****
USACE / NAVFAC / AFCESA / NASA | **UFGS-26 55 53.00 10 (October 2007)**

Preparing Activity: USACE | **Superseding UFGS-26 55 53.00 10 (April 2006)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2012
****

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 55 53.00 10

EXTERIOR LIGHTING INCLUDING SECURITY AND CCTV APPLICATIONS

10/07

2.7 CABLE BOXES
2.8 MANHOLES, HANDHOLES, AND PULLBOXES
2.9 CONDUIT, DUCTS AND FITTINGS
2.9.1 Conduit, Rigid Steel
2.9.2 Conduit Coatings
2.9.3 Conduit Fittings and Outlets
2.9.3.1 Boxes, Metallic Outlets
2.9.3.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers
2.9.3.3 Boxes, Outlet for Use in Hazardous (Classified) Locations
2.9.3.4 Boxes, Switch (Enclosed), Surface Mounted
2.9.3.5 Fittings for Conduit and Outlet Boxes
2.9.3.6 Fittings for Use in Hazardous (Classified) Locations
2.9.3.7 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing
2.9.4 Non-Metallic Duct
2.10 WOOD CROSSARMS
2.11 GROUND RODS
2.12 POLES
2.12.1 Aluminum Poles
2.12.2 Steel Poles
2.12.3 Concrete Poles
2.12.4 Wood Poles
2.12.5 Fiberglass Poles
2.12.6 Anchor Bolts
2.13 POLE LINE HARDWARE
2.14 SERIES ROADWAY LIGHTING INSULATORS
2.15 ELECTRICAL ENCLOSURES
2.15.1 Interior Enclosures
2.15.2 Exposed-to-Weather Enclosures
2.15.3 Corrosion Resistant Enclosures
2.15.4 Hazardous Environment Enclosures
2.16 ILLUMINATION
2.16.1 General Lighting
2.16.2 Roadway Lighting
2.17 LAMPS AND BALLASTS, HIGH INTENSITY DISCHARGE (HID) SOURCES
2.17.1 High-Pressure Sodium
2.17.2 Mercury Vapor
2.17.3 Metal-Halide
2.18 LAMPS, INCANDESCENT
2.19 LAMPS, FLUORESCENT
2.20 LUMINAIRE COMPONENTS
2.21 LIGHTING CONTROL EQUIPMENT
2.21.1 Photo-Control Devices
2.21.2 Timer Control Switches
2.21.3 Manual Control Switches
2.21.4 Safety Switches
2.21.5 Magnetic Contactor
2.22 PHOTOMETRIC DISTRIBUTION CLASSIFICATION
2.23 LUMINAIRES, FLOODLIGHTING
2.23.1 HID and Incandescent
2.23.2 Fluorescent
2.24 FIXTURES
2.24.1 Accessories
2.24.2 Special Fixtures
2.24.3 In-Line Fuse
2.25 SEARCHLIGHTS
2.26 FRESNEL-LENS LUMINAIRES
2.27 FLUORESCENT FLOODLIGHTS, EXTERIOR
2.28 TRANSFORMERS
2.28.1 Outdoor Dry-Type Lighting Transformers

ATTACHMENTS:

Standard Detail No. 40-06-04

Standard Detail No. 40-06-04

-- End of Section Table of Contents --

****
USACE / NAVFAC / AFCESA / NASA	UFGS-26 55 53.00 10 (October 2007)
Preparing Activity: USACE	Superseding
UFGS-26 55 53.00 10 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2012
****

SECTION 26 55 53.00 10

EXTERIOR LIGHTING INCLUDING SECURITY AND CCTV APPLICATIONS
10/07

****
NOTE: This guide specification covers the requirements for lighting for roads, walks, security, and closed circuit television (CCTV) assessment.

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 items(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).
****

PART 1 GENERAL

****
NOTE: This specification does not include provision for high-mast roadway and parking lot lighting (poles over 18.3 meters (60 feet)). Requirements for materials and procedures for special or unusual design will be added as necessary for specific projects. Quantity and quality of illumination will conform to UFC 3-550-03FA. Standard details will conform to the general requirements of UFC 3-550-03FA, and may be modified to suit project conditions.

Incandescent lamps, Fluorescent lamps, and Mercury Vapor Lamps shall not be used for CCTV. In addition, tungsten lamps other than infrared lamps

shall not be used for CCTV.

Two types of infrared luminaires are currently available. Fixtures with special lamps utilizing optical dichroic mirror coatings that produce only infrared light and fixtures that use conventional lamps that pass the light output through infrared filters. Special lamps have the advantage of operating cooler and not requiring a cooling fan, thus operating quieter and requiring less maintenance.

The major disadvantages are high lamp replacement cost due to short bulb life (2000 to 4000 hours) and special lamp design. The 2000 hour lamps produce more infrared light energy and are preferred over the 4000 hour lamps. Another disadvantage is the limited variety of wattages available, but this is normally resolved by fixture placement during site lighting system design. Conventional lamps utilizing special power supplies and infrared filters have the advantages of low bulb replacement cost and bulb life ranging from 1700 to 18000 hours. (Note: Special power supplies reduce current flow to the bulb and allow it to operate at a lower filament temperature to shift light output more into the near infrared (NIR) light spectrum and requires less filtering. This has the additional advantage of extending bulb life.) A variety of bulb sizes are available and no special bulbs are required. The main disadvantage of using a conventional bulb is the heat generated utilizing an infrared filter which must be cooled by a cooling fan. Fans require maintenance and the loss of the fan will destroy the filter. Filters are expensive.

****

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.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS ANSI O5.1	(2008) Wood Poles -- Specifications & Dimensions

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS-5	(2009; Errata 2009; Amendment 1 2010; Amendment 2 2011) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C25	(2003) Sawn Crossarms - Preservative Treatment by Pressure Processes
AWPA C4	(2003) Poles - Preservative Treatment by Pressure Processes
AWPA P1/P13	(2001) Standard for Creosote Preservative
AWPA P8	(2005) Standard for Oil-Borne Preservatives
AWPA P9	(2003) Standards for Solvents and Formulations for Organic Preservative Systems

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A48/A48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A575	(1996; R 2007) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A576	(1990b; R 2006) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM B117	(2011) Standard Practice for Operating

	Salt Spray (Fog) Apparatus
ASTM B2	(2008) Standard Specification for Medium-Hard-Drawn Copper Wire
ASTM B8	(2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C478	(2009) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM D1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA RP-8	(2000; Errata 2004; R 2005; Errata 2007) Roadway Lighting

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
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 C2	(2012) National Electrical Safety Code
IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI ANSLG C78.42	(2009) For Electric Lamps: High-Pressure Sodium Lamps
ANSI C119.1	(2011) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C136.11	(2006) American Standard for Roadway Lighting Equipment Series Sockets and Series Sockets Receptacles
ANSI C136.13	(2004; R 2009) American National Standard

	for Roadway Lighting Equipment, Metal Brackets for Wood Poles
ANSI C136.15	(2011) American National Standard for Roadway Lighting Equipment - High-Intensity-Discharge and Low-Pressure Sodium Lamps in Luminaires - Field Identification
ANSI C136.2	(2004; R 2009) American National Standard for Roadway and Area Lighting Equipment: Luminaires Voltage Classification
ANSI C136.3	(2005; R 2009) American National Standard for Roadway and Area Lighting Equipment Luminaire Attachments
ANSI C136.6	(2004) American National Standard for Roadway Lighting Equipment - Metal Heads and Reflector Assemblies - Mechanical and Optical Interchangeability
ANSI C136.9	(2003) American National Standard for Roadway and Area Lighting Equipment - Socket Support Assemblies for Metal Heads - Mechanical Interchangeability
ANSI C80.1	(2005) American National Standard for Electrical Rigid Steel Conduit (ERSC)
ANSI C82.4	(2002) American National Standard for Ballasts for High-Intensity-Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)
ANSI/ANSLG C78.43	(2007) American National Standard for Electric Lamps - Single-Ended Metal-Halide Lamps
ANSI/NEMA OS 1	(2008; Amd 2010) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
ANSI/NEMA OS 2	(2008; AMD 2010) Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ANSLG C78.40	(2011) Specification for Mercury Lamps
NEMA C136.10	(2010) American National Standard for Roadway and Area Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles--Physical and Electrical Interchangeability and Testing
NEMA ICS 1	(2000; R 2005; R 2008) Standard for Industrial Control and Systems: General

	Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA RN 1	(2005) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 6 & 8	(2003) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
NEMA TC 9	(2004) Standard for Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-232	(1997f; R 2002) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

UNDERWRITERS LABORATORIES (UL)

UL 1029	(1994; Reprint May 2011) High-Intensity-Discharge Lamp Ballasts
UL 1203	(2006) UL Standard for Safety Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations
UL 1449	(2006; Reprint Feb 2011) Surge Protective Devices
UL 1598	(2008; Reprint Jan 2010) Luminaires
UL 44	(2010) Thermoset-Insulated Wires and Cables
UL 467	(2007) Grounding and Bonding Equipment
UL 486A-486B	(2003; Reprint Feb 2010) Wire Connectors
UL 506	(2008; Reprint Mar 2010) Specialty Transformers
UL 514A	(2004; Reprint Apr 2010) Metallic Outlet Boxes

UL 514B	(2004; Reprint Nov 2009) Conduit, Tubing and Cable Fittings
UL 514C	(1996; Reprint Novy 2011) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 651	(2011) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 651A	(2011) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 854	(2004; Reprint Sep 2011) Standard for Service-Entrance Cables
UL 870	(2008) Standard for Wireways, Auxiliary Gutters, and Associated Fittings
UL 98	(2004; Reprint Jan 2011) Enclosed and Dead-Front Switches

1.2 SYSTEM DESCRIPTION

Submit a draft copy of the operation and maintenance manuals, prior to beginning the tests for use during site testing. Final copies of the manuals as specified bound in hardback, loose-leaf binders, within 30 days after completing the field test. The draft copy used during site testing shall be updated with any changes required, prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the field test shall include modifications made during installation checkout and acceptance.

1.2.1 Lighting System

The lighting system shall be configured as specified and shown. The system shall include all fixtures, hardware, poles, cables, connectors, adapters and appurtenances needed to provide a fully functional lighting system.

1.2.2 CCTV Assessment Lighting

****

NOTE: Coordinate the type of CCTV light fixture used with the spectral sensitivity of the CCTV camera installed at each assessment zone. Provide a sufficient lighting level to meet the minimum faceplate illumination requirements of each camera. Provide a light ratio of not greater than 6 to 1 (highlight to shadow) between the perimeter fences or in the CCTV assessment zone. In addition, the

security at some sites may require lighting in areas not normally viewed by the CCTV cameras.

Omit this paragraph if the lighting system is not used for CCTV assessment.

****

Submit test procedures and reports for CCTV assessment lighting. Schedule the tests after receipt of written approval of the test procedures. The final test procedures report shall be delivered after completion of the tests. The CCTV Assessment Lighting system shall be configured as specified and shown. Equipment shall conform to NFPA 70 and IEEE C2. The lighting configuration shall provide sufficient light for optimum CCTV assessment of each zone. The system shall include all fixtures, hardware, poles, cables, connectors, adapters, and appurtenances needed to provide a fully functional lighting system. [For CCTV lighting, data shall include:

a. Infrared light call-up response time.

b. Lamp strike and restrike times.

c. System startup and shutdown operations.

d. Manuals for CCTV Assessment Lighting equipment.

e. A typical zone layout showing light locations, isolux patterns, and lighting ratios.]

1.2.3 Electrical Requirements

The equipment shall operate from a voltage source as shown, plus or minus 10 percent, and 60 Hz, plus or minus 2 percent.

1.2.4 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

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.

The Guide Specification technical editors have designated 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 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.] [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

Lighting System[; G][; G, [_____]]
Detail Drawings[; G][; G, [_____]]
As-Built Drawings

SD-03 Product Data

Equipment and Materials
Spare Parts

SD-06 Test Reports

CCTV Assessment Lighting[; G][; G, [_____]]
Operating Test[; G][; G, [_____]]
Ground Resistance Measurements

SD-10 Operation and Maintenance Data

Lighting System

1.4 QUALITY ASSURANCE

1.4.1 Power Line Surge Protection

****

NOTE: Indicate circuits requiring additional transient voltage surge suppression. Provide requirements on the drawings or in a table.

****

Transient voltage surge suppressors shall be provided for all electronic equipment. Surge suppressors shall meet the requirements of IEEE C62.41.1 and IEEE C62.41.2, and be UL listed as having been tested in accordance with UL 1449. Surge suppressor ratings shall be [as indicated] [[_____] volts rms, operating voltage; [50] [60] Hz; [1-phase] [3-phase]; [2] [3] [4] wire with ground; transient suppression voltage (peak

let-through-voltage) of [_____] volts]. Fuses shall not be used as surge suppression.

1.4.2 Hazardous Locations

****
NOTE: Designer must identify hazardous areas and show them on the drawings.
****

[Wiring shall conform to NFPA 70 for Class [I] [II] [III], Division [1] [2] hazardous locations. Equipment shall be suitable for [Group [_____]] [operating temperature of [_____] degrees C F].] [Wiring and equipment shall be of the classes, groups, divisions indicated, and suitable for the indicated operating temperature.]

1.4.3 Interface Lighting System and Power Distribution

****
NOTE: Include the secondary power panel only for a backup generator as specified in another section. The designer will determine the site requirements for a backup generator.
****

Conductors shall [include all conductors extending from the load side of the primary and secondary power panels that serve assessment lighting equipment] [and] [be as indicated].

1.4.4 Protection of Security Lighting System Components

1.4.4.1 Components and Conductors

****
NOTE: Security and CCTV lighting system conductors will be buried in areas where the likelihood of damage to the conductors is slight. In areas where subsurface utilities are congested and in areas where the chance of accidental or intentional damage is great, the security and CCTV lighting system conductors will be placed in ducts.

Delete part b. if infrared lights are not used for CCTV assessment.
****

a. Security lighting system conductors shall be protected from damage. Lighting system conductors shall be installed in raceways or by means of direct burial, as shown. Where the conductors leave the underground systems, the conductors shall be in rigid steel conduit of the indicated size. Wire guards shall be provided to protect security lighting luminaries mounted below 6.1 m 20 feet. A NEMA ICS 6, Type 4 enclosure shall house exterior group-located electrical equipment such as time switches, safety switches, and magnetic contactors. Where only one piece of equipment is being provided at a location, the equipment shall be provided with its own enclosure.

b. Infrared lights shall be interfaced to the CCTV system and shall provide automatic, alarm actuated call-up of the light associated with

the alarm zone.

1.4.4.2 Tamper Provisions

****
NOTE: When an Intrusion Detection System (IDS) is to be provided or is already in place, tamper switches or welded covers are required. When an IDS is not required, this paragraph will be deleted.
****

Enclosures, cabinets, housings (other than luminaire housings), boxes, raceways, conduits, and fittings having hinged doors or removable covers, and which contain any part of the security lighting system (including power sources), shall be provided with corrosion-resistant tamper switches, connected to an Intrusion Detection System (IDS), that will initiate an alarm signal when the door or cover is opened or moved. Tamper switches shall be inaccessible until the switch is activated. Switch leads and mounting hardware shall be concealed from the exterior of the enclosure. For pull or junction boxes which contain no splices or connections the covers may be protected by 6.4 mm 1/4 inch tack welds on four sides of each cover rather than by tamper switches. Labels shall be affixed to indicate they contain no connections. Labels shall not indicate that the box is part of the security system.

1.4.5 Corrosion Protection

1.4.5.1 Aluminum Materials

[Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486A-486B shall be used.] [Aluminum shall not be used.]

1.4.5.2 Ferrous Metal Materials

a. Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A153/A153M and ASTM A123/A123M.

****
NOTE: A 120 hour test will be specified in a noncorrosive environment and a 480 hour test will be specified in a corrosive environment.
****

b. Equipment and component items, including but not limited to metal poles and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand [120] [480] hours of exposure to the salt spray test specified in ASTM B117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm 1/16 inch from the test mark. The scribed test mark and test evaluation shall have a rating of not less than 7 in accordance with TABLE 1, (procedure A) of ASTM D1654. Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

1.5 PROJECT/SITE CONDITIONS

****
NOTE: If normal service conditions prevail, omit this subparagraph. Unusual service conditions for altitude start above 1 kilometer (3300 feet) for most apparatus. Ambient temperature is generally 40 degrees C, although in some cases 30 degrees C applies. Frequency is generally 60 Hz, although 50 Hz may also be standard. Any unusual service conditions or atmospheres shall be taken into consideration and the specifications adjusted accordingly.
****

Equipment and materials furnished under this section shall be suitable for the following unusual service conditions: altitude [_____] m feet, ambient temperature [_____] degrees C F. Submit data published by the manufacturer of each item on the list of equipment and material, to permit verification that the item proposed is of the correct size, properly rated or applied, or is otherwise suitable for the application and fully conforms to the requirements specified.

1.6 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified, after approval of detail drawings for materials and equipment, and not later than 4 months before the date of beneficial occupancy. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and sources of supply.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

Each major component of equipment shall have a nonferrous metal or engraved plastic nameplate showing, as a minimum, the manufacturer's name and address, the catalog or style number, the electrical rating in volts, and the capacity in amperes or watts.

2.3 BRACKET ARMS

2.3.1 On Aluminum, Steel, Fiberglass, and Concrete Poles

Poles shall be provided with bracket arms of the [support arm] [davit] style and of the length indicated on drawings. Bracket arms shall conform to the design of the pole provided. The bracket arms shall be capable of supporting the equipment to be mounted on it with the maximum wind and ice loading encountered at the site. Strength of bracket arms shall be in accordance with ANSI C136.13. Steel brackets shall be galvanized. Wood bracket arms shall not be used.

2.3.2 On Wood Poles

Poles shall be in accordance with ANSI C136.13 provided with galvanized steel pipe bracket arms coordinated for pole attachment. The bracket arm shall be [cantilever without underbrace] [cantilever with underbrace] [single tie brace] [double tie brace] [truss] [A-frame]. The bracket arm shall be of the length indicated on drawings.

2.3.3 Floodlight Brackets

Floodlight brackets shall be coordinated with the floodlight support provided.

2.4 CABLE

Provide all wire and cable not indicated as government furnished equipment. Wire and cable components shall be able to withstand the jobsite environment for a minimum of 20 years.

2.4.1 Insulated Cable

****
NOTE: Select insulation thickness of column B when approximately 0.381 to 0.508 mm (15 to 20 mils) more insulation is desired and column A when even thicker insulation is necessary. Do not specify for small installations or for limited amounts of one AWG size on large installations, since cable must be manufactured to order.
****

Cable shall be type USE conforming to UL 854, with copper conductors and type RHW or XHHW insulation conforming to UL 44, and shall include green ground conductor. Cable shall be provided with insulation of a thickness not less than that given in column [A] [B] of TABLE 15.1 of UL 854. Cable shall be rated 600 volts. Parts of the cable system such as splices and terminations shall be rated not less than 600 volts. The size and number of conductors and the number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded.

2.4.2 Messenger Cable

****
NOTE: Include this paragraph only for aerial cable. The designer will coordinate with the site to determine acceptable locations and heights for aerial cables. For security reasons, aerial cables shall not cross perimeter fencing.
****

A messenger cable system to support aerial cable shall be furnished. The messenger system shall include guys, hardware and appurtenances needed to install the messenger cable. The messenger system shall be capable of supporting the weight of the lighting system cable with the required messenger cable tensioning without exceeding 30 percent of its breaking strength under 16 degrees C 60 degrees F conditions of no ice and no wind. The messenger shall be sized so that ice and wind loading normally encountered at the site does not cause the messenger to exceed 50 percent

of its breaking strength. Appurtenances, guys, and hardware shall be sized to exceed the rated breaking strength of the messenger cable. Messenger cables shall be galvanized zinc coated steel or aluminum clad steel.

2.4.3 Bare Copper Conductors

Medium-hard-drawn copper conductors shall conform to ASTM B2 and ASTM B8.

2.5 AERIAL CABLE HARDWARE

****
NOTE: Include this paragraph only when aerial cable is being used.
****

Zinc coated aerial cable hardware shall conform to IEEE C135.1. Steel hardware material shall conform to ASTM A575 and ASTM A576. Hardware shall be hot-dip galvanized in accordance with ASTM A153/A153M.

2.6 CABLE SPLICES AND CONNECTORS

Cable splices and connectors shall conform to UL 486A-486B. Underground splices and connectors shall also conform to the requirements of ANSI C119.1.

2.7 CABLE BOXES

Boxes and covers shall be made of cast iron with zinc coated or aluminized finish, and shall be of the sizes indicated on drawings. The minimum inside dimensions shall be not less than 304.8 mm 12 inches square by 152.4 mm 6 inches deep and not less than required to house the cable splice. A suitable gasket shall be installed between the box and cover for watertightness. A sufficient number of screws shall be installed to hold the cover in place along the entire surface of contact. Grounding lugs shall be provided.

2.8 MANHOLES, HANDHOLES, AND PULLBOXES

****
NOTE: Actual strength figures may need to be adjusted to accommodate various manufacturers of glass reinforced polymer boxes.

Cast iron will generally be specified for wheel loadings up to 7,258 kPa (16,000 pounds); cast steel may be used at the Contractor's option. Handhole covers and frames will generally conform to the details of UFC 3-550-03FA. Cast steel will be specified for areas that require heavier loadings, such as airports or other concentrated load applications. When cast steel is required, the specification will be revised to indicate the wheel load, tire or wheel contact area, and tire pressure.

Use tamperproof bolts for handholes that are in a nonsecure area but serve security and CCTV lighting systems.
****

Manholes, handholes, and pullboxes shall be as indicated. Strength of

manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast concrete manholes shall have the required strength established by ASTM C478. Frames and covers for manholes shall be made of [gray cast iron] [or] [cast steel]. A machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A48/A48M, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least [69] [_____] MPa [10,000] [_____] psi and a flexural strength of at least [34.5] [_____] MPa [5,000] [_____] psi. Pullbox and handhole covers in parking lots, sidewalks, and turfed areas shall be of the same material as the box. [Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.] [A sufficient number of tamperproof bolts shall be installed to hold the cover firmly in place along the entire surface of contact; a tool for the tamperproof bolts shall be furnished.]

2.9 CONDUIT, DUCTS AND FITTINGS

2.9.1 Conduit, Rigid Steel

Rigid steel conduit shall conform to ANSI C80.1 and UL 6.

2.9.2 Conduit Coatings

Underground metallic conduit and fittings shall be coated with a plastic resin system conforming to NEMA RN 1, Type 40. Epoxy systems may also be used.

2.9.3 Conduit Fittings and Outlets

2.9.3.1 Boxes, Metallic Outlets

ANSI/NEMA OS 1 and UL 514A.

2.9.3.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

ANSI/NEMA OS 2 and UL 514C.

2.9.3.3 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 1203.

2.9.3.4 Boxes, Switch (Enclosed), Surface Mounted

UL 98.

2.9.3.5 Fittings for Conduit and Outlet Boxes

UL 514B.

2.9.3.6 Fittings for Use in Hazardous (Classified) Locations

UL 1203.

2.9.3.7 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.9.4 Non-Metallic Duct

****

NOTE: Only polyvinyl chloride and high-density polyethylene conduits are presently covered by UL 651, which includes a temperature rating clause. Other plastic materials are covered by NEMA Standards, which do not provide a temperature rating clause. All options will be permitted and the temperature certification required until these materials are covered by an industry temperature rating clause.

****

Non-metallic duct lines and fittings utilized for underground installation shall be suitable for the application. Duct shall be thick-wall, single, round-bore type. Material of one type shall be used. Acrylonitrile-butadiene-styrene (ABS) duct shall conform to NEMA TC 6 & 8 and NEMA TC 9. High-density conduit shall conform to UL 651A. Schedule 40 polyvinyl chloride (PVC) shall conform to UL 651. Plastic utility duct and fittings manufactured without a UL label or listing shall be provided with a certification as follows: "The materials are suitable for use with 75 degree C 167 degree F wiring. No reduction of properties in excess of that specified for materials with a UL label or listing will be experienced if samples of the finished product are operated continuously under the normal conditions that produce the highest temperature in the duct."

2.10 WOOD CROSSARMS

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

2.11 GROUND RODS

****

NOTE: Determine the size, type, and number of ground rods to be used, based on local conditions, earth resistivity data, and on the size and type of the electrical installation. Copper clad steel rods will be specified for normal conditions. Zinc coated steel or stainless steel rods will be used 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 must be 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 19.1 mm (3/4 inch) rods will be specified. 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.

****

Ground rods shall be 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.

2.12 POLES

****

NOTE: Select wind velocities from 50 year mean recurrence isotach maps issued by the U.S. Weather Bureau or reproduced in pole manufacturer's literature. For areas not covered by such a map, select the appropriate wind gust velocity from IEEE C2 and divide by 1.3. Round off values to the nearest nominal size given, except that when extreme wind loading values (values above 161 km/hour (100 mph)) occur, it is recommended that pole manufacturers be consulted as to the availability of poles designed for such pressures. Generally, anchor bolt-mounted poles will be used; however, the application may make the use of embedded concrete poles desirable. Metal poles will not be embedded since corrosion may occur. Climbing facilities will be provided as required by the using service.

****

Metal and concrete poles shall be the pole manufacturer's standard design for supporting the number of fixtures indicated. Poles shall be designed for a wind velocity of [31.3] [35.8] [40.2] [44.7] [49.2] [_____] m/sec [70] [80] [90] [100] [110] [_____] mph at the base of the pole, for a wind gust factor of 1.3, and for the height and drag factors recommended by AASHTO LTS-5. The effective projected area of luminaires and other pole-mounted devices shall be taken into account in pole design. Poles shall have grounding provisions. The type of pole shaft material provided shall not be mixed on any project. Grounding connection shall be provided near the bottom of each metal pole and at each concrete pole anchor base. Scratched, stained, chipped, or dented poles shall not be installed.

2.12.1 Aluminum Poles

Aluminum poles and brackets for [walkway] [_____] lighting shall have a [uniform satin] [dark anodic bronze] [_____] finish to match fixtures and shall not be painted. Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

a. Shafts shall be round and of seamless construction. The wall thickness shall be at least 4.8 mm 0.188 inch. Exterior surfaces shall be free of protuberances, dents, cracks, and discoloration. Material for shafts shall be 6063 aluminum alloy; after fabrication, the alloy shall have a T6 temper. Tops of shafts shall be fitted with a round or tapered cover. Bases shall be anchor bolt mounted, made of cast aluminum alloy 356-T6, and shall be machined to receive the lower end of shafts. Joints between shafts and bases shall be welded. Bases shall be provided with four holes, spaced 90 degrees apart, for

anchorage.

b. Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel.

2.12.2 Steel Poles

Steel poles shall be hot-dip galvanized in accordance with ASTM A123/A123M and shall not be painted. Poles shall have tapered tubular members, either round in cross-section or polygonal. Pole shafts shall be one piece. Poles shall be welded construction with no bolts, rivets, or other means of fastening except as specifically approved. Pole markings shall be approximately 900 to 1270 mm 3 to 4 feet above grade and shall include manufacturer, year of manufacture, top and bottom diameters, length, and a loading tree. Attachment requirements shall be provided as indicated, including grounding provisions. Climbing facilities are not required. Bases shall be of the anchor bolt-mounted type.

2.12.3 Concrete Poles

****
NOTE: In areas where freezing temperatures occur, the minimum compressive strength given for concrete in spun poles should be increased in line with the usual concrete design for such temperatures.
****

Concrete poles shall be designed to withstand the loads specified in IEEE C2 multiplied by the appropriate overload capacity factors. Poles shall be reinforced or prestressed, either cast or spun. Spun poles shall be manufactured by a centrifugal spinning process with concrete pumped into a polished round tapered metal mold.

a. Concrete for spun poles shall have a compressive strength of at least 34.5 MPa 5,000 psi at 28 days; steel wire shall have an ultimate tensile strength of at least 827 MPa 120,000 psi; and reinforcing bars shall have an ultimate tensile strength of at least 276 MPa 40,000 psi.

b. After the high speed spinning action is completed, a spun pole shall be cured by a suitable wet steam process. Spun poles shall have a water absorption of not greater than 3 percent to eliminate cracking and to prevent erosion. Concrete poles shall have hollow shafts. Poles shall have a hard, smooth, nonporous surface that is resistant to soil acids, road salts, and attacks of water and frost.

c. Poles shall not be installed for at least 15 days after manufacture. Fittings and brackets that conform to the concrete pole design shall be provided. Poles shall conform to strength calculations performed by a registered professional engineer.

d. Submit detail drawings for the complete system and for [poles,] [lighting fixtures,] [bracket arms,] [cable boxes,] [handholes,] [transformers,] [controllers,] [and] [_____]. [Detail drawings for precast handholes shall include a design analysis to determine that strength is equivalent to indicated cast-in-place concrete handholes.] [Drawings shall indicate bonding method for concrete encasement.] [Drawings shall include design calculations showing adequate strength of screw foundations.]

2.12.4 Wood Poles

Wood poles shall conform to ATIS ANSI O5.1. Poles shall be pressure treated in accordance with AWPA C4 with creosote conforming to AWPA P1/P13 and oil-borne preservatives and petroleum conforming to AWPA P8 and AWPA P9. Species listed in ATIS ANSI O5.1 for which a preservative treatment is not specified in AWPA C4 shall not be used. Northern white cedar may be used if treated as specified for western red cedar, and western fir may be used if treated as specified for Douglas fir. Pole markings shall be located approximately 3 m 10 feet from the butt of the pole or as approved. Poles shall be machine trimmed by turning smooth full length and shall be roofed, gained, and bored before pressure treatment.

2.12.5 Fiberglass Poles

Fiberglass poles shall conform to AASHTO LTS-5 and shall be designed specifically for supporting luminaires and shall have factory-formed cable entrance and handholes. Resin color shall be [dark bronze][as indicated], and pigment shall provide uniform coloration throughout entire wall thickness. Finished surface shall be pigmented polyurethane which may be omitted if the surface layer of the pole is inherently ultra-violet inhibited. Minimum fiberglass content shall be 65 percent with resin and pigment comprising the other 35 percent material content.

2.12.6 Anchor Bolts

Anchor bolts shall be the pole manufacturer's standard, but not less than necessary to meet the pole wind and ice loading, herein and other specified design requirements.

2.13 POLE LINE HARDWARE

Zinc coated hardware shall conform to IEEE C135.1, and steel hardware material shall conform to ASTM A575 and ASTM A576. Hardware shall be hot-dip galvanized in accordance with ASTM A153/A153M.

2.14 SERIES ROADWAY LIGHTING INSULATORS

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

Pin insulators shall be Class 55-5. Line-post insulators shall be Class 57-1 or 57-11.

2.15 ELECTRICAL ENCLOSURES

****
NOTE: The designer will show on the drawings which specific type of enclosure is needed.
****

Provide metallic enclosures as needed to house the [security] [and] [CCTV] lighting equipment. Enclosures shall conform to NEMA ICS 6 and NEMA 250. Enclosures shall be provided with lockable or padlock handles. Keys for lockable enclosures shall be delivered to the Contracting Officer. The enclosures shall be as specified or as shown on the drawings.

2.15.1 Interior Enclosures

Enclosures to house lighting equipment in an interior environment shall meet the requirements of a NEMA 12 enclosure as defined in NEMA 250.

2.15.2 Exposed-to-Weather Enclosures

Enclosures to house lighting equipment in an outdoor environment shall meet the requirements of a NEMA 4 enclosure as defined in NEMA 250.

2.15.3 Corrosion Resistant Enclosures

Enclosures to house lighting equipment in a corrosive environment shall meet the requirements of a NEMA 4X enclosure as defined in NEMA 250.

2.15.4 Hazardous Environment Enclosures

Equipment installed in a hazardous environment shall be installed as described in paragraph Hazardous Locations.

2.16 ILLUMINATION

****
NOTE: Insert appropriate sheets from CE Standard Detail 04-06-04 into these specifications. Add references used in 40-06-04 to paragraph REFERENCES. Delete paragraphs not required.
****

2.16.1 General Lighting

Luminaires, ballasts, lamps, and control devices required for [general area] [and] [_____] lighting [, including floodlighting] shall be in accordance with [sheet] [sheets] [_____] of Standard Detail No. 40-06-04, attached to these specifications.

2.16.2 Roadway Lighting

Luminaires, ballasts, lamps, and control devices required for roadway lighting shall be in accordance with [sheet] [sheets] [_____] of Standard Detail No. 40-06-04, attached to these specifications.

2.17 LAMPS AND BALLASTS, HIGH INTENSITY DISCHARGE (HID) SOURCES

****
NOTE: Lighting system shall produce required lumen output within 3 minutes after primary or emergency power is applied.

Incandescent lamps may be used to provide required light output during periods of restart.
****

2.17.1 High-Pressure Sodium

Lamps shall conform to ANSI ANSLG C78.42. Ballasts shall conform to ANSI C82.4, or UL 1029. High-pressure sodium lamps shall be clear.

2.17.2 Mercury Vapor

****
NOTE: To save energy, mercury vapor fixtures shall only be used when matching existing fixtures.
****

Lamps shall conform to NEMA ANSLG C78.40. Ballasts shall conform to ANSI C82.4.

2.17.3 Metal-Halide

Lamps shall be made by a manufacturer with not less than 5 years experience in making metal-halide lamps. Metal-halide lamps shall conform to ANSI/ANSLG C78.43. Ballasts shall conform to ANSI C82.4 or UL 1029.

2.18 LAMPS, INCANDESCENT

Incandescent lamps shall conform to UL 1598 and shall be rated for 120 volt operation unless otherwise specified.

2.19 LAMPS, FLUORESCENT

Fluorescent lamps shall have standard cool-white color characteristics and shall not require starter switches. The lamps shall be of the rapid-start type.

2.20 LUMINAIRE COMPONENTS

Luminaire components shall conform to the following: attachments, ANSI C136.3; voltage classification, ANSI C136.2; field identification marking, ANSI C136.15; interchangeability, ANSI C136.6 and ANSI C136.9; and sockets, ANSI C136.11.

2.21 LIGHTING CONTROL EQUIPMENT

2.21.1 Photo-Control Devices

****
NOTE: If automatic control of luminaires is desired, first consideration shall be given to photo-control. If both photo-control and remote manual override are required for the lighting system, a central contactor and a single system photo-cell shall be used. Individual luminaire photo-control of security lighting systems will not be used where a remote manual override is required.
****

Photo-control devices shall conform to NEMA C136.10. Each photo-control element shall be a replaceable, weatherproof, plug-in or twist-lock assembly adjustable operation range of approximately 5.4 to 53.8 lux 0.5 to 5.0 foot-candles. Luminaires shall be equipped with weatherproof plug-in or twist-lock receptacle to receive the photo-control element.

2.21.2 Timer Control Switches

****
NOTE: If automatic control of luminaires is desired

and photo-control is not used, operation by timer control shall be provided to ensure that luminaires come on automatically. Normally, the astronomic dial timer control switch shall be of the automatically wound spring mechanism type. A battery backed electronic switch capable of maintaining accurate time for 7 hours following a power failure may be substituted with the approval of the Contracting Officer.

****

Astronomic dial type arranged to turn "ON" at sunset, and turn "OFF" at a pre-determined time between [2030 hours] [_____] hours and [0230 hours] [_____] hours or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise shall be provided. A switch rated [_____] volts, having [automatically wound spring mechanism] [battery backed electronic clock] to maintain accurate time for a minimum of 7 hours following a power failure shall be provided. A time switch with a manual on-off bypass switch shall be provided. Housing for the time switch shall be a surface mounted, NEMA [3R] [1 (indoor)] [4 (outdoor)] enclosure conforming to NEMA ICS 6.

2.21.3 Manual Control Switches

****

NOTE: Manual switches shall be used for control of the lighting system when controls are located in a space that is continuously supervised, such as a gaurdhouse, gatehouse, or watchtower.

Mechanically held, electrically operated magnetic contactors shall be used to control operation of the lighting system circuits.

****

Manual control switches shall conform to UL 98. The switches shall be the heavy-duty type and shall be suitable for operation on a 120 volt, 60 Hz system. The number of poles and ampere rating shall be as indicated. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. The selector switch shall have a minimum of three positions: ON, OFF, and AUTOMATIC. The automatic selection shall be used when photoelectric or timer control is desired. The selector switch shall interface with the lighting system magnetic contactor and control its activity.

2.21.4 Safety Switches

****

NOTE: Delete NEMA ICS 6 enclosures when not required.

****

Switches shall be the heavy-duty type with NEMA ICS 6 Type [1] [4] enclosures and shall be suitable for operation on a [480Y/277] [208Y/120] [480] [277] [240] [120] volt, 60 Hz, [three-phase] [single-phase] system. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. Blades shall be visible with door open and shall be of the quick-make, quick-break type. Terminal lugs shall be coordinated with the wire size. Switches shall conform to UL 98.

2.21.5 Magnetic Contactor

****
NOTE: Mechanically held, electrically operated magnetic contactors shall be used to control operation of the lighting system circuits.
****

Magnetic contactors shall be mechanically held, electrically operated, and shall conform to NEMA ICS 1 and NEMA ICS 2. The contactor shall be suitable for [480] [277] [240] [208] [120] volts, [single] [3] phase, 60 Hz. Coil voltage shall be [120] [277] [208] [240] volts. Maximum continuous ampere rating and number of poles shall be as indicated on drawings. Enclosures for contactors mounted indoors shall be NEMA ICS 6, Type 1. Each contactor shall be provided with a spare, normally open auxiliary contact. Terminal lugs shall be coordinated with the wire size.

2.22 PHOTOMETRIC DISTRIBUTION CLASSIFICATION

Photometrics shall conform to IESNA RP-8.

2.23 LUMINAIRES, FLOODLIGHTING

2.23.1 HID and Incandescent

HID lighting fixtures shall conform to UL 1598. Incandescent lighting fixtures shall conform to UL 1598.

2.23.2 Fluorescent

Fluorescent lamps shall conform to [_____].

2.24 FIXTURES

****
NOTE: The designer will carefully review and select fixtures from Standard Detail No. 40-06-04. Sheet numbers which show the fixture types selected will then be entered in this paragraph.
****
Standard fixtures shall be as detailed on Standard Detail No. 40-06-04, Sheet Nos. [_____] which accompany and form a part of this specification. Special fixtures shall be as indicated on the drawings. Illustrations shown on these sheets or on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar design, equivalent light distribution and brightness characteristics, equal finish and quality will be acceptable as approved.

2.24.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

2.24.2 Special Fixtures

The types of special fixtures are designated by letters and numbers. For example, SP-1 denotes special Type 1.

2.24.3 In-Line Fuse

An in-line fuse shall be provided for each fixture, and shall consist of a fuse and a UL approved waterproof fuse holder rated [at 30 amperes, 600 volts] [as indicated], with insulated boots. Fuse rating shall be [600 volts] [as indicated].

2.25 SEARCHLIGHTS

Special type [_____] searchlights shall be [304.8 mm 12 inch] [457.2 mm 18 inch] [609.6 mm 24 inch] nominal size and shall be of weatherproof, dust-tight, corrosion-resistant construction. Each searchlight shall include a housing and hinged door, two reflectors, a receptacle, a trunnion, and a base. Searchlights shall be provided for operation at [120 Vac] [[_____] Vdc]. Each searchlight shall have a range for observing objects the size of an automobile at [243.8] [365.8] [457.2] [609.6] m [800] [1200] [1500] [2000] feet on a clear night. Searchlights shall be [hand-controlled, with pedestal base and slip rings] [pilot-house controlled, with low base and slip rings]. The housing and hinged door shall be made of nonferrous metal. A heat-resistant, clear, smooth cover glass tempered to withstand sudden changes in temperature shall be gasketed and mounted to the door. The door shall be gasketed to form a weatherproof seal. A parabolic reflector of silver-mirrored glass or aluminum approximately 6.4 mm 1/4 inch thick shall be mounted at the back of the housing, and a spherical auxiliary reflector designed to permit relamping shall be mounted in front of the lamp. The auxiliary reflector shall have a permanent, nontarnishing, nonabsorptive aluminum oxide reflecting surface. Receptacle shall be of proper size to receive the lamp and shall be installed in a manner to ensure accurate positioning of the light center. Searchlights shall be arranged for horizontal and vertical adjustment. Stranded, two-conductor, weatherproof, flexible cable shall feed out of the housing through a weatherproof entrance bushing. Searchlights shall be optically arranged to provide a horizontal and vertical beam spread of [2.5] [3.5] [4.5] [5.5] [6.5] [7.5] [8.5] [_____] degrees. Provision shall be made for tilting searchlights to any position within 45 degrees above and below the horizontal. The searchlights shall be provided with slip rings to permit continuous horizontal rotation. [Each searchlight installation shall include a [_____] 12 volt [_____] kVA transformer conforming to UL 506.] [Searchlight installation on guard towers Nos. [_____] shall also include a manually operated, two-pole, enclosed transfer switch, a 200 ampere-hour, 12 volt, lead-acid, flat pasted positive plate design storage battery, and an automatic battery charger. The battery charger shall be silicon type, full wave, with high and low charging rate, arranged to go on high rate after resumption of power and emergency discharge, and return to low rate automatically when battery has reached full charge. An ammeter shall be provided in the charging circuit to indicate rate of charge.]

2.26 FRESNEL-LENS LUMINAIRES

Special type [_____] luminaires shall consist of mounting bracket, head, socket, reflector, and fresnel-lens assembly for multiple circuit. Luminaire shall be of weatherproof, dust tight, and insect proof construction. Mounting bracket shall be for [crossarm] [[38.1] [50.8] mm [1-1/2] [2] in slip fitter] [wood-pole] [pipe] mounting. Readily accessible means shall be provided to permit horizontal adjustment and locking of the luminaire within a 30 degree arc each side of the center, and tilting and locking the luminaire within a 30 degree arc each side of

vertical. The length of the mounting bracket shall be such that the center of the luminaire, when hanging vertically, will be not less than 200 mm 8 inches nor more than 600 mm 2 feet from the surface of the pole or cross-arm. [Luminaire shall have a 300 watt incandescent lamp that will produce an average candela not less than 3000.] [Luminaire shall have a 500 watt incandescent lamp that will produce an average candela of not less than 5000.] The unit shall be provided with an auxiliary reflector of white glossy-type porcelain enamel or aluminum reflecting surface. The assembly, consisting of a 180 degree cylindrical fresnel lens and a semicylindrical reflector housing, shall produce a horizontal beam spread of approximately 180 degrees, and a vertical beam spread of approximately 15 to 25 degrees.

2.27 FLUORESCENT FLOODLIGHTS, EXTERIOR

Special type [_____] fluorescent floodlight fixtures shall be suitable for outdoor installations and shall use a 2.4 m 96 inch T-12, rapid start, 1.5 ampere lamp. The fixture shall consist of a highly polished aluminum reflector with specular finish. The fixture sockets shall be spring loaded, and shall have plunger sockets with silver-plated contacts and neoprene boots. The fixture shall have provisions for aiming throughout 360 degrees of rotation with a graduated aiming dial. Door assembly shall consist of a stainless steel frame, a clear acrylic plastic cover, a sponge neoprene weatherproof gasket, and stainless steel hinges and latches. Housing shall be finished with [green] [_____] acrylic baked enamel. The fixture shall be equipped with a mounting hub assembly at each end. The fixture shall be provided with a thermally protected, weatherproof, high power factor ballast, not integral with the fixture, for remote mounting. The ballast shall be rated for -29 degrees C -20 degrees F for cold weather starting.

2.28 TRANSFORMERS

****
NOTE: In corrosive atmospheres, specify transformers with PVC coating on exterior metallic surfaces. Consult transformer manufacturers about derating that might result from the application of additional protective coatings.
****

Transformers shall conform to UL 506. Exterior transformer cases shall be given rust-inhibiting treatment and standard finish by the manufacturer.

2.28.1 Outdoor Dry-Type Lighting Transformers

****
NOTE: Transformers will be provided in the security lighting system to serve 120 volt incandescent or quartz lamps from distribution systems of higher voltages.
****

Transformers shall be single phase, 60 Hz, two winding, with two wire secondary and with a [240] [480] [_____] volt primary to 120 volt secondary, [1] [_____] kVA.

2.28.2 Buck-Boost Transformers

****
NOTE: The kVA rating for the buck-boost transformer will be not less than 125 percent of the required load (as determined by multiplying the current by the boost voltage). In order to keep conductor size to a minimum, buck-boost transformers will be used in security and CCTV lighting circuits that have excessive voltage drop due to the circuit lengths. See American Electrician's Handbook, Ninth Edition, for diagrams.
****

Transformers shall be suitable for outdoor installation. The transformers shall have a 150 degree C 302 degree F insulation system for an 80 degree C 176 degree F rise. Transformers shall be for 60 Hz with 4 windings, 2 for primary and 2 for secondary, with all leads brought out to permit parallel or series connections of primary and secondary windings. The voltage ratings, kVA ratings, percent of boost and/or buck, and connections shall be as indicated on drawings.

2.29 WIREWAY, RAINTIGHT, SUPPORT

Raintight wireway shall conform to UL 870. Wireway used for supporting floodlights on wood poles shall be [101.6 by 101.6] [_____] mm [4 by 4] [_____] inches and length shall be [1.8] [_____] m [6] [_____] feet [as indicated].

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify that site conditions are in agreement with the design package and report all changes to the site or conditions that will affect performance of the system to the Government. Do not take any corrective action without written permission from the Government.

3.2 GENERAL

Install all system components, including government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2, and contract documents, and furnish necessary hardware, fixtures, cables, wire, connectors, interconnections, services, and adjustments required for a complete and operable system.

a. Connect to and utilize existing lighting equipment and devices as shown. Lighting equipment that is usable in their original configuration without modification may be reused with Government approval. Perform a field survey, including testing and inspection of existing lighting equipment and control lines intended to be incorporated into the lighting system, and furnish a report to the Government.

b. For those items considered nonfunctioning, provide with the report specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, include the scheduled need date for connection to all

existing equipment.

c. Make written requests and obtain approval prior to disconnecting any control lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Government approval of these requests. If any device fails after the Contractor has commenced work on that device, diagnose the failure and perform any necessary corrections to the equipment. The Government is responsible for maintenance and repair of Government equipment. The Contractor will be held responsible for repair costs due to negligence or abuse of Government equipment.

3.3 ENCLOSURE PENETRATIONS

Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

3.4 PREVENTION OF CORROSION

3.4.1 Aluminum

Aluminum shall not be used in contact with earth or concrete, and where connected to dissimilar metal, shall be protected by approved fittings and treatment.

3.4.2 Steel Conduits

Steel conduits shall not be installed within concrete slabs-on-grade. Steel conduits installed underground or under slabs-on-grade, or penetrating slabs-on-grade, shall be field wrapped with 254 micrometers 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlap, or shall have a factory-applied plastic resin, epoxy coating. Zinc coating may be omitted from steel conduit which has a factory-applied epoxy coating.

3.4.3 Cold Galvanizing

Field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc. shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.5 CABLE INSTALLATION

****
NOTE: Security and CCTV lighting system conductors will be buried in areas where the likelihood of damage to the conductors is slight. In areas where subsurface utilities are congested and in areas where the chance of accidental or intentional damage is great, the security and CCTV lighting system conductors will be placed in ducts.
****

Cable and all parts of the cable system such as splices and terminations shall be rated not less than 600 volts. The size and number of conductors and the number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded. Each circuit shall be identified by means of fiber or nonferrous metal tags, or approved equal, in each [handhole] [and] [junction box,] and at each terminal.

3.5.1 Splices

Splices below grade shall be made with nonpressure-filled resin systems using transparent, interlocking, self-venting, longitudinally split plastic molds. Splices above grade shall be made with sealed insulated pressure connectors and shall provide insulation and jacket equal to that of the cable. In order to prevent moisture from entering the splice, jackets shall be cut back to expose the required length of insulation between the jacket and the tapered end of the insulation.

3.5.2 Installation in Duct Lines

[Ground] [Ground and neutral] conductors shall be installed in duct with the associated phase conductors. Cable splices shall be made in handholes only.

3.5.3 Direct Burial

Minimum cover from top of cable to finished grade shall be 750 mm 30 inches for direct buried cable, but not less than the depth of the frost line.

3.5.3.1 Trenching

****
NOTE: Where soil does not contain rocks or abrasive material, the requirements for placing protection over the cable will be deleted. Delete planks if not required.
****

Trenches shall be excavated to the depths required to provide the minimum cable cover. The bottom of the trench shall be smooth and free of stones and sharp objects. Where the bottom of the trench consists of material other than sand or earth, an additional 75 mm 3 inch layer shall be removed and replaced by a 75 mm 3 inch layer of sand or stone-free earth compacted to the approximate density of the surrounding firm soil. The cables shall be unreeled in place along the side of or in the trench and carefully placed on the sand or earth bottom. Pulling cables into a direct-burial trench from a fixed reel position will not be permitted. Where cables cross, a separation of at least 75 mm 3 inches shall be provided, unless the cables are protected by nonmetallic conduit sleeves at the crossing. The radius of bends in cables shall be not less than 12 times the diameter of the cable. Cables shall not be left under longitudinal tension. The first layer of backfill shall be 150 mm 6 inches thick and shall consist of sand or stone-free earth. One-inch untreated planks, not less than 200 mm 8 inches in width, or approved equal protection, shall be placed end to end along the cable run, approximately 75 mm 3 inches above the cable. A 0.127 mm 5 mil, brightly colored plastic tape not less than 75 mm 3 inchesin width and suitably inscribed at not more than 3 m 10 feet on centers, or other approved dig-in warning indication, shall be placed approximately 300 mm 12 inches below finished grade levels of trenches. Selected backfill of sand or stone-free earth shall be provided to a minimum depth of 75 mm 3

inches above cables.

3.5.3.2 Requirements for Installation in Duct

Where indicated on drawing, cable shall be installed in duct lines. Ground and neutral conductors shall be installed in duct with the associated phase conductors. The segments of direct-burial cable that cross under new railroad tracks, roads, or paving exceeding 1.5 m 5 feet in width, shall be installed in plastic, or rubber duct encased in concrete in accordance with paragraph DUCT LINES. Pulling of cable into conduit from a fixed reel position will be permitted. At interfaces with direct-burial cable, the direct-burial cable shall be centered in the entrance to the duct, using an approved waterproof, nonhardening mastic compound to facilitate the centering. Where crossing existing railroad tracks, coated rigid steel conduit shall be installed under the tracks, in lieu of concrete-encased duct, in accordance with paragraph DUCT LINES. Installation shall be in accordance with NFPA 70 and the regulations of the railroad.

3.5.3.3 Location of Cable Splices

Splices in direct-burial cable will not be permitted in runs of 150 m 500 feet or less or at intervals of less than 150 m 500 feet in longer runs except as required for taps. Where cable splices in shorter intervals are required to avoid obstructions or damage to the cable, the location shall be as approved. Cable splices shall be installed in cable boxes or concrete handholes.

3.5.3.4 Markers

****
NOTE: Markers will be detailed on drawings in accordance with UFC 3-550-03FA.
****

Cable and cable splice markers shall be located near the ends of cables, at each cable splice, approximately every 120 m 400 feet along the cable run, and at changes in direction of the cable run. Markers need not be placed along cables laid in relatively straight lines between lighting poles that are spaced less than 120 m 400 feet apart. Markers shall be placed approximately 600 mm 2 feet to the right of the cable or cable splice when facing the longitudinal axis of the cable in the direction of the electrical load. The marker shall be concrete with a 28 day compressive strength of 17 MPa 2500 psi in accordance with Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE. The letter "C" shall be impressed in the top of each marker.

3.5.3.5 Warning Tape

Direct burial cable shall be placed below a plastic warning tape buried in the same trench or slot. A 0.127 mm5 mil brightly colored plastic tape, not less than 75 mm 3 inches in width and suitably inscribed at not more than 3 m 10 feet on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm 1 mil metallic foil core to permit easy location of the buried cable, shall be placed approximately 300 mm 12 inches below finished grade.

3.5.4 Messenger Cable

3.5.4.1 Installation

****
NOTE: The designer will verify local electrical installation requirements to determine if new grounding conductors and electrodes are required at each messenger cable ground connection.
****

Messenger shall be attached to poles with approved clamps and not less than 15.9 mm 5/8 inch through bolts. Messenger cable tensioning shall not exceed 30 percent of its rated breaking strength under 16 degrees C 60 degrees F conditions of no ice and no wind. Messengers shall be stressed to a tension higher than the final tension in order to prestretch the cable, so that when the messenger is dead-ended under its final tension and sag, there shall be minimum variation from the calculated values.

3.5.4.2 Grounding and Bonding Connections

Messengers shall be grounded and guyed at corners, dead-ends, and entrances to each facility, and grounded at intervals not exceeding 300 m 1000 feet. [New grounding conductors and electrodes shall be provided at each ground connection.] [Where grounding connections are made in the vicinity of existing grounding conductors and electrodes, the grounding connection may be made by a bolted or welded connection to the existing grounding conductor.] Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.5.4.3 Grounding Conductors and Electrodes

Ground conductors shall be soft drawn copper, having a current capacity of at least 20 percent of that of the messenger to which it is connected. Ground conductors shall not be smaller than No. 6 AWG. The ground conductor shall be connected to a ground rod 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. After installation is completed, the top of the ground rod shall be approximately 300 mm 1 foot below finished grade. The ground conductor shall be protected by half-round wood, plastic, or fiber molding from the ground to a point at least 2.4 m 8 feet above the ground.

3.5.4.4 Ground Resistance Testing

The resistance to ground shall be measured using the fall-of-potential method described in IEEE 81. The maximum resistance shall not exceed 25 ohms under normally dry conditions. Whenever the required ground resistance is not met, additional electrodes shall be provided, [interconnected with grounding conductors] [as indicated], to achieve the specified ground resistance. The additional electrodes shall be [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, the Contracting Officer shall be notified immediately.

3.6 AERIAL CABLE SPLICES

Splices in aerial cable shall be within 900 mm 3 feet of a pole and placed inside a watertight enclosure. Drip loops shall be formed at the cable entrance to the enclosure. Lashing clamps shall be placed within 300 mm 12 inches of the enclosure.

3.7 LASHING WIRE

Lashing wire shall be wound tightly around both the communication cable and the messenger cable by machine methods. The lashing wire shall have a minimum of one turn per 355.6 linear mm 14 linear inches and not less than the number of turns per linear meter foot that is recommended by the cable manufacturer for the distance between cable support points and the combined ice and wind loading and extreme wind loading shown or normally encountered for the installed location. Lashing clamps shall be placed at all poles and splices.

3.8 STRESS LOOPS

Loops shall be formed in the aerial cable at all points of connection and at all poles to prevent damage from thermal stress and wind loading. Aerial cable shall be protected from chafing and physical damage with the use of spiral cut tubing and PVC tape, or plastic sleeves.

3.9 CONNECTIONS TO BUILDINGS

****

NOTE: Where this guide specification is used for installation of a security and CCTV lighting system in an existing facility, the designer will delete the reference to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and incorporate pertinent paragraphs from the referenced guide specification.

****

Cables shall be extended into the various buildings as indicated and shall be properly connected to the indicated equipment. Empty conduits to the indicated equipment from a point 1.5 m 5 feet outside the building wall and 600 mm 2 feet below finished grade [are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM] [shall be provided]. After installation of cables, conduits shall be sealed to prevent moisture or gases from entering the building.

3.10 DUCT LINES

3.10.1 Requirements

Numbers and size of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 100 mm/30 m 4 inches/100 feet. Depending on the contour of the finished grade, the high point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short radius manufactured 90 degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 450 mm 18 inches for ducts of less than 80 mm 3 inches in diameter, and 900 mm 36 inches for duct 80 mm 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 m 25 feet shall be used for a change of direction of more than 5

degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells when duct lines terminate in manholes or handholes.

3.10.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and shall match factory tapers. A coupling recommended by the duct manufacturer shall be used when an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.10.3 Concrete Encasement

****
NOTE: For crossings of existing railroads and airfield pavements greater than 15.2 m (50 feet) in length, the pre-drilling method or the jack-and-sleeve method will be used.
****

Ducts requiring concrete encasements shall comply with NFPA 70 except that electrical duct bank configurations for ducts 150 mm 6 inches in diameter shall be determined by calculation and as shown on the drawings. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. At any point, except railroad and airfield crossings, tops of concrete encasements shall not be less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface landings. Tops of concrete encasement shall not be less than 1.5 m 5 feet below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit shall be installed. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 15 m 50 feet in length, the predrilling method or the jack-and-sleeve method shall be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not more than 1.2 m 4 foot on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete, and joints shall be staggered at least 150 mm 6 inches vertically.

3.10.4 Nonencased Direct-Burial

****
NOTE: Specify cover requirements in accordance with NFPA 70 and ANSI C2. Specify frost line depth.
****

Top of duct lines shall be below the frost line depth of [_____] mm inches, but not less than [_____] mm inches below finished grade and shall be installed with a minimum of 75 mm 3 inches of earth around each duct,

except that between adjacent electric power and communication ducts, 300 mm 12 inches of earth is required. Bottom of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 75 mm 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 150 mm 6 inches. The first 150 mm 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 75 to 150 mm 3 to 6 inch layers. Duct banks may be held in alignment with earth. However, high tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

3.10.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendation for the particular type of duct and coupling selected and as approved. Duct joints shall be made by brushing a plastic solvent on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4 turn to set the joint tightly.

3.10.6 Concrete

Concrete work shall be as specified in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE. Concrete shall be plain, 17 MPa 2500 psi at 28 days, except that reinforced concrete shall be 21 MPa 3000 psi at 28 days. Duct line encasement shall be of monolithic construction. Where a connection is made to an existing duct line, the concrete encasement shall be well bonded or doweled to the existing encasement.

3.10.7 Duct Line Markers

Duct line markers shall be provided [as indicated] [at the ends of long duct line stubouts or for other duct locations that are indeterminate because of duct curvature or terminations at completely below-grade structures]. In addition to markers, a 0.127 mm 5 mil brightly colored plastic tape, not less than 75 mm 3 inches in width and suitably inscribed at not more than 3 m 10 feet on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 300 mm 12 inches below finished grade levels of such lines.

3.11 HANDHOLES

The exact locations shall be determined after carefully considering the locations of other utilities, grading, and paving. Exact locations shall be approved before construction is started.

3.11.1 Construction

Handholes shall be constructed as indicated on drawings, including appurtenances. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic construction. Concrete shall be 21 MPa 3000 psi at 28 days. Precast concrete handholes having the same strength and inside dimensions as cast-in-place concrete handholes may be used. In paved areas, the top of entrance covers shall be flush with the finished surface of the paving. In unpaved areas, the top of entrance

covers shall be approximately 13 mm 1/2 inch above the finished grade. Where finished grades are in cut areas, unmortared brick shall be installed between the top of handhole and entrance frame to temporarily elevate the entrance cover to existing grade level. Where duct lines enter walls, the sections of duct may be cast in the concrete or may enter the wall through a suitable opening. The openings around entering duct lines shall be caulked tight with lead wool or other approved material.

3.11.2 Appurtenances

The following appurtenances shall be provided for each handhole.

3.11.3 Cable Pulling-In Irons

A cable pulling-in iron shall be installed in the wall opposite each duct line entrance.

3.11.4 Ground Rods

In each handhole, at a convenient point close to the wall, a ground rod conforming to paragraph GROUNDING shall be driven into the earth before the floor is poured; approximately 100 mm 4 inches of the ground rod shall extend above the floor after pouring. When precast concrete units are used, the top of the ground rod may be below the floor; a No. 1/0 AWG copper ground conductor shall be brought inside through a watertight sleeve in the wall.

3.12 POLE INSTALLATION

Pole lengths shall provide a luminaire mounting height of [9.1] [10.7] [12.2] [_____] m [30] [35] [40] [_____] feet. Luminaire mounting height may be increased by the height of the transformer base where required. Electrical cabling shall be provided to the light pole as specified in Section [_____]. The mount interfaces shall have ac power connected, and the pole wiring harness shall be connected to the luminaire. Light poles shall not be installed outside the site or inside the perimeter zone. [CCTV light poles shall be installed inside the secure area and 1.5 m 5 feet from the inner perimeter fence.] [Security system light poles shall be installed inside the secure area.] Pole installation shall conform to the manufacturer's recommendations, NFPA 70, and IEEE C2. Poles shall be set straight and plumb.

3.12.1 Pole Brackets

Brackets shall be installed as specified by the manufacturer and as shown on drawings. Mounting hardware shall be sized appropriately to secure the mount, luminaire, and housing with wind and ice loading normally encountered at the site. [CCTV luminaires shall be located inside the perimeter zone and at a minimum of 9 m 30 feet vertically above the finished grade.] [When security lights are used along roadways, brackets shall correctly position roadway luminaires and fresnel-lens luminaires not less than [1.2] [1.8] [2.4] [3.1] [3.7] or [4.6] m [4] [6] [8] [10] [12] [or] [15] feet from the pole, at not less than the mounting height specified by the fixture manufacturer.] Pole brackets for floodlights shall have the number of tenons indicated, arranged to provide the indicated spread between each tenon. Where indicated on drawings, adjustable heads shall be installed on the brackets to position the luminaires. Identical brackets shall be used with one type of luminaire.

3.12.2 Concrete Foundations

Concrete foundations shall have anchor bolts accurately set in the foundation using a template supplied by the pole manufacturer. Once the concrete has cured, the pole shall be set on the foundation, leveled on the foundation bolts, and secured with the holding nuts. The space between the foundation and the pole base shall be grouted. Concrete and grout work shall conform to Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE. Concrete shall be 21 MPa 3000 psi at 28 days.

3.12.3 Rigid Steel Conduit Ells

Rigid steel conduit ells shall be provided [at all poles] [where specified or indicated on drawings]. Rigid steel conduit shall be connected to the ells and shall extend to a minimum height of 3 m 10 feet above grade. Rigid steel conduit ells shall be provided for wood poles, where required

3.12.4 Wood Pole Installation

****
NOTE: Where specific pole setting depths cannot be given because the type of soil is not known, use the second bracketed choices; otherwise detail requirements.
****

Wood poles shall be set straight and firm. In normal firm ground, minimum pole-setting depths shall be as listed in Table II. In rocky or swampy ground, pole-setting depths shall be decreased or increased [as shown] [respectively in accordance with the local utility's published standards and as approved]. In swampy or soft ground, a bog shoe shall be used where support for a pole is required. Poles in straight runs shall be in a straight line. Curved poles shall be placed with curvatures in the direction of the pole line. Poles shall be set to maintain as even a grade as practicable. When the average ground run is level, consecutive poles shall not vary more than 1.5 m 5 feet in height. When the ground is uneven, poles differing in length shall be kept to minimum by locating poles to avoid the highest and lowest ground points. If it becomes necessary to shorten a pole, a piece shall be sawed off the top end and roofed. If any pole is shortened after treatment, the shortened end of the pole shall be given an application of hot preservative. Where poles are set on hilly terrain, along edges of cuts or embankments, or where soil may be washed out, special precautions shall be taken to ensure durable pole foundations, and the setting depth shall be measured from the lower side of the pole. Holes shall be dug large enough to permit proper use of tampers to the full depth of a hole. Earth shall be placed into a hole in 150 mm 6 inch maximum layers, then thoroughly tamped before the next layer is placed. Surplus earth shall be placed around a pole in a cone and packed tightly to drain water from poles.

TABLE I - MINIMUM POLE-SETTING DEPTH
(Meters)

Length Overall Meters	Straight Lines	Curves, Corners, and Points of Extra Strain
6.1	1.5	1.5

TABLE I - MINIMUM POLE-SETTING DEPTH
(Meters)

Length Overall Meters	Straight Lines	Curves, Corners, and Points of Extra Strain
7.6	1.7	1.7
9.2	1.7	1.7
10.7	1.8	1.8
12.2	1.8	2.0
13.7	2.0	2.1
15.2	2.1	2.3
16.7	2.3	2.5
18.3	2.5	2.6

TABLE I - MINIMUM POLE-SETTING DEPTH
(Feet and Inches)

Length Overall Feet	Straight Lines	Curves, Corners, and Points of Extra Strain
20	5-0	5-0
25	5-6	5-6
30	5-6	5-6
35	6-0	6-0
40	6-0	6-6
45	6-6	7-0
50	7-0	7-6
55	7-6	8-0
60	8-0	8-6

3.12.5 Aluminum, Steel, Fiberglass and Concrete Poles

Poles shall be mounted on cast-in-place or power-installed screw foundations. Concrete poles shall be embedded in accordance with the details shown. Conduit elbows shall be provided for cable entrances into pole interiors.

3.12.5.1 Cast-In-Place Foundations

Concrete foundations, sized as indicated, shall have anchor bolts accurately set in foundations using templates supplied by the pole manufacturer. Concrete work and grouting is specified in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE. After the concrete has cured, pole anchor bases shall be set on foundations and leveled by shimming between anchor bases and foundations or by setting anchor bases on leveling nuts and grouting. Poles shall be set plumb. Anchor bolts shall be the manufactures standard, and not less than necessary to meet the pole wind loading and other specified design requirements.

3.12.5.2 Power-Installed Screw Foundations

Power-installed screw foundations having the required strength mounting bolt and top plate dimensions may be utilized. Screw foundations shall be of at least 6.4 mm 1/4 inch thick structural steel conforming to

ASTM A36/A36M and hot-dip galvanized in accordance with ASTM A123/A123M. Conduit slots in screw foundation shafts and top plates shall be marked to indicate orientation. Design calculations indicating adequate strength shall be approved before installation of any screw foundation.

3.13 LIGHTING

****
NOTE: Following a power outage, a minimum of 10.8 lux (1 foot candle) at grade within 30 seconds is required. Requirement may be met by including dual re-strike element lamps for instant re-strike, using incandescent fixtures for backup lighting or by 5 minute UPS to allow standby power to pickup lighting loads. When the asset being protected justifies the additional cost, interleaving of power circuits should be considered for additional security and reliability. When interleaving is used, the loss of any one circuit should not significantly reduce the visual detection of intruders. Interleaving may also be useful in reducing the power demand for backup power sources.
****

3.13.1 Lamps

Lamps of the proper type, wattage, and voltage rating shall be delivered to the project in the original containers and installed in the fixtures just before completion of the project.

3.13.2 Fixture Installation

Standard fixtures shall be installed as detailed on Standard Detail No. 04-06-04, Sheet Nos. [_____], which accompany and form a part of this specification. Special fixtures shall be as indicated on drawings. Illustrations shown on these sheets or on the drawings are indicative of the general type desired and are not intended to restrict selection of fixtures to any particular manufacturer. Fixtures of similar design, equivalent light-distribution and brightness characteristics, and equal finish and quality will be acceptable as approved.

3.13.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be installed as required for proper installation.

3.13.2.2 In-Line Fuses

An in-line fuse shall be provided for each fixture.

3.13.2.3 Special Fixtures

The types of special fixtures are designated by letters and numbers. For example, SP-1 denotes special type 1.

3.14 TRANSFORMER INSTALLATION

Transformers for lighting fixtures on [aluminum] [or steel] [or concrete] poles shall be installed in the transformer base. A transformer base shall

be provided for poles that require transformers. Transformers shall be securely mounted to steel supporting plates and bolted to wood poles.

3.15 LIGHTING CONTROL SYSTEM

3.15.1 Photo-Control

****
NOTE: If automatic control of luminaires is desired, first consideration shall be given to photo-control. If both photo-control and remote manual override are required for the lighting system, a central contactor and a single system photo-cell shall be used. Individual luminaire photo-control of security lighting systems will not be used where a remote manual override is required.
****

Lighting luminaires shall be [controlled in banks by a single photo-control element mounted within each bank.] [individually controlled by photo-control elements mounted [on] [or] [adjacent to] the heads of the luminaires.]

3.15.2 Time Control Switches

****
NOTE: If automatic control of luminaires is desired and photo-control is not used, operation by timer control shall be provided to ensure that luminaires come on automatically. Normally, the astronomic dial timer control switch shall be of the automatically wound spring mechanism type. A battery backed electronic switch capable of maintaining accurate time for 7 hours following a power failure may be substituted with the approval of the Contracting Officer.
****

Switches shall be installed with not less than four 6.4 mm 1/4 inch bolts. The use of sheet metal screws will not be allowed.

3.15.3 Manual and Safety Switches

****
NOTE: Manual switches shall be used for control of the lighting system when controls are located in a space that is continuously supervised, such as a gaurdhouse, gatehouse, or watchtower.
****

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than four 6.4 mm 1/4 inch bolts. The use of sheet metal screws will not be allowed.

3.15.4 Magnetic Contactors

****
NOTE: Mechanically held, electrically operated

magnetic contactors shall be used to control operation of the lighting system circuits.

****

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than four 6.4 mm 1/4 inch bolts. The use of sheet metal screws will not be allowed.

3.15.5 CCTV Alarm Interface

****

NOTE: Delete this paragraph if assessment infrared lights are not used. Determine the number of alarm inputs needed for the alarm interface. Calculate the percentage of expansion for future needs, and determine if 10 percent is adequate.

****

An alarm interface shall be furnished with the lighting control system. The interface shall be compatible with the CCTV alarm annunciation system. The alarm interface shall monitor alarm closures for processing by the system CPU. Alarm inputs to the alarm interface shall be relay contact or through an TIA-232 interface. The alarm interface shall be modular and shall allow for system expansion. The alarm interface to be installed at the site shall be configured to handle [_____] alarm points, and shall have an expansion capability of not less than [10] [_____] percent. An output shall be provided to actuate a video recorder.

3.16 GROUNDING

****

NOTE: Butt grounds will not be permitted as an option in dry desert areas. See UFC 3-550-03FA.

****

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following. Grounding conductors shall be soft-drawn, stranded copper. Ground rods shall be driven into the earth so that after the installation is complete, the top of the ground rod will be approximately 300 mm 1 foot below finished grade, except in handholes. [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 may be used where a ground resistance of 25 ohms or less can be obtained by this method.] [Butt grounds shall not be used.]

3.16.1 Ground Rods and Pole Butt Electrodes

****

NOTE: Designer will determine the size, type, and number of ground rods to be used, based on local conditions, earth resistivity data, and on the size and type of the electrical installation. Copper clad steel rods will be specified for normal conditions. Zinc coated steel or stainless steel rods will be used 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, but use of stainless

steel must be 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 19.1 mm (3/4 inch) rods will be specified. 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.

****

The resistance to ground shall be measured using the fall-of-potential method described in IEEE 81. The maximum resistance of a [driven ground rod] [pole butt electrode] shall not exceed 25 ohms under normally dry conditions. Whenever the required ground resistance is not met, additional electrodes shall be provided [interconnected with grounding conductors] [as indicated], to achieve the specified ground resistance. The additional electrodes shall be [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, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.16.2 Items to be Grounded

Ground conductors, metallic conduits, junction boxes, and noncurrent-carrying metallic parts of equipment shall be grounded. Connections above grade shall be made with solderless connectors, and those below grade shall be made by a fusion-welding process.

3.16.3 Lighting Pole

One ground rod shall be provided at each pole. Bases of metal or concrete lighting poles shall be connected to ground rods by means of No. 8 AWG bare copper wire. Lighting fixture brackets on wood and concrete poles shall be grounded to a No. 6 AWG bare copper grounding conductor connected to the ground rod.

3.16.4 Handhole

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

3.16.5 Metal Cable Boxes

Metal cable boxes for direct-burial cable shall be connected 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.

3.17 TESTS

3.17.1 Testing For CCTV Assessment Lighting

****
NOTE: Omit this paragraph if the lighting is not used for CCTV Assessment.
****

Perform site testing and adjustment of the completed CCTV lighting in conjunction with Section 28 23 23.00 10 CLOSED CIRCUIT TELEVISION SYSTEMS. Provide personnel, equipment, instrumentation, and supplies necessary to perform testing. Written notification of planned testing shall be given to the Government at least 14 days prior to the test; notice shall not be given until after the Contractor has received written approval of the specific test procedures. Test procedures shall explain, in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. Test reports shall be used to document results of the tests. Reports shall be delivered to the Government within 7 days after completion of each test.

3.17.2 Operating Test

After the installation is completed and at such time as the Contracting Officer may direct, conduct an operating test for approval. Submit test procedures and reports for the Operating Test. Schedule the tests after receipt of written approval of the test procedures. The final test procedures report shall be delivered after completion of the tests. The equipment shall be demonstrated to operate in accordance with the requirements specified. The test shall be performed in the presence of the Contracting Officer. Furnish instruments and personnel required for the test, and the Government will furnish the necessary electric power.

3.17.3 Ground Resistance Measurements

The resistance to ground shall be measured by the fall-of-potential method described in IEEE 81. Submit the measured resistance to ground of each separate grounding installation, indicating the location of the rods, the resistance of the soil in ohms per mm and the soil conditions at the time the measurements were made. The information shall be in writing. Maintain a separate set of drawings, elementary diagrams and wiring diagrams of the lighting to be used for "as-built" drawings. This set shall be accurately kept up to date with all changes and additions to the lighting system. In addition to being complete and accurate, this set of drawings shall be kept neat and shall not be used for installation purposes. Final as-built drawings shall be finished drawings on mylar or vellum and shall be delivered with the final test report. Upon completion of the 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 shall complete the work as required.

-- End of Section --