UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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SECTION 26 56 13.00 40

LIGHTING POLES AND STANDARDS

11/14

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-- End of Section Table of Contents --

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USACE / NAVFAC / AFCEC / NASA	**UFGS-26 56 13.00 40 (November 2014)**

Preparing Activity: NASA	**Superseding**
	UFGS-26 56 13.00 40 (November 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

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SECTION 26 56 13.00 40

LIGHTING POLES AND STANDARDS
11/14

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NOTE: This guide specification covers the requirements for lighting poles, standards, and related mounting accessories for exterior lighting, including, but not limited to, area lighting, flood lighting, roadway lighting, and security lighting systems.

Use UFGS Section 26 09 23.00 40 LIGHTING CONTROL DEVICES for control devices (includes tailoring for exterior lighting).

Use UFGS Section 26 55 53.00 40 SECURITY LIGHTING for security and closed circuit television {CCTV} special lighting.

Use UFGS Section 26 56 19.00 40 ROADWAY LIGHTING for roadway and street lighting.

Use UFGS Section 26 56 36.00 40 FLOOD LIGHTING for specific facility exterior illumination requirements.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

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

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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NOTE: TO DOWNLOAD UFGS GRAPHICS

Go to
http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/for

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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 U.S. Customary (IP) system dimensions.

Do not include list of sketches, or sketches themselves, in project specifications. Use luminaire sketches as details on drawings whenever possible. If special features are required, do not modify sketches, but indicate these changes as notes in fixture schedule. The "XL" style numbers and dates should remain on the drawing details.

Sketch No.	Title
XL-20	Round Fiberglass Pole, Direct Set Tenon Mount
XL-21	Round Fiberglass Pole, Direct Set Mast Arm Mount
XL-22	Round Concrete Pole, Direct Set Tenon Mount
XL-23	Round Concrete Pole, Direct Set Mast Arm Mount
XL-24	Round Steel Pole, Direct Set Tenon Mount
XL-25	Round Steel Pole, Direct Set Mast Arm Mount
XL-26	Round Steel Pole, Anchor Base, Tenon Mount
XL-27	Round Steel Pole, Anchor Base, Mast Arm Mount
XL-28	Luminaire Mounting Brackets
XL-29	Various Luminaire Mounting Arm Types
XL-30	Miscellaneous Luminaire Mounting Brackets
XL-31	Luminaire Mounting Arms
XL-32	Luminaire Mounting Arms
XL-33	Bolt-Down Pole Foundation
XL-34	Grounding Installation Details for Direct Set Poles

NOTE: Do not include this index in project specification.
****

****

NOTE: Show the following information on the drawings or specify in the project specifications:

a. Luminaire schedule and indicate pertinent information; i.e., mounting, lamps, ballasts, and voltage.

1. Type of luminaire;

2. Voltage, wattage, and frequency rating required;

3. Accessories required, such as photocell, time switches, and auxiliary lamps;

4. Location of poles or standards;

5. Referenced sketch; and

6. Extent and location of the work to be accomplished and wiring and equipment necessary for a complete installation.

****

****

NOTE: Demolition work that involves disposal of fluorescent and HID lamps and ballasts requires the use of Section 02 84 16 HANDLING OF LIGHTING BALLASTS AND LAMPS CONTAINING PCBs AND MERCURY.

****

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 Reference Identifier (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.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS ANSI O5.1	(2017) Wood Poles -- Specifications & Dimensions

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS	(2013; Errata 2013) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C1	(2003) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C4	(2003) Poles - Preservative Treatment by Pressure Processes
AWPA C25	(2003) Sawn Crossarms - Preservative Treatment by Pressure Processes
AWPA M6	(2013) Brands Used on Preservative Treated Materials
AWPA P1/P13	(2019) Standard for Creosote Preservative
AWPA P8	(2014) Standard for Oil-Borne Preservatives

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A575	(2020) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A576	(2017) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM B108/B108M	(2019) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM C1089	(2013) Standard Specification for Spun Cast Prestressed Concrete Poles
ASTM E2129	(2018) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM G154	(2016) Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

ILLUMINATING ENGINEERING SOCIETY (IES)

IES HB-10	(2011; Errata 2015) IES Lighting Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth

	Surface Potentials of a Ground System
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE C135.1	(1999) Standard for Zinc-Coated Steel Bolts and Nuts for Overhead Line Construction
IEEE C135.30	(1988) Standard for Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

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)

ANSI C136.3	(2020) Roadway and Area Lighting Equipment - Luminaire Attachments
ANSI C136.13	(2014) Roadway and Area Lighting Equipment - Metal Brackets for Wood Poles
ANSI C136.21	(2014) American National Standard for Roadway and Area Lighting Equipment - Vertical Tenons Used with Post-Top-Mounted Luminaires
NEMA C136.20	(2012) American National Standard for Roadway and Area Lighting Equipment - Fiber Reinforced Composite (FRC) Lighting Poles

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 345-67	(1998) REA Specification for Filled Telephone Cables, PE-39

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-P-38	(Rev E; Notice 1) Paint, Aluminum, Ready-Mixed
FS TT-P-645	(Rev C) Primer, Paint, Zinc-Molybdate, Alkyd Type

UNDERWRITERS LABORATORIES (UL)

UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment

1.2 DEFINITIONS

Groundline section is that portion between 305 mm one foot above and 610 mm 2 feet below the groundline. Refer to IEEE Stds Dictionary for additional related definitions and terminology.

1.3 ADMINISTRATIVE REQUIREMENTS

****
NOTE: Include the following paragraph and related information if required by applicable state or agency sustainable regulations.
****

[1.3.1 Sustainable Design Requirements

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.

[Submit 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.

a. Local/Regional Materials

b. Sustainable acquisition

c. Environmental Data

[Submit Table 1 of ASTM E2129 for the following products:

a. [_____]

b. [_____]

]

] 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.

a. Operational Service

Coordinate with manufacturer for [maintenance agreement] [take-back program]. Collect information from the manufacturer about [maintenance agreement] [green lease] options, and submit to the Contracting Officer. [Maintenance agreement] [Green lease] for services to reclaim materials for recycling and/or reuse may not be used for landfill or burned. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, seek local recyclers to reclaim the materials.

]1.3.2 Pre-Installation Meetings

Within [30] [_____] calendar days after [date of award] [date of receipt by him of notice of award], submit for the approval of the Contracting Officer [six (6)] [_____] copies of specified drawings of all equipment to be furnished under this contract, together with weights and overall dimensions. Submit the following data and drawings:

a. Poles

b. Installation details

[c. Concrete poles

][d. Aluminum poles

][e. Steel poles

][f. Fiberglass poles

][g. Pressure treated wood pole quality

] h. Brackets

i. Anchorage systems

After submittals are received and approved the Contracting Officer will hold a pre-work conference to review the following:

a. The drawings, including poles, showing complete Installation Details, and specifications. Include details for the following for review:

(1) Foundation requirements
(2) Anchorage systems
(3) Manufacturer's catalog data including mounting and bracket details
[(4) Factory color finish
]

b. Finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

c. Methods and procedures related to pole and luminaire installation, including manufacturer's written instructions and verification of pole system assembly wind load classification listings.

d. Governing regulations and requirements for insurance, certificates, tests and inspections if applicable. Include certification for

sustainable acquisition and pole system assembly wind load rating classification. Safety plan review includes applicable Safety Data Sheets.

e. Temporary protection requirements for pole assembly during and after installation.

f. Pole system observation and repair procedures after complete installation. Include review of sample [Galvanizing Repair Paint][Enamel Repair Paint][Aluminized Steel Repair Paint].

g. Sample [20 year "No-Dollar-Limit" warranty][Warranty].

1.4 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification 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

Poles[; G[, [____]]]

Installation Details[; G[, [____]]]

SD-03 Product Data

[Local/Regional Materials[; G[, [____]]]

][Environmental Data[; G[, [____]]]]

[Concrete Poles[; G[, [____]]]
]
[Aluminum Poles[; G[, [____]]]
]
[Steel Poles[; G[, [____]]]
]
[Fiberglass Poles[; G[, [____]]]
]
[Pressure Treated Wood Pole Quality[; G[, [____]]]
]

Brackets[; G[, [____]]]

Anchorage Systems[; G[, [____]]]

SD-05 Design Data[; G[, [____]]]

[Lighting Standards[; G[, [____]]]
]

Soil Tests[; G[, [____]]]

Seismic Design Data[; G[, [____]]]

[Tests for Fiberglass Poles[; G[, [____]]]
]

Manufacturer's Catalog Data[; G[, [____]]]

Manufacturer's Color Charts and Chips[; G[, [____]]]

[Factory Color Finish[; G[, [____]]]
]

Safety Data Sheets[; G[, [____]]]

SD-07 Certificates

Sustainable Acquisition[; G[, [____]]]

SD-08 Manufacturer's Instructions

[Fiberglass Poles[; G[, [____]]]
]

Foundation Requirements[; G[, [____]]]

Mounting Details[; G[, [____]]]

SD-10 Operation and Maintenance Data

Operational Service[; G[, [____]]]

SD-11 Closeout Submittals

[20 year "No-Dollar-Limit" Warranty[; G[, [____]]]
]
[Warranty[; G[, [____]]]
]
Record Drawings[; G[, [____]]]

1.5 QUALITY CONTROL

1.5.1 Drawing Requirements

1.5.1.1 Poles

Include dimensions, wind load determined in accordance with AASHTO LTS, pole deflection, pole class, and other applicable information conforming to IES HB-10.[For concrete poles, include: section and details to indicate quantities and position of prestressing steel, spiral steel, inserts, and through holes; initial prestressing steel tension; and concrete strengths at release and at 28 days.]

[Include seismic design data and calculations for earthquake zone [_____] projects.

] Submit soil tests to the Contracting Officer prior to the commencement of work

[1.5.2 Pressure Treated Wood Pole Quality

****
NOTE: Select the appropriate bracketed reference based on environmental requirements and the type of preservative treatment selected.
****

Ensure the quality of pressure treated wood poles. Furnish an inspection report (for wood poles) of an independent inspection agency, approved by the Contracting Officer, stating that offered products comply with AWPA M6,[AWPA P1/P13] [AWPA P8] and RUS Bull 345-67 standards. The RUS approved Quality Mark "WQC" on each pole will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.5.2.1 Wood Crossarms

Provide Douglas fir or dense southern pine of sizes specified or indicated, with pressure treatment conforming to AWPA C25.

][1.5.3 Tests for Fiberglass Poles

****
NOTE: Whenever fiberglass poles are required for a project, include the following test.
****

a. Ultraviolet resistance tests: Perform according to ASTM G154 using a UV-B lamp having a 313 nanometer wavelength, operated at 54 degrees C 130 degrees F, cycling the lamp on for 4 hours and off for 4 hours for

a total test period of 1500 hours minimum with the following results:

Fiber exposure:	None
Crazing:	None
Checking:	None
Chalking:	None
Color:	May dull slightly

b. Flexural strength and deflection test: Test load as a cantilever beam with pole butt as fixed end and a force simulating wind load at the free end.

]1.5.4 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.

1.5.5 Alternative Qualifications

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

1.5.5.1 Material and Equipment Manufacturing Date

Products manufactured more than [3] [_____] years prior to date of delivery to site are not allowed, unless specified otherwise.

1.5.6 Manufacturer's Color Charts and Chips

Submit manufacturer's color charts and chips, approximately 10 by 10 cm 4 by 4 inches, showing full range of colors, textures and patterns available for [aluminum] [fiberglass] poles with factory applied finishes.

[1.6 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle poles[and] [standards], and all related accessories and other manufactured items in a manner to prevent damage or deformation.

****
NOTE: Select the applicable paragraph(s) from the following.
****

[1.6.1 Wood Poles

Stack poles stored for more than [2 weeks][_ -days] on decay-resisting skids arranged to support the poles without producing noticeable distortion. Store poles to permit free circulation of air, such that the bottom poles in the stack are at least 305 mm one foot above ground level and growing vegetation. Do not permit decayed or decaying wood to remain underneath stored poles. Do not drag treated poles along the ground. Do

not use pole tongs, cant hooks, and other pointed tools capable of producing indentation more than 25 mm one inch in depth in handling the poles. Do not apply tools to the groundline section of any pole.

][1.6.2 Concrete Poles

Do not store poles on ground. Support poles so they are at least 305 mm one foot above ground level and growing vegetation.

][1.6.3 Fiberglass Poles

Do not store poles on ground. Support poles so they are at least 305 mm one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

][1.6.4 [Aluminum][Steel]Poles

Do not store poles on ground. Support poles so they are at least 305 mm one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

]][1.7 WARRANTY

Provide support for the equipment items by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

]PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

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 under similar circumstances and of similar size, and have been 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. Submit [_____] copies of all mounting details.

Products and materials not considered to be lighting equipment or lighting fixture accessories are specified in[Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION,] Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION,[and] Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.[Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in Section 26 51 00 INTERIOR LIGHTING.]

2.2 COMPONENTS

2.2.1 Lighting Standards

Lighting standard, includes pole, anchor base, transformer base, brackets, and accessories, 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.

[2.2.2 Poles

****
NOTE: This guide specification does not cover decorative poles or high-mast lighting systems. Poles, luminaire mounting assemblies, and lowering mechanisms for high-mast lighting are specially fabricated and should be individually designed to suit a specific project. Pole specifications for high-mast system should, as a minimum, include wind loading and ultimate strength meeting the loading requirements of AASHTO LTS-5. Do not specify embedded type metal poles for Army facilities.
****

Provide poles designed for wind loading of [161][_____] km/hr [100][_____] miles per hour determined in accordance with AASHTO LTS while supporting luminaires and all other appurtenances indicated. Provide effective projected areas of luminaires and appurtenances used in calculations specific to the actual products provided on each pole. Provide[embedded][anchor] type bases designed for use with[underground][overhead] supply conductors.[Provide[, in other than wood poles,] an oval-shaped handhole having a minimum clear opening of 65 by 130 mm (2.5 by 5 inches) 2.5 by 5-inches. Secure handhole cover with stainless steel captive screws.][Provide metal poles with an internal grounding connection accessible from the handhole near the bottom of each pole.] Do not install scratched, stained, chipped, or dented poles.

[2.2.2.1 Concrete Poles

****
NOTE: If other than round pole is chosen, revise Sketch XL-22 and XL-23 to suit the cross-sectional shape selected.
****

Provide concrete poles conforming to ASTM C1089, with[round][or][multi-sided] cross-sectional shape, preformed, prestressed, and centrifugally cast, with the base cast as an integral part of the standard. Provide poles with a smooth hollow core not less than 300 millimeter 12-inches in diameter, suitable as a raceway for electrical wiring.

[Provide black and light gray color standards with a ground smooth, water-polished terrazzo finish.

][Provide light gray color standards with a natural smooth finish as obtained from the metal mold.

] a. Steel Reinforcing

Reinforce prestressed concrete pole shafts with steel prestressing members, designed to provide internal longitudinal loading by either pretensioning or post tensioning of longitudinal reinforcing members.

b. Tensioned Reinforcing

Tension primary reinforcement steel used for a prestressed concrete pole

shaft between 60 to 70 percent of its ultimate strength, with the amount of reinforcement being such that when reinforcement is tensioned to 70 percent of its ultimate strength, the total resultant tensile force does not exceed the minimum section compressive strength of the concrete.

c. Coating and Sleeves for Reinforcing Members

Where minimum internal coverage cannot be maintained next to required core openings, such as handhole and wiring inlet, protect reinforcing with a vapor proof non-corrosive sleeve over the length without the 13 mm 1/2-inch concrete coverage. Provide each steel reinforcing member which is to be post-tensioned with a non-migrating slipper coating applied prior to the addition of concrete to ensure uniformity of stress throughout the length of such member.

d. Strength Requirement

As an exception to the requirements of ASTM C1089, allow poles to cure naturally to achieve a 28-day compressive strength of 48.23 MPa 7000 psi. Do not allow poles to be subjected to severe temperature changes during the curing period.

e. Shaft Preparation

Provide completed prestressed concrete pole shafts with a hard, smooth, nonporous surface that is resistant to soil acids, road salts, and attacks of water and frost, clean, smooth, and free of surface voids and internal honeycombing. Do not install poles for at least 15 days after manufacture.

][2.2.2.2 Aluminum Poles

a. Finish

Provide aluminum poles with a [brushed satin] [uniform satin] [dark anodic bronze] [_____] finish, manufactured of corrosion resistant aluminum alloys conforming to AASHTO LTS for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys and Alloy 356-T4 (3,5) for cast alloys. Do not paint.

Provide aluminum castings conforming to ASTM B108/B108M. Provide seamless extruded or spun seamless type poles with minimum 4.8 mm 0.188-inch wall thickness, with tenon end to support luminaire indicated.

b. Grounding Connection Provisions

Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Provide aluminum standard with a M18 x 2 as specified in ISO 261 and ISO 262 1/2-inch square nut, 13 threads per inch, as specified in ISO 263, welded to the inside of the pole for ground connections.

c. Ground Rods

****

NOTE: Determine the size, type, and number of ground rods to be used, based on local conditions, earth resistively data, and on the size and type of the electrical installation. Specify copper clad steel rods for normal conditions. Use zinc coated steel or stainless steel rods where low soil

resistivities are encountered and galvanic corrosion may occur between adjacent underground metallic masses and the copper clad rods. Stainless steel rods have a longer life than zinc coated steel, but use of stainless steel should be justified based on the higher cost. Rods 15.9 mm 5/8 inch in diameter and2.4 m 8 feet in length are generally acceptable; however in rocky soils specify 19.1 mm 3/4 inch rods. In high Resistivity soils, 3.1 m 10 feet or sectional rods may be used to obtain the required resistance to ground; however, where rock is encountered, additional rods, a counterpoise, or ground grid may be necessary.

Coordinate and standardize rod selection for individual facilities with other specification sections.

****

Provide ground rods made of[copper clad steel conforming to UL 467] [zinc coated steel conforming to IEEE C135.30] [solid stainless steel] not less than [15.9] [19.1] mm [5/8] [3/4]-inch in diameter by [2.4] [3.1] m [8] [10]-feet in length of the sectional type driven full length into earth.

d. Top Cover and Bases

Fit tops of shafts with a round or tapered cover. Mount bases with anchor bolts, made of cast 356-T6 aluminum alloy in accordance with ASTM B 108, machined to receive the lower end of shaft. Weld the joint between shaft and base. Provide cast 356-T6 aluminum alloy base cover in accordance with ASTM B 108. Provide hardware, except anchor bolts, made with either 2024-T4 anodized aluminum alloy or stainless steel.

e. Transformer Base

Include one-piece cast-aluminum alloy transformer base, with a removable cast-aluminum flanged access cover secured with bolts or screws. Predrill anchor bolt holes in base for connection to anchor bolts in the foundation.

Equip standards without transformer bases with an oval-shaped handhole, covered with a removable reinforced sheet aluminum frame and sheet centered 450 millimeter 18-inches above the foundation.

f. Transport and Handling Protection

Ensure manufacturer's standard provision is made for protecting the finish during shipment and installation. Minimum protection consists of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

][2.2.2.3 Steel Poles

Provide continuously tapered and seam welded steel lighting standards, conforming to AASHTO LTS. Provide steel poles having minimum 11-gage steel with minimum yield/strength of 331 MPa (48,000 psi) 48,000 psi and[hot-dipped galvanized in accordance with ASTM A123/A123M][iron-oxide primed] factory finish.

a. Pole Mounting

Provide[direct set][anchor bolt mounted] type pole, with tapered tubular members, either round in cross section or polygonal.[Provide one piece pole shafts, of welded construction with no bolts, rivets, or other means of fastening except as specifically approved.]

[Provide structural quality hot-rolled carbon steel plate base covers having a minimum yield of 248 MPa (36,000 psi) 36,000 psi.

] b. Accessories

Provide accessories, including cast-steel ornamental pole-top cap, pole-top tenons, galvanized nuts, bolts, and washers, and galvanized sheet metal leveling shims.

c. Pole Markings

Provide pole markings approximately 900 to 1270 mm 3 to 4-feet above grade, to include manufacturer, year of manufacture, top and bottom diameters, and length.

d. Steel Standard Finish

Clean all exposed metal surfaces of steel lighting standards, including anchor bases, transformer bases, brackets, and other uncoated steel component parts, and apply [a prime coat and two finish coats of paint as follows:

(1) Clean prior to the application of paint in conformance with SSPC SP 10/NACE No. 2.

(2) Apply prime coat of zinc chromate in an alkyd vehicle conforming to FS TT-P-645.

(3) Apply ready-mix aluminum paint finish coats in conformance with FS TT-P-38.]

[(4) Hot-dipped-galvanized coat after fabrication in accordance with [ASTM A123/A123M] [ASTM A153/A153M].

]][2.2.2.4 Wood Poles

****

NOTE: Other wood species which are covered by ANSI 05.1, REA, and AWPA may be specified, provided they are available at the project location. Indicate pole class and height on the drawings.

****

Provide wood poles conforming to ATIS ANSI O5.1 and RUS Bull 345-67 of[Southern Yellow Pine][Douglas Fir][_____]. Gain, bore, and roof poles before treatment, and treat full length with chromated copper arsenate (CCA) or ammoniacal copper arsenate (ACA) according to AWPA C1 and AWPA C4 as referenced in RUS Bull 345-67. Provide poles branded by manufacturer with manufacturer's mark and date of treatment, height and class of pole, wood species, preservation code, and retention. Place the brand so that the bottom of the brand or disc is 3050 mm 10-feet from the pole butt for poles up to 15250 mm 50-feet long[and 4270 mm 14-feet from the butt for poles over 15250 mm 50-feet long].

]2.2.2.5 Fiberglass Poles

Provide fiberglass poles conforming to NEMA C136.20, designed specifically for supporting luminaires and having factory-formed cable entrance and handhole, with [dark bronze][as indicated] [_____] resin color, uniformly pigmented for coloration throughout entire wall thickness. Provide pigmented polyurethane finish surface having a minimum dry film thickness of 0.038 mm 1.5 mils. Polyurethane may be omitted if the surface layer of the pole is inherently ultraviolet inhibited. Provide minimum fiberglass content of 65 percent with resin and pigment comprising the other 35 percent material content.

]2.2.3 Brackets And Supports

****
NOTE: Include bracketed reference for wood poles only.
****

Provide brackets and supports conforming to ANSI C136.3,[ANSI C136.13,] and ANSI C136.21, as applicable, with pole brackets not less than 31.75 mm 1 1/4-inch[galvanized steel pipe][aluminum] secured to pole. Slip-fitter or pipe-threaded brackets may be used, if brackets are coordinated to luminaires provided. Provide identical brackets for use with one type of luminaire. Provide brackets for pole-mounted street lights which correctly position luminaire no lower than mounting height indicated. Mount brackets not less than 7320 mm 24-feet above street. Provide special mountings or brackets as indicated of metal which do not promote galvanic reaction with luminaire head.

[2.2.3.1 Concrete Standard Detachable Brackets

Provide detachable brackets, with fabricated steel clamps, including galvanized welded bracket and clamp assembly in accordance with ASTM A123/A123M. Provide with all necessary corrosion-resistant steel or silicon bronze nuts and bolts. Accommodate luminaire indicated at tenon end of the bracket.

Provide accessories 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.

]2.2.4 Pole Line Hardware

Provide zinc coated hardware conforming to IEEE C135.1, and steel hardware material conforming to ASTM A575 and ASTM A576. Provide hot-dip galvanize hardware in accordance with ASTM A153/A153M.

[2.2.4.1 Series Roadway Lighting Insulators

****
NOTE: Delete this paragraph when series roadway lighting is not required.
****

Provide Class 55-5 pin insulators. Provide Class 57-1 or 57-11 line-post insulators.

]2.2.5 Foundations for Lighting Standards

Provide foundations for lighting standards in accordance with manufacturer's recommendations. Submit Equipment Foundation Data in accordance with referenced standards in this section.

2.2.5.1 Concrete Foundations

****
NOTE: Select one of the following bracketed statements and delete the other.
****

[Proportion, mix, and place concrete materials to provide a minimum 28-day compressive strength of 21,000 kilopascal 3,000 pounds per square inch.

][Provide concrete as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

] a. Anchor Bolts

Provide galvanized high strength steel rod anchor bolts, with a lower deformed 90 degree bend and threaded top conforming to ASTM A36/A36M, having a minimum yield strength of 344.5 MPa (50,000 psi) 50,000 psi; with the top 305 mm 12-inches of the rod galvanized in accordance with ASTM A153/A153M.

PART 3 EXECUTION

3.1 INSTALLATION

Provide electrical installations conforming to IEEE C2, NFPA 70, and to the requirements specified herein.

[3.1.1 Wood Poles

****
NOTE: Poles set in swampy or rocky soil will require different settings or foundations than those set in average bearing soils. Consult pole manufacturer and structural engineer for proper setting or foundation requirements for these and other unusual soil conditions.
****

Make pole holes at least as large at the top as at the bottom and large enough to provide 100 mm 4-inches of clearance between the pole and the side of the hole.

****
NOTE: At the text below, delete setting information for pole lengths not required.
****

a. Setting depth: Pole setting depths are as follows:

Length of Pole (feet)	Setting in Soil (feet)
6100	1575
7625	1575
9150	1575
10675	1830
12200	1830
13725	6.5
14250	7.0
16775	7.5
18300	8.0

Length of Pole (feet)	Setting in Soil (feet)
20	5.0
25	5.5
30	5.5
35	6.0
40	6.0
45	6.5
50	7.0
55	7.5
60	8.0

b. Soil setting: "Setting in Soil" depths applies where pole holes are in soil, sand, or gravel or any combination of these.[At corners, dead ends and other points of extra strain, set poles 12,200 mm 40-feet long or more, 150 mm 6-inches deeper.]

c. Setting on sloping ground: On sloping ground, measure the depth of the hole from the low side of the hole.

d. Backfill: Tamp pole backfill for the full depth of the hole and mound the excess fill around the pole.

][3.1.2 Concrete Poles

****

NOTE: Poles set in swampy or rocky soil will require different settings or foundations than those set in average bearing soils. Consult pole manufacturer and structural engineer for proper setting or foundation requirements for these and other unusual soil conditions.
****

Install according to pole manufacturer's instructions.

][3.1.3 Fiberglass Poles

****
NOTE: Poles set in swampy or rocky soil will require different settings or foundations than those set in average bearing soils. Consult pole manufacturer and structural engineer for proper setting or foundation requirements for these and other unusual soil conditions.
****

Install according to pole manufacturer's instructions.

][3.1.4 [Aluminum][Steel] Poles

****
NOTE: Poles set in swampy or rocky soil will require different settings or foundations than those set in average bearing soils. Consult pole manufacturer and structural engineer for proper setting or foundation requirements for these and other unusual soil conditions.
****

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 1.57 rad 90 degrees at the bottom end. Provide ornamental covers to match pole and galvanized nuts and washers for anchor bolts. Concrete for anchor bases, polyvinyl chloride (PVC) conduit ells, and ground rods are as specified in Section[33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION][_____]. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.[After installation, paint exposed surfaces of steel poles with two finish coats of[exterior oil paint of a color as indicated][aluminum paint].]

][3.1.5 Standard Foundations

3.1.5.1 Excavation

Restrict excavation in size to that which provides 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, take the excavation down to firm soil and fill to required grade with concrete or satisfactory soil materials as directed.

Perform excavations in a manner to prevent surface, subsurface, and ground water from flowing into the excavation. Use pumps or other dewatering

methods necessary to convey the water away from the excavation work below ground-water level.

[Depth is as indicated [on the drawings] [in the table above]. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 150 mm 6-inch maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.

]3.1.5.2 Formwork

Construct forms of wood, plywood, steel, or other acceptable materials fabricated to conform to the configuration, line, and grade required. Reinforce formwork to prevent deformation while concrete is being placed and consolidated. Wet or coat formwork with a parting agent before placing concrete.

3.1.5.3 Setting of Anchor Bolts

Set anchor bolts or rods with exposed threaded ends vertically positioned in the concrete [using a template supplied by the pole manufacturer] [in accordance with the lighting standard manufacturer's recommendations.]

3.1.5.4 Concrete Placement

Level and steel trowel concrete bearing surface to a smooth, hard, dense finish surface. After form work is removed, protect the exposed concrete with impervious paper or burlap material and keep wet for the full curing period.

][3.1.6 Special Foundations

3.1.6.1 Power-Installed Screw Foundations

Power-installed screw foundations having the required strength mounting bolt and top plate dimensions may be utilized. Provide screw foundations of at least 6.4 mm 1/4-inch thick structural steel conforming to ASTM A36/A36M, hot-dip galvanized in accordance with ASTM A123/A123M. Clearly mark conduit slots in screw foundation shafts and top plates to indicate orientation. Secure approval of design calculations indicating adequate strength before installation of any screw foundation

]3.1.7 Standard Setting

Install standards, with their bases level so that standards are plumb. Once the concrete has cured, set the pole on the foundation, level on the foundation bolts, and secure with the holding nuts. Grout the space between the foundation and the pole base. Conform concrete and grout work to Section03 30 00 CAST-IN-PLACE CONCRETE. Provide concrete strength of 21 MPa 3000 psi at 28 days.

3.1.8 Grounding

****
NOTE: Butt grounds are not be permitted as an option in dry desert areas. See HREF=http://www.wbdg.org/ccb/DOD/UFC/ufc_3_550_01.pdf>UFC 3-550-01, "Exterior Electrical Power Distribution"**.**
****

Provide grounding conforming to NFPA 70, the contract drawings, and the following:

a. Provide soft-drawn, stranded copper grounding conductors.

b. Drive ground rods into the earth so that after the installation is complete, the top of the ground rod is approximately 300 mm 1-foot below finished grade, except in handholes.

[c. Use butt grounds made of at least 4 m 13-feet of No. 6 bare copper wire stapled to the butts of wood poles in spirals where a ground resistance of 25 ohms or less can be obtained by this method.

][d. Butt grounds are not allowed.

]3.1.8.1 Ground Rods and Pole Butt Electrodes

****

NOTE: Designer is to determine the size, type, and number of ground rods to be used, based on local conditions, earth resistively data, and on the size and type of the electrical installation. Specify copper clad steel rods for normal conditions. Use zinc coated steel or stainless steel rods where low soil resistivities are encountered and galvanic corrosion may occur between adjacent underground metallic masses and the copper clad rods. Stainless steel rods have a longer life than the zinc coated steel; use only if the use of stainless steel is justified based on the higher cost. Rods 15.9 mm 5/8 inch in diameter and 2.4 m 8 feet in length are generally acceptable; however in rocky soils specify 19.1 mm 3/4 inch rods. In high resistively soils, use 3.1 m 10 feet or sectional rods to obtain the required resistance to ground; however where rock is encountered, additional rods, a counterpoise, or ground grid may be necessary.

****

Measure the resistance to ground using the fall-of-potential method described in IEEE 81. The maximum resistance of a [driven ground rod] [pole butt electrode] is not to exceed 25 ohms under normally dry conditions. Whenever the required ground resistance is not met, provide additional electrodes [interconnected with grounding conductors] [as indicated], to achieve the specified ground resistance. Provide additional electrodes [up to three, [2.4] [3] m [8] [10]-feet long rods spaced a minimum of 3 m 10-feet apart] [a single extension-type rod, [15.9] [19.1] mm[5/8] [3/4]-inch] in diameter, up to 9.1 m 30-feet long, [driven perpendicular to grade] [coupled and driven with the first rod]. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer immediately. Fusion weld connections below grade. Fusion weld or use UL 467 approved connectors for above grade connections.

3.1.8.2 Items to be Grounded

Ground all ground conductors, metallic conduits, junction boxes, and

noncurrent-carrying metallic parts of equipment. Make connections above grade with solderless connectors, and fusion weld those below grade.

3.1.8.3 Lighting Pole

Provide one ground rod at each pole. Connect bases of metal or concrete lighting poles to ground rods by means of No. 8 AWG bare copper wire. Ground the lighting fixture brackets on wood and concrete poles to a No. 6 AWG bare copper grounding conductor connected to the ground rod.

3.1.8.4 Handhole

In each handhole, at a convenient point close to the wall, drive a ground rod into the earth before the floor is poured. Make provision for approximately 100 mm 4 inches of the ground rod to extend above the floor after pouring. When precast concrete units are used, the top of the ground rod may be below the floor, and bring a No. 1/0 AWG copper ground conductor inside through a watertight sleeve in the wall. Make connection to ground rods by means of bolted-clamp terminals or by an approved fusion-welding process. Neatly and firmly attach ground wires to handhole walls, holding the amount of exposed bare wire to a minimum.

3.1.8.5 Metal Cable Boxes

Connect metal cable boxes for direct-burial cable to adjacent ground rods by wires with current-carrying capacities of at least 20 percent of the spliced phase conductors, but not less than No. 6 AWG.

3.2 FIELD QUALITY CONTROL

3.2.1 Ground Resistance Measurements

Measure the resistance to ground by the fall-of-potential method described in IEEE 81.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Record Drawings

Maintain and keep up to date, a separate set of drawings, elementary diagrams and wiring diagrams of the lighting to be used for "record" drawings, showing all changes and additions to the lighting system. In addition to being complete and accurate, keep this set of drawings separate and do not use for installation purposes. Upon completion of the record drawings, a representative of the Government will review the as-built work with the Contractor. If the as-built work is not complete, the Contractor will be so advised and complete the work as required.

-- End of Section --