming ballast control in at full light output for 100 hours before dimming.

#### ] ] 3.2 FIELD APPLIED PAINTING

\*\*\*\*\*  
NOTE: Use and coordinate paint and coating requirements with Section 09 90 00 PAINTS AND COATINGS when provided in the job. If Section 09 90 00 PAINTS AND COATINGS is not provided or when requirements are beyond what is specified in Section 09 90 00 PAINTS AND COATINGS, specify the requirements in this paragraph.  
\*\*\*\*\*

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

#### 3.3 FIELD QUALITY CONTROL

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

##### 3.3.1 Electronic Dimming Ballast

Test for full range of dimming capability. Observe for visually detectable flicker over full dimming range.

#### 3.4 FIELD TESTING

Demonstrate that all incandescent lighting fixtures and their accessories, including lowering devices, operate satisfactorily in the presence of the Contracting Officer.

Perform operational tests in accordance with referenced standards in this section.

-- End of Section --