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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
NASA-16524 (November 2004)  
NASA  
Superseding NASA-16524  
(June 2004)  
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SECTION TABLE OF CONTENTS

DIVISION 16 - ELECTRICAL

SECTION 16524

ROADWAY LIGHTING

11/04

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 GENERAL REQUIREMENTS

PART 2 PRODUCTS

- 2.1 STREET-LIGHTING FIXTURES
- 2.2 LIGHTING STANDARDS
  - 2.2.1 Aluminum Lighting Standards
  - 2.2.2 Steel Lighting Standards
  - 2.2.3 Concrete Lighting Standards
- 2.3 STREET-LIGHTING LUMINAIRES
  - 2.3.1 End-Mounted High-Intensity-Discharge (HID) Luminaires
  - 2.3.2 Side-Mounted (HID) Luminaires
  - 2.3.3 Lamp Ballasts
    - 2.3.3.1 Multiple-Circuit Ballasts
    - 2.3.3.2 Series Circuit Transformers
  - 2.3.4 Lamps
    - 2.3.4.1 (HID) Lamps and Ballasts
    - 2.3.4.2 Low Pressure Sodium
  - 2.3.5 Side-Mounted Incandescent Luminaires
  - 2.3.6 Incandescent Lamps

PART 3 EXECUTION

- 3.1 FOUNDATIONS FOR LIGHTING STANDARDS
- 3.2 INSTALLATION
  - 3.2.1 Field Testing

-- End of Section Table of Contents --

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SECTION 16524

ROADWAY LIGHTING  
11/04

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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 highway and roadway lighting standards and luminaires.

Drawings should show details of each street lighting fixture with letter designation keyed to the drawings and electrical symbols describing the type, style, class, kind, and size of fixture as follows:

Roadway lighting fixtures including lighting standards, brackets, foundations, and luminaires for IES as listed in IES RP-8, "Lighting Distribution Patterns."

Roadway-lighting standards and fixture details on drawings should describe, in plan and elevation, the type and kind of pole, bracket, luminaire, base, and foundation required for installation at the location indicated. Elevation details should indicate height of pole, bracket-spread length, luminaire, depth of foundation, anchor bolts, underground conduit connections, ground rods, and ground connections. Plan views should indicate foundation configuration, conduit stub-ups, base dimensions, and bolt circles. Foundation detail drawings should accurately describe the nature and properties of soil surrounding foundations for the support of lighting standards.

Foundations for installation of roadway and flood-lighting standards and fixtures in filled locations may require modification to resist horizontal movement without permanent set under stipulated wind loads.

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PART 1 GENERAL

1.1 REFERENCES

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**NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.**

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The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI C78.1350 (1990) Electric Lamps - 400-Watt, 100-Volt, S51 Single Ended, High-Pressure Sodium Lamps
- ANSI C78.1352 (1990) 1000-Watt S52 High-Pressure Sodium Lamps
- ANSI C78.1353 (1990) 70-Watt S62 High-Pressure Sodium Lamps
- ANSI C78.1355 (1989) 150-Watt 55-Volt S55 High-Pressure Sodium Lamps
- ANSI C82.5 (1990; R 1995) Reference Ballasts - High-Intensity-Discharge and Low Pressure Sodium Lamps

ASTM INTERNATIONAL (ASTM)

- ASTM A 123/A 123M (2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A 153/A 153M (2004) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- ASTM A 36/A 36M (2004) Standard Specification for Carbon Structural Steel

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

- IESNA RP-8 (2000) Roadway Lighting

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

- ISO 261 (1998) ISO General Purpose Metric Screw Threads - General Plan
- ISO 262 (1998) ISO General Purpose Metric Screw Threads - Selected Sizes for Screws, Bolts and Nuts
- ISO 263 (1973) ISO Inch Screw Threads - General Plan and Selection for Screws, Bolts and Nuts - Diameter Range 0.06 to 6 inch

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA C82.4 (2002) For Lamp Ballasts - Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type)
- NEMA C82.9 (1996; C82.9b) High-Intensity-Discharge and Low-Pressure Sodium Lamps, Ballasts, and Transformers - Definitions

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

- SSPC SP 10 (2000) Joint Surface Preparation, Standard Near-White Metal Blast Cleaning (NACE No. 2)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

- FS TT-P-38 (Rev E) Paint, Aluminum, Ready-Mixed
- FS TT-P-645 (1990b) Primer, Paint, Zinc-Molybdate, Alkyd Type

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

- 21 CFR 1040 (1995) Performance Standards for Light-Emitting Products

1.2 SUBMITTALS

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**NOTE: Review submittal description (SD) definitions in Section 01330 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. Include a columnar list of appropriate products and tests beneath each submittal description.**  
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The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists shall be submitted for highway and roadway lighting fixtures in accordance with paragraph entitled, "General Requirements," of this section.

SD-02 Shop Drawings

Fabrication drawings shall be submitted for the following items consisting of fabrication and assembly details to be performed in the factory.

- Street-Lighting Fixtures
- Lighting Standards

Street-Lighting Luminaires

Installation Drawings shall be submitted for the highway and roadway lighting systems in accordance with the paragraph entitled, "Installation," of this section.

SD-03 Product Data

Equipment and Performance Data shall be submitted for highway and roadway lighting systems in accordance with paragraph entitled, "General Requirements," of this section.

Equipment Foundation Data for highway and roadway lighting shall be in accordance with the paragraph entitled, "Foundations for Lighting Standards," of this section.

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

- Street-Lighting Fixtures
- Lighting Standards
- Street-Lighting Luminaires

SD-06 Test Reports

Test reports shall be submitted for Operational Tests on incandescent lighting fixtures in accordance with the paragraph entitled, "Field Testing," of this section.

SD-07 Certificates

Certificates shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

1.3 GENERAL REQUIREMENTS

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**NOTE: If Section 16003 GENERAL ELECTRICAL PROVISIONS is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.**  
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Section 16003 GENERAL ELECTRICAL PROVISIONS applies to work specified in this section.

Material, Equipment, and Fixture Lists shall be submitted for highway and roadway lighting fixtures including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

Equipment and Performance Data shall be submitted for highway and roadway lighting systems consisting of life test, system functional flows, safety features, mechanical automated details, automatic interlocks, and such features as electrical system protective device ratings.

Certificates shall be submitted showing compliance with the following requirements:

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.

PART 2 PRODUCTS

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**NOTE: Revise as necessary to meet project requirements.**  
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2.1 STREET-LIGHTING FIXTURES

Street-lighting fixtures, including standards and luminaires, shall be furnished complete with wiring and mounting devices ready for installation at the locations indicated. Fixtures shall be equipped with lamps.

2.2 LIGHTING STANDARDS

Lighting standard, includes pole, anchor base, transformer base, brackets, and accessories. Lighting standards shall be designed to withstand vertical and horizontal loading on the entire structure and supported equipment without damage or permanent deformation to any component of the lighting standard.

2.2.1 Aluminum Lighting Standards

Aluminum poles shall be continuously tapered and shall have a brushed satin finish.

Brackets for street lighting luminaires shall be detachable with pole and bracket adapter fittings of cast-aluminum alloy. Adapter fittings shall be welded to pole and bracket and bolted together with aluminum alloy or corrosion-resistant steel hexagon-head bolts. Tenon end of the bracket shall accommodate the luminaire indicated.

Anchor base shall be cast-aluminum alloy, seam welded to the pole at the upper outer edge of the flange and the lower edge of the pole. Anchor base shall have anchor-bolt holes for connection to anchor bolts or the top of transformer base.

Transformer base shall be a one-piece casting of cast-aluminum alloy, with a removable cast-aluminum flanged access cover held in place with bolts or screws. Transformer base shall have anchor-bolt holes in the base for connection to anchor bolts in the foundation and bolt holes in the top for connection to pole anchor base.

Standards without transformer bases shall be equipped with oval-shaped handhole with reinforced sheet aluminum frame and cover with center of opening 18-inches 450 millimeter above the foundation.

Standards shall be furnished with a 1/2-inch square nut, 13 threads per inch, as specified in ISO 263 M18 x 2 as specified in ISO 261 and ISO 262, welded to the inside of the pole for ground connections.

Accessories shall be provided, including cast-aluminum ornamental pole-top cap, pole-top tenons, aluminum-alloy or corrosion-resistant steel nuts,

bolts, and washers, and galvanized sheet metal leveling shims.

### 2.2.2 Steel Lighting Standards

Steel poles shall be continuously tapered and seam welded.

Brackets for street lighting luminaires shall be detachable with welded steel-plate pole and bracket adapter fittings. Adapter fittings shall be welded to the pole and bracket, and bolted together with hexagon-head corrosion-resistant steel bolts. Tenon end of the bracket shall accommodate the luminaire indicated.

Anchor base shall be cast steel, seam-welded to the pole at the upper outer edge of the flange and the lower edge of the pole. Anchor base shall have anchor-bolt holes for connection to the top of transformer base.

Welded transformer base shall have anchor-bolt holes in the base for connection to anchor bolts in the foundation, bolt holes in the top for connection to pole anchor base, and a removable cast-steel flanged access cover held in place with corrosion-resistant steel bolts or screws.

Standards without transformer bases shall be equipped with oval-shaped handhole with reinforced sheet-steel frame and cover with center of opening 18 inches 450 millimeter above the foundation.

Standards shall be furnished with a 1/2-inch square nut, 13 threads per inch, as specified in ISO 263, M18 x 2 as specified in ISO 261 and ISO 262, welded to the inside of the pole for ground connections.

Accessories shall be provided, including cast-steel ornamental pole-top cap, pole-top tenons, galvanized nuts, bolts, and washers, and galvanized sheet metal leveling shims.

Exposed metal surfaces of steel lighting standards, including anchor bases, transformer bases, brackets, and other uncoated steel component parts, shall be [cleaned and given a prime coat and two finish coats of paint as follows:

Cleaning treatment prior to the application of paint shall conform to SSPC SP 10.

Prime coat shall be zinc chromate in an alkyd vehicle conforming to FS TT-P-645.

Finish coats shall be ready-mixed aluminum paint conforming to FS TT-P-38.]

[hot-dipped-galvanized coated after fabrication in accordance with [ASTM A 123/A 123M] [ASTM A 153/A 153M].]

### 2.2.3 Concrete Lighting Standards

Concrete poles shall be preformed, prestressed, and centrifugally cast, with the base cast as an integral part of the standard. Poles shall have a smooth hollow core not less than 12 inches 300 millimeter in diameter, suitable as a raceway for electrical wiring.

[Standards shall be black and light gray in color and shall have a ground smooth, water-polished terrazzo finish.]

[Standards shall be light gray in color and have a natural smooth finish as obtained from the metal mold.]

Brackets for street-lighting luminaires shall be detachable, with fabricated steel clamps. Welded bracket and clamp assembly shall be galvanized in accordance with ASTM A 123/A 123M. Nuts and bolts shall be corrosion-resistant steel or silicon bronze. Tenon end of the bracket shall accommodate the luminaire indicated.

Accessories shall be provided, including cast-aluminum or hot-dip-galvanized ornamental pole-top cap, pole-top adapters and access covers, aluminum-alloy or corrosion-resistant steel nuts, bolts, and washers, and galvanized sheet metal leveling shims.

### 2.3 STREET-LIGHTING LUMINAIRES

Street-lighting luminaires shall be enclosed and gasketed vaportight fixtures in accordance with IESNA RP-8 for Types I, II, III, IV, and V lighting-distribution patterns.

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**NOTE: Select street-lighting luminaires, ballasts, and lamps from the following parts to suit project requirements.**

**Factors which will affect the selection of luminaire types include the following:**

**Fixture efficiency is the percent of available lumens from the light source that will be emitted from the fixture. The most efficient fixture should be selected commensurate with the other design requirements.**

**The spacing to mounting height ratio (S/MH) indicates how far apart the fixtures can be placed in relation to their mounting height. This ratio should be available in the fixture manufacturer's literature. A medium-to-wide distribution of light from the fixture should be selected. Fewer fixtures will be required using the larger, more efficient light sources, and overlapping light patterns will provide greater uniformity of illumination and increase light on vertical surfaces.**

**High power factor ballasts should be selected.**

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#### 2.3.1 End-Mounted High-Intensity-Discharge (HID) Luminaires

End-mounted HID luminaires with horizontal lamp-burning position shall include a hinged two- or three-piece housing, reflector, refractor, refractor holding ring, lampholder, fuses, fuseholders, terminal block, ballast, and lamp in a completely sealed optical system for end-mounting to street-lighting standards. Wiring shall be concealed in street-lighting standards and luminaires.

Upper housing shall be cast aluminum with fixture-leveling pad, integral



slip fitter, pipe stop, and clamps with provision for vertical adjustments of plus or minus 3 degrees for leveling purposes.

Porcelain lampholder shall be mounted on an adjustable supporting bracket that will permit vertical and horizontal positioning of the lamp. Reflector shall be formed from anodized sheet aluminum and shall have a specular finish. Refractor shall be molded prismatic heat-resistant borosilicate glass designed to provide the lighting-distribution pattern indicated. Refractor cover shall allow for expansion and contraction of the refractor with ambient temperature changes from 0 to 105 degrees F minus 18 to 41 degrees C.

Refractor holding ring and ballast cover shall be cast aluminum and shall form the lower housing. Lower housing shall be equipped with corrosion-resistant steel hinge and hinge pin, spring-loaded safety catch, and refractor latching mechanism. Upper housing shall overlap the lower housing with a heat-resistant gasket that will provide a seal against moisture, dirt, and insects.

### 2.3.2 Side-Mounted (HID) Luminaires

Side-mounted (HID) luminaires with base-up vertical lamp-burning position shall include a universal head with built-in ballast, lamp, porcelain lampholder, and reflector assembly in a completely sealed optical system for bracket mounting to street-lighting standards. Wiring shall be concealed in street-lighting standards and luminaires.

Universal head shall be cast aluminum with integral side-mounting slip fitter, pipe stop, and clamps with provisions for vertical adjustments of plus or minus 3 degrees for leveling purposes.

Reflector assembly shall include a reflector, refractor, and clamping band.

Reflector shall be formed from anodized sheet aluminum and shall have a specular finish. Refractor shall be molded prismatic heat-resistant borosilicate glass designed to provide the lighting-distribution pattern indicated. Clamping band shall be formed from sheet aluminum or corrosion-resistant steel and shall completely seal the joint between reflector and refractor against moisture, dirt, and insects.

Reflector assembly shall latch directly to the universal head with aluminum or corrosion-resistant steel latches. Latches and seating flange shall provide a seal against moisture, dirt, and insects.

### 2.3.3 Lamp Ballasts

#### 2.3.3.1 Multiple-Circuit Ballasts

Multiple-circuit ballasts shall include a two-winding core-and-coil assembly with a saturated-iron regulating element and capacitors impregnated with an insulating material in accordance with NEMA C82.4, ANSI C82.5, and NEMA C82.9.

Ballasts shall maintain correct lamp operation over a voltage-input range of plus or minus 13 percent of rated voltage. Capacitors shall provide a power factor lamp load of not less than 95 percent.

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

Ballasts shall be designed for a minimum lamp starting temperature of minus 20 degrees F 29 degrees C and a maximum ambient temperature of 105 degrees F 41 degrees C.

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**NOTE: Select solid-state ballasts, if available and most efficient.**  
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#### 2.3.3.2 Series Circuit Transformers

Series transformers shall include a two-winding core-and-coil assembly designed for connection to constant-current supply circuits in accordance with ANSI C82.5 and NEMA C82.9.

Primary winding of the transformer shall be designed for connection to 6.6-or 20-ampere constant-current street-lighting circuits. Transformer shall provide the proper starting voltage and operating current for the lamp indicated.

Transformers shall be designed for a maximum ambient temperature of 105 degrees F 41 degrees C.

#### 2.3.4 Lamps

Lamps, if used in a populated area, shall be certified to be automatically self-extinguishing and shall conform to 21 CFR 1040, Section 30.

\*\*\*\*\*  
**NOTE: Select one of the following two paragraphs. Add watt requirements on the drawings.**  
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##### 2.3.4.1 (HID) Lamps and Ballasts

(HID) lamps and ballasts shall be compatible and shall be furnished as specified on drawings. High pressure sodium lamps shall comply with the following industry standards:

1,000 watts	ANSI C78.1352
400 watts	ANSI C78.1350
150 watts	ANSI C78.1355
70 watts	ANSI C78.1353

##### 2.3.4.2 Low Pressure Sodium

Lamps shall be certified by manufacturer as meeting the requirements defined by the contract drawings.

##### 2.3.5 Side-Mounted Incandescent Luminaires

Side-mounted incandescent-lamp luminaires with base-up vertical lamp-burning position shall include a universal head with lamp and porcelain lampholders and reflector assembly in a completely sealed optical system suitable for bracket mounting to street-lighting standards. Wiring shall be concealed in street-lighting standards and luminaires.

Universal head shall be cast aluminum with integral side-mounting slip fitter, pipe stop, and clamps with provision for vertical adjustments of plus or minus 3 degrees for leveling purposes.

Reflector assembly shall include a reflector, refractor, and clamping band. Reflector shall be formed from anodized sheet aluminum and shall have a specular finish. Refractor shall be molded prismatic heat-resistant borosilicate glass designed to provide the type of lighting-distribution pattern indicated. Clamping band shall be formed from sheet aluminum or corrosion-resistant steel and shall completely seal the joint between reflector and refractor against moisture, dirt, and insects.

Reflector assembly shall latch directly to the universal bead with aluminum or corrosion-resistant steel latches. Latches and seating flange shall provide a seal against moisture, dirt, and insects.

#### 2.3.6 Incandescent Lamps

General-purpose incandescent lamps shall be clear or inside frosted. Lamps with wattage ratings up to and including 300 watts shall have medium brass screw bases. Lamps with wattage ratings in excess of 300 watts shall have mogul brass screw bases.

Special-purpose lamps include PAR and R lamps. PAR lamps shall have clear molded heat-resistant hard-glass bulbs with parabolic aluminized inner-bulb wall reflectors for spotlighting or floodlighting applications. R lamps shall have clear soft blown-glass bulbs with silver-deposited, inner-bulb wall reflector for spotlighting or floodlighting applications.

Lamps shall be designed for operation on 120-volt, 60-hertz circuits unless otherwise specified.

### PART 3 EXECUTION

#### 3.1 FOUNDATIONS FOR LIGHTING STANDARDS

Foundations for lighting standards shall be in accordance with manufacturer's recommendations.

Excavation shall be restricted in size to that which will provide sufficient working space for installation of concrete forms.

Should soil conditions at the bottom of the excavation be unsuitable as a foundation, as determined by the Contracting Officer, the excavation shall be taken down to firm soil and filled to required grade with concrete or satisfactory soil materials as directed.

Excavations shall be performed in a manner to prevent surface, subsurface, and ground water from flowing into the excavation. Excavation work below ground-water level shall require use of pumps or other dewatering methods necessary to convey the water away from the excavation.

Concrete forms shall be constructed of wood, plywood, steel, or other acceptable materials fabricated to conform to the configuration, line, and grade required. Form work shall be reinforced to prevent deformation while concrete is being placed and consolidated. Form work shall be wetted or coated with a parting agent before placing concrete.

Concrete materials shall be proportioned, mixed, and placed to provide a minimum 28-day compressive strength of 3,000 pounds per square inch 21,000 kilopascal.

Anchor bolts shall be galvanized high-strength steel rods with lower deformed 90-degree bend and threaded top conforming to ASTM A 36/A 36M. Anchor rods with exposed threaded ends shall be vertically positioned in the concrete in accordance with the lighting standard manufacturer's recommendations.

Concrete bearing surface shall be leveled and steel troweled to a smooth, hard, dense finish surface.

After form work is removed, the exposed concrete shall be protected with impervious paper or burlap material and kept wet for the full curing period.

Equipment Foundation Data shall be submitted in accordance with referenced standards in this section.

### 3.2 INSTALLATION

A street-lighting fixture shall be installed at each location indicated, and lamps of the proper type, voltage, and wattage shall be installed in each fixture.

Standards shall be installed on foundations, and their bases shall be leveled so that standards are plumb.

New lamps shall be installed immediately prior to completion of the project. Lamps shall be installed with the light center at the focal point of the reflector and in the proper burning position.

Installation Drawings shall be submitted for the highway and roadway lighting systems. Drawings shall indicate overall physical features, dimensions, ratings, service requirements, and weights of equipment.

Operational Tests shall be performed in accordance with referenced standards within this section.

#### 3.2.1 Field Testing

Street lighting shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer. Demonstration shall take place after sunset.

-- End of Section --