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**USACE / NAVFAC / AFCESA / NASA** **UFGS-26 51 13.09 40 (April 2006)**

**Preparing Activity: NASA** **Superseding NASA-16511S (December 2005)**

**UNIFIED FACILITIES GUIDE SPECIFICATIONS**

**References are NOT in agreement with UMRL dated 01 April 2006**

**Revised throughout - changes not indicated by CHG tags**

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 51 13.09 40

FLUORESCENT LUMINAIRES

**04/06**



-- End of Section Table of Contents --

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**UNIFIED FACILITIES GUIDE SPECIFICATIONS**

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SECTION 26 51 13.09 40

FLUORESCENT LUMINAIRES
**04/06**

**********
**NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.**

**This section covers fluorescent lighting fixtures, ballasts, and lamps.**

**Drawings should show a three-dimensional detail of each fixture with letter designation keyed to the drawings and electrical symbols describing the type, style, class, kind, and size of fixture as follows:**

**Commercial type fixtures including recessed surface-and pendant-mounted luminaires for direct, semidirect, direct/indirect, semi-indirect, and indirect lighting distribution and recessed combination light and air-handling troffers for direct-lighting distribution.**

**Industrial fixtures including pendant- and chain-mounted luminaires for direct and semidirect lighting distribution and enclosed and gasketed fixtures.**

**All fixture drawings should indicate the materials and finishes for reflectors, refractors, diffusers, and shielding; fixture mounting details; the number, size, and description of lamps; and electrical characteristics of branch-circuit or feeder connections.**

**Industrial fluorescent-fixture drawings should indicate type of luminaire, including direct lighting with zero percent and 8 to 20 percent upward component of light, and semi-direct with 10 to 20 percent upward component of light.**

**Combination light and air-handling troffer drawings should indicate noise criteria and**

**sound-transmission class rating, air-flow quantities, throw patterns, velocity, and any other criteria necessary to complete the specification.**

**Fixture or luminaire details shall be presented in a fixture schedule.**

**Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of 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).**

**Use of electronic communication is encouraged.**

**Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.**

**********

PART 1 GENERAL

1.1 REFERENCES

**********

**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.**

**********

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI C82.1 | (2004) Standard for Lamp Ballast - Line Frequency Fluorescent Lamp Ballast |

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

| | |
|---|---|
| ANSI/IEC C78.901 | (2005) Standard for Electric Lamps - Single Base Fluorescent Lamps - Dimensional and Electrical Characteristics |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| ANSI/NEMA C82.2 | (2002) Method of Measurement of Fluorescent Lamp Ballasts |

U.S. DEPARTMENT OF ENERGY (DOE)

| | |
|---|---|
| DOE LT-1 | (2000) How to Buy Energy-Efficient Fluorescent Tube Lamps |
| DOE LT-2 | (2000) How to Buy Energy-Efficient Fluorescent Ballasts |
| DOE LT-3 | (2000) How to Buy Energy-Efficient Fluorescent Luminaires |
| DOE LT-5 | (2000) How to Buy Energy-Efficient Compact Fluorescent Light Bulbs |

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

| | |
|---|---|
| FCC Part 18 | RF Lighting Devices |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 844 | (1999; 2005) Standard for Electric Lighting Fixtures for Use in Hazardous (Classified) Locations |
| UL 935 | (2001; R 2003e10) Standard for Safety Fluorescent-Lamp Ballasts |

1.2 GENERAL REQUIREMENTS

**********
**NOTE: If Section 26 00 00.00 40 GENERAL ELECTRICAL PROVISIONS is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.**
**********

Section 26 00 00.00 40 GENERAL ELECTRICAL PROVISIONS applies to work specified in this section.

Outline Drawings shall be submitted for the fluorescent fixtures indicating overall physical features, dimensions, ratings, service requirements, and weights of equipment.

Manufacturer's catalog data shall be submitted for all fluorescent lighting fixtures, ballasts and lamps.

Test Reports shall show compliance with the requirements of this

specification as follows:

Lighting-Distribution Curves for each type of fixture shall be prepared utilizing the fixture manufacturer's own facilities or those of an independent nationally recognized laboratory, in accordance with the standard procedure developed by the Illuminating Engineering Society.

1.3 SUBMITTALS

**********

**NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.**

**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. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.**

**Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.**

**********

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

SD-02 Shop Drawings

Fabrication drawings shall be submitted for the following items:

Fluorescent Lighting Fixtures
Fluorescent Lamp Ballast
Fluorescent Lamps

Outline Drawings shall be submitted for fluorescent fixtures in

accordance with paragraph entitled, "General Requirements," of this section.

SD-03 Product Data

Equipment and performance data shall be submitted for the following including life, test, system functional flows, safety features, and mechanical automated details.

Fluorescent Lighting Fixtures
Fluorescent Lamp Ballast
Fluorescent Lamps

Manufacturer's catalog data shall be submitted for the following items:

Compact Fluorescent Fixtures

SD-06 Test Reports

Test Reports shall be submitted for the following in accordance with paragraph entitled, "General Requirements," of this section.

Lighting-Distribution Curves

SD-07 Certificates

Certificates shall be submitted for the following showing conformance with the referenced standards contained in this section.

Fluorescent Lighting Fixtures
Fluorescent Lamp Ballast
Fluorescent Lamps
Compact Fluorescent Fixtures
Efficiencies

1.4 ELECTRONIC BALLAST WARRANTY

Furnish the electronic ballast manufacturer's warranty. The warranty period shall not be less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. The warranty shall state that the malfunctioning ballast shall be exchanged by the manufacturer and promptly shipped to the using Government facility. The replacement ballast shall be identical to, or an improvement upon, the original design of the malfunctioning ballast.

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Fixtures in hazardous areas shall conform to UL 844.

Fluorescent lighting fixtures shall be furnished completely assembled with wiring and mounting devices and ready for installation at the locations indicated. Recessed fixtures in suspended ceilings shall be designed and equipped for installation in the type of ceiling in which the fixture is to

be installed. Fixtures shall be designed to be supported independent of the ceiling and shall be equipped with the lamps indicated.

Lighting fixtures shall have efficiencies in accordance with the recommended levels specified in DOE LT-3.

## 2.2 COMMERCIAL FIXTURES

Lighting fixtures shall include wiring channel, end plates, end caps, side panels, top reflectors, bottom closures, lampholders, lamps, ballasts, suspension stems, wiring, and other necessary materials and devices.

Ballasts and wiring shall be completely enclosed in the wiring channel and shall be easily accessible. Ballast shall be replaceable without removing the fixture from its mounting. Lamps shall be replaceable without the use of tools and without removal of other lamps and equipment.

Wiring channel, end plates, and other sheet steel enclosure components shall be cold-rolled carbon-steel sheet of commercial quality not less than [20] [_____] gage [1] [_____] millimeter.

When two or more fixtures are joined together in continuous rows, the wiring channel shall form an open and continuous wireway.

### 2.2.1 Surface-Mounted Fixtures

Surface-mounted fixtures shall be designed to be fastened to wall or ceiling flush-mounted outlet boxes. When two or more fixtures are joined together in continuous rows, the wiring channel shall form an open and continuous wireway.

### 2.2.2 Recessed Fixtures

Recessed fixtures in suspended ceilings shall be equipped with frames, yokes, and adjustable mounting brackets designed for the type of ceiling construction in which the fixture is to be installed. Bottom closure shall be hinge framed with [chromium] [nickel]-plated latching devices.

### 2.2.3 Pendant-Mounted Fixtures

Pendant-mounted fixtures shall be equipped with stems, swivel, ball-and-socket self-aligning hangers, ceiling canopies, and fixture-leveling devices. Stems shall be not less than [1/2] [_____] inch [13] [_____] millimeter in diameter, made from seamless [brass] [aluminum] [steel] [corrosion-resistant steel] tubing. Stem length, material, and finish shall be as indicated.

**********
**NOTE: For ceiling heights greater than or equal to 10 feet3 meters include the following paragraph.**
**********

Pendant-mounted fixtures shall be suspended [13] [____] [18] inches [330] [____] [457] millimeters from the ceiling.

**********
**NOTE: Include the following paragraph for semi-direct, direct/indirect, or semi-indirect fixtures.**

**********

The ratio of upward to downward components of light shall be [80:20][90:10].

2.2.4 Combination Light and Air-Handling Troffers

Electrical equipment, except lamps and lampholders, shall be completely separated from the air path through the fixture and from the air space in the plenum.

Joints in the wiring channel shall be [lapped] [sealed] to prevent air leakage and the infiltration of lint and dirt into the wiring compartment.

Air-handling fixtures shall be equipped with bottom flanges, air trim openings, metal filler strips, and single or double air-diffuser side units. Inlet connections shall be located on the side of single units and on the top or side of double units.

Supply-terminal air devices shall be equipped with adjustable air pattern controllers in outlets and with volume controls in housings. Both controls shall be accessible from the face of the outlet without disturbing the lamp enclosure. Pattern- and volume-control devices shall be positive locking in all positions. Return-air units shall be equipped with volume controls.

Air-diffuser assemblies shall be constructed of mill-galvanized steel. Interior surfaces exposed to view and the metal filler strips shall be finished with a matte-black enamel. Filler strips shall be used to close unused air-trim openings.

2.2.5 Compact Fluorescent Fixtures

Compact fluorescent fixtures shall be 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.

2.3 INDUSTRIAL FIXTURES

Lower edge of the reflector shall be formed into a flange or bead to provide stiffness and shall be completely covered by the finish. Each reflector shall be removable and securely maintained in position with latch fastening devices. Reflector shall form the bottom of the wiring-channel enclosure.

Direct-lighting fixture reflectors shall be so shaped that the ratio of the candlepower luminance at 55 degrees nadir to the candlepower luminance at nadir shall be not less than 55 percent. Upward component of light shall be a minimum of 8 percent and a maximum of 20 percent of the total light output.

**********
**NOTE: For ceiling heights greater than or equal to 10 feet3 meters include the last sentence of the following paragraph.**
**********

Semidirect lighting-fixture reflectors shall be so shaped that the ratio of the candlepower luminance at 45 degrees nadir to the candlepower luminance at nadir shall be not less than 60 percent. The ratio of upward to

downward components of light shall be [80:20][90:10]. Fixtures shall be suspended [13][____][18] inches[330][____][457] millimeters from the ceiling.

Lighting-fixture unit, when viewed at any angle from the minimum shielding angle to the horizontal plane, shall have a brightness no greater than 40 percent of the brightness of the bare lamp.

**********
**NOTE: For ceiling heights greater than or equal to 10 feet 3 meters include the last sentence of the following paragraph. Include the second to last sentence for semi-direct, direct/indirect, or semi-indirect fixtures**
**********

Pendant-mounted fixtures shall be equipped with straps, brackets, conduit stems, ball-and-socket self-aligning hangers, ceiling canopies, slide-clamp fixture hangers, and leveling devices. Stems shall be not less than 1/2 inch 13 millimeter in diameter, seamless brass, steel, or aluminum tubing. Stem length and finish shall be as indicated. When two or more fixtures are joined together, the wiring channel shall form an open and continuous wireway. The ratio of upward to downward components of light shall be [80:20][90:10]. Fixtures shall be suspended [13][____][18] inches [330][____][457] millimeters from the ceiling.

Chain-supported fixtures shall be equipped with straps, brackets, ceiling-mounted chain hangers, chain, hooks, and slide-clamp fixture hangers.

Compact fluorescent fixtures shall be 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.

## 2.4 FLUORESCENT LAMP BALLAST

Fluorescent lamp ballasts shall be Class [P] [_____] in accordance with ANSI C82.1, ANSI/NEMA C82.2, and UL 935.

Ballasts shall have efficiencies in accordance with the recommended levels specified in DOE LT-2.

Ballasts shall be designed for single- or two-lamp operation with line power factor not less than 90 percent. Two-lamp ballasts shall operate the two lamps out of phase with each other. Lamp cathodes shall be continuously heated during lamp operation.

Fluorescent lighting fixtures with lamps 30 watts or more shall be equipped with [rapid-start] [instant start] ballasts. All fluorescent lighting fixtures with lamps rated 20 watts or less shall be equipped with [rapid-start] [instant start] ballasts. Auxiliary lamp starters shall not be permitted.

Ballasts shall be voltage rated for operation on [120] [277]-volt, single-phase, 60-hertz lighting distribution systems as indicated.

Ballasts shall be designed for a maximum ambient temperature of [105] [_____] degrees F [40] [_____] degrees C.

Ballasts for outdoor lamps shall have a minimum starting temperature of minus [20] [_____] degrees F [29] [_____] degrees C.

2.4.1 Electronic Ballasts

Ballasts shall not contain polychlorinated biphenyls (PCB's).

Ballasts shall operate with a 90 to 110 percent input voltage variation at an input frequency of 60 Hz. Light output shall remain constant for line voltage fluctuations of plus or minus 3 percent. Ballasts shall be rapid start type.

Ballasts shall have a minimum power factor of 0.95.

Ballasts shall comply with Class A (20-24 DB) sound rating.

Ballasts shall comply with Electromagnetic Interference (EMI) and Radio Interference (RFI) limits set by the FCC Part 18, CFR, Chapter 18, Part C.

Ballasts shall have less than 10 percent Total Harmonic Distortion.

Ballasts shall have a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

Ballast size and mounting configuration shall be consistent with standard electromagnetic ballast for same application.

Single or three lamp ballast shall be tandem wired, if they are in the same room and within the following distances: recess mounted - 10 feet center to center pendant or surface mounted 1 foot separation.

2.4.2 Dimmable Electronic Ballasts

Ballast shall be [rapid-start][instant-start] designed to operate high efficient [T-8 32 watt][T-5] lamps and provide continuous dimming from 100 to 10 percent of light output, flicker free. Ballast shall start lamp at any preset light output setting. Dimming shall be controlled by a 9 to 10 volt interface. [When power is applied, ballast shall not ramp up to full light output and then dim to preset level.] Total harmonic distortions shall be limited to less than 10 percent and third harmonic distortion shall be limited to less than 6 percent. Ballast shall operate at a frequency greater than 20 kHZ from an input frequency of 60 Hz. Power factor shall be a minimum of 0.95 at full light output and a minimum of 0.90 over the entire dimming range.

2.4.3 Rapid Start Ballasts

Ballast factor shall be between 0.85 and 1.0 when tested with a full-wattage [T-8][T-5] lamp.

Ballasts shall be capable of operating remaining lamps if one or more companion lamps fail or are removed.

**********

**NOTE: The most efficient ballasts for four-foot T8, 32 watt lamps are "instant-start" ballasts, which may shorten lamp life in applications where lamps**

**are turned on and off frequently; slightly less efficient "rapid-start" ballasts are preferable in these applications. The specifier should only include the following subpart for applications where lamps are rarely turned on and off.**

**********

2.4.4 Instant Start Ballasts

Ballast factor shall be between 0.85 and 1.0 when tested with a full wattage [T-8][T-5] lamp.

Rated lamp life shall not be reduced more than 25 percent compared with rapid start operation, based on three hours per start.

Multi-lamp ballasts shall operate lamps in parallel, so that when one lamp burns out the other lamps will continue operating in full light output.

2.4.5 Compact Fluorescent Ballasts

Ballast factor shall be no less than 0.85 when tested with a compatible lamp.

Ballasts and related hardware for indoor use shall start lamps at a starting temperature of 50 degrees F 10 degrees C.

For outdoors applications or where ambient temperatures may fall below 50 degrees F 10 degrees C, manufacturer's minimum starting temperatures for ballasts and related hardware shall be [____]degrees F [____]degrees C. Outdoor applications shall use Type I outdoor rated ballasts.

2.5 FLUORESCENT LAMPS

**********

**NOTE: The following paragraphs cover energy-efficient lamps to be used for indoor lighting when the ambient temperature is above 60 degrees F 16 degrees C and the lighting is not subjected to strong drafts of air. Should these adverse conditions exist, delete the following paragraphs and insert the following words for this paragraph: Fluorescent lamps shall be standard cool white.**

**********

Lamps shall conform to [ANSI/IEC C78.901] [ANSI/IEC C78.901] and shall be the energy-efficient type with a minimum starting temperature of [60] [_____] degrees F [16] [_____] degrees C.

2.5.1 Rapid Start Lamp

Lamps shall have efficiencies in accordance with the recommended levels specified in DOE LT-1

Rapid start lamps shall have bulb designation [T-8] [T-5] a base configuration of medium bipin contact.

Lamps shall have an average rated life at 3 hours per start of 20,000 hours.

Lamp lumen depreciation shall result in a mean lumen value of at least 90 percent of the finial lamp lumens at 8,000 operating hours and at least 84 percent of the initial lamp lumens at 14,000 operating hours.

Bulb color shall be [3500K] [Cool White] [White] [Warm White] [Daylight] with a minimum color rendering index of 70. Lamp dimensions shall be in accordance with ANSI/IEC C78.901.

**********

**NOTE: The most efficient ballasts for four-foot T8, 32 watt lamps are "instant-start" ballasts, which may shorten lamp life in applications where lamps are turned on and off frequently; slightly less efficient "rapid-start" ballasts are preferable in these applications. The specifier should only include the following subpart for applications where lamps are rarely turned on and off.**

**********

2.5.2 Instant Start Lamp

Lamps shall have efficiencies in accordance with the recommended levels specified in DOE LT-1

Rated lamp life shall be at least 15,000 hours.

Lamp lumen depreciation shall result in a mean lumen value of at least 90 percent of the finial lamp lumens at 6,000 operating hours and at least 84 percent of the initial lamp lumens at 10,500 operating hours.

Bulb color shall be [3500K] [Cool White] [White] [Warm White] [Daylight] with a minimum color rendering index of 70. Lamp dimensions shall be in accordance with ANSI/IEC C78.901.

2.5.3 Compact Fluorescent Lamp

Lamps shall have efficiencies in accordance with the levels specified in DOE LT-5.

Lamps shall utilize phosphors of a composition which includes rare earth phosphors with a color temperature of 3000 K and a minimum color rendering index of 80.

Lamp lumen depreciation shall result in a mean lumen value of at least 85 percent of pintail lamp lumens at 40 percent of rated life.

For outdoors applications or where ambient temperatures may fall below 50 degrees F10 degrees C, manufacturer's minimum starting temperatures for lamps shall be [____]degrees F[____] degrees C.

PART 3 EXECUTION

3.1 INSTALLATION

A fixture shall be installed at each outlet indicated, and lamps of the proper type and wattage shall be installed in each fixture.

Immediately prior to occupancy, clean reflector cones, reflectors, aperture plates, lenses, louvers, and decorative elements. To prevent static

buildup on lenses and reflectors, clean with a manufacturer's recommended water-diluted solution of glass cleaner and allow to air-dry after installation.

Replace any broken or defective parts prior to final inspection.

Fixtures shall be installed parallel and perpendicular to major axes of structures and shall be plumb and aligned to a tolerance of [1/2] [_____] inch in [10] [_____] feet [13] [_____] millimeter in [3000] [_____] millimeter.

Supports for recessed fixtures shall have a minimum capacity of [150] [_____] pounds [670] [_____] newtons, and all parts of the support shall be arranged to prevent them from vibrating free.

[Supports for recessed fixtures in suspended ceilings shall be so arranged that each corner of each fixture is supported by a hanger wire anchored to a structural member or to the structure to afford adequate seismic anchorage.]

Surface-mounted fixtures shall be attached securely to structural members or to metal supports that span structural members. Fixtures shall be fastened near each end and, when over [4] [_____]-feet [1200] [_____] millimeter long, shall also be fastened at the center. When surface-mounted fixtures are not UL approved for direct mounting on combustible ceilings, suitable spacers shall be installed.

Fixtures located in equipment rooms shall be so installed that they clear all obstructions such as duct, piping, bracing, and supports.

## 3.2 FIELD TESTING

Fluorescent lighting fixtures shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer.

-- End of Section --