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USACE / NAVFAC / AFCEC / NASA **UFGS-34 43 00.00 20 (February 2010)**

Preparing Activity: NAVFAC **Superseding**
UFGS-34 43 00.00 20 (August 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2015
****

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DIVISION 34 - TRANSPORTATION

SECTION 34 43 00.00 20

AIRFIELD LIGHTING

02/10

-- End of Section Table of Contents --

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SECTION 34 43 00.00 20

AIRFIELD LIGHTING
02/10

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NOTE: This guide specification covers the requirements for airfield lighting including transformers, light fixtures, underground wiring, controls, regulators, and all other associated equipment.

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)**.**

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NOTE: Depending on the specific application, additional technical sections will probably have to be added to the project specification. The construction drawings and specifications establish the scope for the construction project. Electrical drawings shall include: a legend dedicated to the airfield lighting fixtures; an airfield map depicting runways, and electrical vaults; demolition plans, single line electrical riser diagrams, schematic diagrams for fixture wiring, conduit and duct bank schedules; cable schedule, and a fixture schedule; and construction installation details for each airfield lighting fixture.Where an option is given for military and FAA specifications, the electrical designer of the specific project shall determine if the project requires a military

specification component without option for the FAA specification. Where the words "as indicated," "as specified," "unless specified otherwise," "when specified," or similar words are used, the designer shall ensure that the appropriate requirements are included in the project drawings or specifications. The drawings should show new portions of the work on existing airfields and should indicate clearly the existing wires, cables, ducts, and equipment as applicable. The designer should refer to the NAVAIR 51-50AAA-2, "General Requirements for Shore Based Airfield Marking and Lighting." Electrical Designer shall specify Primary type I or Secondary type II Class A or Class B electrical cable system. Designer must specify FAA style for the cable/receptacle system. Connectors shall be certified by ETL.

****

PART 1 GENERAL

1.1 REFERENCES

****

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

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

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

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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.

ASTM INTERNATIONAL (ASTM)

ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B3	(2013) Standard Specification for Soft or Annealed Copper Wire

ASTM B8	(2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C603	(2014) Extrusion Rate and Application Life of Elastomeric Sealants
ASTM C639	(2001; R 2011) Rheological (Flow) Properties of Elastomeric Sealants
ASTM C661	(2006; R 2011) Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
ASTM C679	(2003; E 2009; R 2009) Tack-Free Time of Elastomeric Sealants
ASTM C719	(2014) Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)
ASTM C792	(2004; R 2008) Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants
ASTM C793	(2005; R 2010) Effects of Accelerated Weathering on Elastomeric Joint Sealants
ASTM D1248	(2012) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D1535	(2014) Specifying Color by the Munsell System
ASTM D412	(2006a; R 2013) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D709	(2013) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013; INT 8 2014) National Electrical Safety Code
IEEE C62.11	(2012) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)
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 C37.44	(1981; R 1992) Special for Distribution Oil Cutouts and Fuze Links
NEMA ICS 4	(2010) Terminal Blocks
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2013) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2013) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA TC 6 & 8	(2013) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
NEMA WC 3	(1992; Rev 1 1994) Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 7	(1988; Rev 3 1996) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1988; Rev 3 1996) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code
NFPA 70B	(2013) Recommended Practice for Electrical Equipment Maintenance

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 1	(2015) Solvent Cleaning

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS5351	(1987; Rev F; R 2006) Steel Castings, Sand, Corrosion and Moderate Hear Resistant, 13Cr, Normalized and Tempered

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 1751F-205	(1987) Filled Telephone Cables (PE-39)

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-DTL-5904	(2010; Rev E) Light, Runway Marker, Elevated, Type C-1
MIL-DTL-7830	(2007; Rev E; Notice 1) Light Assembly, Marker, Aircraft Obstruction
MIL-L-26764	(1970; Rev B) Light, Marker, Airport Approach, High Intensity, Type MB-2
MIL-L-26990	(1967; Rev B; Am 2 1978) Light, Marker, Airport Approach, High Intensity, Type MB-1
MIL-L-29575	(1989) Light, Wave-Off, Flashing, Capacitance-Discharge
MIL-L-7158	(1969; Rev E; Notice 1 1991) Light, Beacon, Rotating, 24-Inch
MIL-P-8944	(1970; Rev A; Am 1 1983; Notice 2) Panel, Airport Lighting Control, General Specification for
MIL-STD-108	(1966; Rev E; Am 1 1985; Notice 2 1990) Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment
MIL-STD-461	(2007; Rev F) Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-T-27535	(1964; Rev A; Supp 1 1964; Am 2 1965; Notice 1 1993; Notice 3 1999) Transformer, Power, Isolation, Series Circuit, Airport Lighting, General Specification for
MS 17814	(1972; Rev C; Am 1 2002; Notice 1 2006; Notice 2 2012) Coupling, Frangible, Aviation Ground Lights

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 150/5340-30	(2010; Rev E) Design and Installation Details for Airport Visual Aids
FAA AC 150/5345-10	(2014; Rev H) Specification for Constant Current Regulators Regulator Monitors
FAA AC 150/5345-12	(2005; Rev E) Specification for Airport and Heliport Beacon
FAA AC 150/5345-13	(2007; Rev B) Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot

	Control of Airport Lighting Circuits
FAA AC 150/5345-26	(2008; Rev D) FAA Specification for L-823 Plug and Receptacle, Cable Connectors
FAA AC 150/5345-27	(2013; Rev E) Specification for Wind Cone Assemblies
FAA AC 150/5345-28	(2005; Rev F) Precision Approach Path Indicator (PAPI) Systems
FAA AC 150/5345-3	(2007; Rev F) Specification for L-821 Panels for Control to Airport Lighting
FAA AC 150/5345-42	(2013; Rev G) Specification for Airport Light Bases, Transformer Housings, Junction Boxes and Accessories
FAA AC 150/5345-43	(2006; Rev F) Specification for Obstruction Lighting Equipment
FAA AC 150/5345-44	(2007; Rev H) Specification for Runway and Taxiway Signs
FAA AC 150/5345-46	(2009; Rev D) Specification for Runway and Taxiway Light Fixtures
FAA AC 150/5345-47	(2005; Rev B) Specification for Series to Series Isolation Transformers for Airport Lighting Systems
FAA AC 150/5345-5	(2006; Rev B) Specification for Airport Lighting Circuit Selector Switch
FAA AC 150/5345-51	(2005; Rev A) Specification for Discharge-Type Flashing Light Equipment
FAA AC 150/5345-7	(2013; Rev F) Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
FAA AC 150/5370-10	(2014; Rev G) Standards for Specifying Construction of Airports
FAA AC 70/7460-1	(2007; Rev K) Obstruction Marking and Lighting
FAA E-1315	(1967; Rev A; Am 1971) Light Base and Transformer Housing
FAA E-2628	(1979; Rev B) Sequenced Flashing Lighting System, Elevated and Semiflush with Dimming and Monitoring
FAA E-2690	(2000; Rev A) Isolation Transformer (1500 watt) for High Intensity Approach Lighting Systems
FAA E-2702	(2007; Rev A)Low Impact Resistant (LIR)

	Structures
FAA E-2756	(2004; Rev B) Four Box Precision Approach Path Indicator (PAPI) without Remote Monitoring Subsystem (RMS)
FAA E-2980	(2005) Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR)
FAA E-982	(2003; Rev J) PAR-56 Lampholder

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS SS-S-200	(Rev E; Am 1; Notice 1) Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

U.S. NAVAL SEA SYSTEMS COMMAND (NAVSEA)

QPL-26202	(2011) Light, Marker, Airport, Semiflush, General Specification for

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jul 2012) Standard for Flexible Metal Conduit
UL 1242	(2006; Reprint Mar 2014) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 360	(2013; Reprint Jan 2015) Liquid-Tight Flexible Steel Conduit
UL 44	(2014; Reprint Feb 2015) Thermoset-Insulated Wires and Cables
UL 467	(2007) Grounding and Bonding Equipment
UL 50	(2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations
UL 510	(2005; Reprint Jul 2013) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2013) Metallic Outlet Boxes
UL 6	(2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel
UL 6A	(2008; Reprint Nov 2014) Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel
UL 773	(1995; Reprint Mar 2002) Standard for

	Plug-In, Locking Type Photocontrols for Use with Area Lighting
UL 773A	(2006; Reprint Nov 2013) Standard for Nonindustrial Photoelectric Switches for Lighting Control
UL 797	(2007; Reprint Dec 2012) Electrical Metallic Tubing -- Steel
UL 83	(2014) Thermoplastic-Insulated Wires and Cables
UL 854	(2004; Reprint Nov 2014) Standard for Service-Entrance Cables

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, applies to this section with additions and modifications specified herein.

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.

An "S" following a submittal item indicates that the submittal is required for the Sustainability Notebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

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

item for Army projects.
****

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Landing signal officer (LSO) control panel

Approach lighting frangible tower

Each type of airfield lighting fixture installation

Wind cone indicator assembly connection

Wave-Off system

SD-03 Product Data

Control cable

Series airfield lighting cable

Obstruction marker lights

Rotating light beacon

Heliport light beacon

High/Medium intensity obstruction lights

Wind cone

Isolating transformers

Constant current regulators

Each type of runway and taxiway lighting fixture

Each type of light bases

Frangible couplings

FAA Type P-606 sealant

FAA Type L-823 connectors

Circuit selector cabinets

Pilot relay panel

Control transfer panel

Control panel

Sequenced flashing light system components

Wave-Off system components complete

SD-06 Test Reports

Counterpoise system test

SD-07 Certificates

Installer Qualifications; G[, [_____]]

Construction Outage Plan; G[, [_____]]

SD-10 Operation and Maintenance Data

Constant current regulators, Data Package 5

Rotating light beacon assembly, Data Package 3

Sequenced flashing light system, Data Package 5

Wave-Off system, Data Package 5

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Do not install materials which are not approved as "Approved Airport Equipment" by FAA unless specifically approved by the electrical design engineer. Inspect wire and cable for date of manufacture. Do not use wire and cable manufactured more than one year before delivery to job site.

1.4.2 Regulatory Requirements

Provide materials and equipment listed by FAA, UL, ETL or approved by Factory Mutual Engineering and Research (FM), when such equipment is listed or approved. Do not use askarel, tetrachlorethylene and insulating liquids containing polychlorinated biphenyls (PCBs) in equipment. Provide submersible type equipment installed below grade in vaults, manholes, and handholes. Materials must be certified and listed as "Approved Airport Lighting Equipment" downloadable from: http://www.faa.gov/arp/pdf/534553ad.pdf.

1.4.3 Installer Qualifications

The aviation lighting equipment contractor and installation electricians must be experienced in installing, testing and maintaining aviation lighting systems of a similar complexity. The contractor must provide a list of government projects and 3 years of experience in constructing similar projects. Include written certification that systems have performed satisfactorily for not less than 18 months.

1.4.4 Construction Outage Plan

The contractor must provide a construction outage plan and schedule for installing new and retrofitting the existing lighting system to ensure that aviation lighting circuits are fully operational between dusk and dawn during each day of the construction contract. The plan must be submitted to and approved by the Contracting Officer and the Airfield Manager prior to starting construction.

1.5 EXTRA MATERIALS

1.5.1 Oil Fuses

Provide one spare fuseholder and three spare fuses for each ampere size.

1.5.2 Sequenced Flashing Light System

Provide a spare part trunk with parts.

1.6 EQUIPMENT

1.6.1 Equipment for Silicone Sealant

Equipment for silicone sealant shall be air-powered pump, components, and hoses as recommended by the sealant manufacturer. Hoses and seals shall be lined to prevent moisture penetration and withstand pumping pressures. Equipment shall be free of contamination from previously used other type sealant.

[1.7 EXISTING AIRFIELD LIGHTING SYSTEMS

****

NOTE: When modifications, additions, or any other work is to be performed on an existing airfield lighting system, the designer shall add a carefully worded paragraph to cover maintenance of airfield lighting circuits and operations. Local conditions and the specifics of the Contract will affect this paragraph. An example of this paragraph follows:

"Existing airfield lighting systems shall remain in operating condition and interruptions shall be held to a minimum. Where interruptions are necessary, they shall be scheduled as approved in writing by the Contracting Officer. Prior to the scheduled time for each interruption, all necessary materials and a sufficient labor force shall be assembled to permit completing the work within the scheduled time interval. Under no circumstances shall any of the existing airfield lighting circuits be left inoperative without making provisions for suitable temporary connections in the affected area or areas. All airfield lighting circuits covered under this Contract shall be replaced in such a manner that they will be operational at dusk each day. The Contractor shall submit to the Contracting Officer a plan for outages and maintaining lighting and lighting control."

****

[_____.]

]PART 2 PRODUCTS

2.1 ELECTRICAL TAPE

UL 510, plastic insulating tape.

2.2 NAMEPLATES

Provide laminated plastic nameplates for equipment, controls, and devices to identify function, and where applicable, position. Provide 3.17 mm 1/8 inch thick laminated Melamine plastic conforming to ASTM D709, Grade ES-2, white with black center core. Surface shall be a matte finish with square corners. Align and engrave lettering accurately into the black core. Size of nameplates shall be 25 mm by 65 mm one by 2 1/2 inches minimum with minimum 6.35 mm 1/4 inch high normal block lettering. Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet metal screws or two rivets.

2.3 CONDUIT, CONDUIT FITTINGS, AND BOXES

2.3.1 Rigid Steel or Intermediate Metal Conduit (IMC) and Fittings

UL 6, UL 6A and UL 1242, respectively[, coated with a polyvinylchloride (PVC) sheath bonded to the galvanized exterior surface, nominal one millimeter 40 mils thick, conforming to NEMA RN 1].

2.3.2 Flexible Metal Conduit

UL 1, zinc-coated steel. Use UL 360 liquid-tight flexible metal conduit in wet locations.

2.3.3 Outlet Boxes for Use with Steel Conduit, Rigid or Flexible

UL 514A, cast metal with gasketed closures.

2.3.4 Plastic Duct for Concrete Encased Burial

[PVC conforming to NEMA TC 6 & 8, Type EB.][Provide as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.]

2.3.5 Plastic Conduit for Direct Burial

[PVC conforming to NEMA TC 2 (conduit) and NEMA TC 3 (fittings), Type [EPC-40 PVC][EPC-80 PVC].][Provide as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

]2.3.6 Frangible Couplings and Adapters

MS 17814. Provide upper section of frangible coupling with one of the following:

a. Unthreaded for slip-fitter connections.

b. 60 mm 2 13/32 inch: 16N-1A modified thread for nut and compression ring to secure 53 mm 2 inch EMT.

c. 53 mm 2 inch: 11 1/2-N.P.T. (tapered) with 5.5 mm 7/32-inch nominal wall thickness to accept rigid conduit coupling.

[2.3.6.1 Frangible Couplings for Specialized Applications

Acceptable as approved.

]2.3.6.2 Electrical Metallic Tubing

UL 797. Provide where indicated for use with frangible couplings and adapters.

2.4 WIRE AND CABLE

Do not provide or install wire and cable manufactured more than one year before delivery to the job site. Conductors shall be copper.

2.4.1 Conductor Sizes

Conform to American Wire Gage (AWG).

2.4.2 Low Voltage Wire and Cable

****
NOTE: Type THW insulation can only be obtained in large quantity. Use of this type insulation is not recommended for small project.
****

[UL 854, Type USE, 600 volts for underground low voltage power cables.] [[UL 83, Type [_____][THW][THWN]][UL 44, Type [XHHW][_____]] for secondary series lighting circuits. Provide wire with "W" in the type designation in wet or damp locations.][As specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

]2.4.3 Power Cables for Use in Airfield Lighting

[Rated [5][_____] kV, [133 percent][_____] insulation level, with shield and jacket conforming to [NEMA WC 7 for crosslinked polyethylene][or][NEMA WC 8 for ethylene-propylene rubber] insulated cables.][Provide as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

]2.4.4 Wire and Cable for Airfield Lighting Systems

****
NOTE: FAA AC 150/5345-7 covers Type A (rubber), Type B (ethylene-propylene), and Type C (crosslinked polyethylene) cable. Each type has 600-volt and 5000-volt ratings with single and multiple conductors. Types A and B have overall jackets while Type C only has the overall jacket for the multiple conductor cables. Type C is recommended. If soil conditions require a jacketed cable for protection of insulation, specify Type B.
****

2.4.4.1 Airfield Lighting Cable

FAA AC 150/5345-7, Type L-824, for [crosslinked polyethylene Type C] [_____][600][5000]-volt cable. Series airfield lighting cable shall be unshielded. [Airfield lighting cable in multiple power airfield circuits shall be [shielded][unshielded].]

2.4.4.2 Cable for Pavement Slot Installation

UL 83, Type THWN.

2.4.4.3 Counterpoise Wire

ASTM B3, ASTM B8. No. [4][_____] AWG bare stranded copper, annealed or soft drawn.

2.4.4.4 Control Cable

[Multiconductor type for 120 V ac control, rated 600 volts, No. 12 AWG, and conforming to the following unless indicated or specified otherwise. Insulate each conductor with a thickness of not less than 0.762 mm 30 mils and rate for continuous operation at 90 degrees C. Conductors shall be color coded. An overall jacket of [heavy-duty neoprene][_____] rated for direct burial shall be included. Cable shall conform to NEMA WC 3for rubber insulation, NEMA WC 7 for cross-linked polyethylene insulation, or NEMA WC 8 for ethylene-propylene rubber insulation.][Multiconductor type for 48 V dc control, rated 300 volts, No. 19 AWG, conforming to RUS Bull 1751F-205.]

2.4.4.5 Fused Cable Connectors

Provide connector consisting of a line side receptacle and a load side plug, each in a molded rubber form and including crimp-on fittings for the cable ends to accommodate a 250-volt cartridge-type fuse. Provide fuse with rating indicated. Provide connectors in kit form properly sized for the specific cable diameter involved. Completed connection shall be watertight.

2.4.4.6 Cable for Sequence Flashing Trigger Circuits

RUS Bull 1751F-205.

2.4.5 Cable Tags

Provide cable tags for each cable or wire at duct entrances entering or leaving of manholes, handholes, and at each terminal within the lighting vault. Provide stainless steel, bronze, lead strap, or copper strip tags approximately 1.55 mm 1/16 inch thick or hard plastic 3.17 mm 1/8 inch thick suitable for immersion in salt water and impervious to petroleum products. Provide sufficient length for imprinting the legend on one line using raised letters not less than 6.35 mm 1/4 inch in size. Permanently mark or stamp with the identification as directed. Two-color laminated plastic is acceptable. Provide dark colored plastic tags with markings of light color to provide contrast so that identification can be easily read. Provide fastening material of a type that will not deteriorate when exposed to water with a high saline content and petroleum products.

2.4.6 Concrete Markers for Direct Buried Cable Systems

Provide as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.5 GROUND RODS

UL 467. Copper-clad steel with diameter adequate to permit driving to full length of the rod, but not less than 19 mm 3/4 inch in diameter and 3050 mm 10 feet long, unless indicated otherwise.

2.6 ROTATING LIGHT BEACON

[MIL-L-7158 with double peak white beam][or][Type L-802 [A] [S] of FAA AC 150/5345-12]. Provide duplex type beacon with alternating green and white beams. White beam shall have a double peak required by MIL-L-7158. [Beacon shall have a low temperature heater package for use in temperatures below minus 30 degrees C.]

2.6.1 Power Supply

Provide weatherproof circuit-breaker panelboard having four single-pole 120-volt circuits, a ground bus and a solid neutral bus to provide separately protected circuits for the beacon lamps, motor, [heater circuit] and obstruction lights. Provide cabinet with a NEMA Type [3R][_____] enclosure of zinc-coated steel.

2.7 HELIPORT LIGHT BEACON

FAA AC 150/5345-12, Type L-801H, with flashing lights coded white-green-yellow.

2.8 OBSTRUCTION MARKER LIGHTS

FAA AC 150/5345-43, Type L-810, or MIL-DTL-7830. Obstruction marker lights shall emit a steady burning aviation red light. [Provide light assembly supplied by [120][240]-volt multiple circuit.][Provide light assembly supplied by a series circuit power adapter as recommended by the obstruction light manufacturer.] Provide [single-][or][double-] unit type obstruction marker lights [as indicated]. Provide control for obstruction marker lights as indicated.

2.9 HIGH/MEDIUM INTENSITY OBSTRUCTION LIGHTS

****
NOTE: Use high intensity or medium intensity obstruction lighting as authorized.
****

FAA AC 150/5345-43.

2.9.1 High Intensity Lighting

White, flashing light for daytime marking of obstructions in accordance with FAA AC 70/7460-1, and fixtures in accordance with FAA AC 150/5345-43, Type L-856.

2.9.2 Medium Intensity Lighting

White or red, flashing light for twilight/night marking of obstructions in accordance with FAA AC 70/7460-1 and fixtures in accordance with FAA AC 150/5345-43, Type L-866. Photoelectric light control shall meet FAA requirements.

2.9.3 Solid State Flasher

Provide zero voltage switching, at zero point of sine wave, to regulate the on-off cycle of red hazard beacons. Flasher shall supply [one][two][three] circuits[as indicated].

2.10 EXTERNALLY LIGHTED WIND CONE

FAA AC 150/5345-27, Type L-807, with a frangible support assembly, lighted with four lamps, and [an orange][a white] 3660 mm 12 foot fabric cone. Provide wiring and controls. Supplemental wind cones, where used, shall be Type L-806.

2.11 RUNWAY DISTANCE AND ARRESTING GEAR MARKERS

Runway distance markers shall conform to FAA AC 150/5345-44, Type L-858B, Size 4, Style 3 with white or yellow numerals on a black background. Provide markers to withstand a static wind load of 1.93 kPa 0.28 pound per square inch, and suitable for connection to the secondary of the isolation transformers specified. Provide internally illuminated markers with illumination of the face not significantly decreasing when the series lighting circuit is operated at the lowest brightness step. Construct marker housing of fiber reinforced epoxy, with information face of high-impact acrylic or ultraviolet stabilized polycarbonate.

2.11.1 Power Supply and Lamps

Style 3, [Class 1][Class 2][as indicated][as recommended by the sign manufacturer].

2.11.2 Arresting Gear Markers

Markers shall have a 990 mm 3.25 foot translucent yellow circle in place of numerals as specified above.

2.12 TRANSFORMERS

****

NOTE: Occasionally, power transformers will be needed to support airfield systems. Edit this paragraph as necessary to suit the specific airfield installation.

****

2.12.1 Encapsulated Isolating Transformers

FAA AC 150/5345-47, Type (G) L-830 or MIL-T-27535. Provide each transformer with rating as indicated. Insulation Level Primary voltage rating 5000 volts RMS, Secondary 600 V RMS. Operating Temperature range minus 55 degrees Celsius to plus 65 degrees Celsius. Resistant to UV exposure and ozone. Suitable for areas contaminated with oils, aircraft fuels, soil acids, alkalis, and deicing fluids. Compatible with FAA Style

2 and Style 9 connectors.

2.12.1.1 Transformers for Frangible Towers

FAA E-2690. Encapsulated, submersible type with lifting handles and rating of 1500 watts, 2400 volts, 20 amp primary, [6.6][20] amp secondary, [as indicated,] single phase, 60 Hz. Primary and secondary leads shall conform to FAA AC 150/5345-7, Type L-824.

[2.12.2 Power Transformers

****
NOTE: Insert appropriate Section number and title in the blank below using format per UFC 1-300-02.
****

As specified in [_____].

]2.13 LIGHT BASES

****
NOTE: Use Type L-867 bases for applications not subject to aircraft or vehicle loading. Use Type L-868 bases for applications subjected to aircraft or vehicle loading. Use Type L-869 as a junction box in all pavements.
****

FAA AC 150/5345-42 Type [L-867][L-868][L-869][or][FAA E-1315Type [LB-1A][_____]]. Provide steel bases, Class 1, [Size [A][B][C][D] as indicated] [or] as required to accommodate the fixture or device installed thereon if diameter is not shown.

2.13.1 Accessories

Provide base plates, cover plates, and adapter plates to accommodate various sizes of fixtures. Bolts shall be stainless steel.

2.14 SEALING FIXTURES AND WIRES IN DRILLED HOLES OR SAW KERFS

FAA AC 150/5370-10, Type P-606.

2.14.1 Sealant Type

FAA Type P-606 sealant for use in asphaltic concrete (AC) or Portland cement concrete (PCC) pavement compatible with AC pavement and having a minimum elongation of 50 percent. Formulations of Type P-606 which are compatible with PCC pavement only are prohibited.

2.14.2 Single Component Cold-Applied Silicone

Silicone sealant shall be self-leveling, non-acid curing, and meet the following requirements.

TEST	TEST METHOD	REQUIREMENTS
Weight Loss	ASTM C792 Modified (See Note 1)	10 percent max.
Flow	ASTM C639 (Type I)	Smooth and level
Extrusion Rate	ASTM C603	30 sec. max.
Tack Free Time	ASTM C679	5 hours max.
Hardness (Shore 00) (See Note 2)	ASTM C661	30 - 80
Tensile Stress at 150 Percent Elongation (See Note 2)	ASTM D412 (Die C)	207 kPa 30 psi max.
Percent Elongation (See Note 2)	ASTM D412 (Die C)	700 min.
Accelerated Weathering	ASTM C793	Pass 5000 hours
Bond and Movement Capability	ASTM C719	Pass 10 cycles at plus 50 percent movement (no adhesion or cohesion failure)
Flame Resistant	FS SS-S-200	Pass
NOTES: 1. Percent weight loss of wet (uncured) sample after placing in forced-draft oven maintained at 70 degrees C at plus 2 degrees C 158 degrees F plus 1 degree F for two hours.		
2. Specimen cured 21 days at 23 degrees plus 2 degrees C 73 degrees F plus 1 degree F and 50 percent.		
ACCELERATED WEATHERING FACTORY TEST REPORT. For Accelerated Weathering test, in lieu of testing of actual joint sealant to be used on the project, a report of a factory test, performed within two years of contract award, may be submitted.		

2.15 CONSTANT CURRENT REGULATORS

FAA AC 150/5345-10, Type L-828, without monitor system and with ratings as indicated.

2.15.1 Regulator

Regulators shall operate on [60][_____] Hz, have internal primary switch [included][excluded], have input voltage of [240][480][2400][_____] and be

controlled by 120-volt external control voltage. Provide [three][five] brightness steps[as indicated]. [Provide monitors as indicated.]

2.15.2 Basic Impulse Level (BIL)

Provide 60-kV series circuit BIL except that 4-kW, 7.5-kW and 10-kW regulator series circuits may have a BIL of 25 kV.

2.16 LAMPS AND FILTERS

Provide lamps of size and type indicated, or required by fixture manufacturer for each lighting fixture required under this contract. Provide filters as indicated and conforming to the specification for the light concerned or to the standard referenced.

2.17 SUMP PUMPS FOR MANHOLES AND VAULTS

Provide submersible type with a capacity of not less than [_____] L/s gal/min at a total dynamic head of [3050][_____] mm [10][_____] feet. Motor shall include automatic thermal overload protection. Provide an internal magnetic float switch, stainless steel shaft, bronze impeller, and cast iron motor housing and volute. Provide a continuous waterproof cable with watertight plug of sufficient length to include slack and allow connection to receptacle shown.

2.18 OIL FUSE CUTOUTS

****

NOTE: Fuses shall normally be rated at 150 percent of the full load current rating of the transformer or the device protected.

****

ANSI C37.44. [Provide subway type oil fuse cutouts.] Rate cutouts [_____] volts, [_____] amperes, [_____] kV BIL. Provide hermetically sealed cutouts with expansion chambers for full rating. Provide with[gang operating mechanism,] mounting channel, oil, compound, and fuse links rated [_____] amperes. Mount cutout on galvanized steel junction boxes with bolted-on covers, unless indicated otherwise.

2.19 TRANSFORMERS, SUBSTATIONS AND SWITCHGEAR

Provide as specified in Section 26 11 16 SECONDARY UNIT SUBSTATIONS and Section 26 12 19.10 THREE-PHASE PAD-MOUNTED TRANSFORMERS.

2.20 EMERGENCY GENERATOR AND AUTOMATIC TRANSFER SWITCH SYSTEM

****

NOTE: Section 26 32 13.00 20 SINGLE OPERATION GENERATOR SETS shall be edited and modified as necessary to suit the specific airfield installation. Airfield requirements include the following. Emergency generator sets shall be rated 0.8 power factor lagging, either 4160/2400 or 480/277 volts, 3-phase, 4-wire, grounded wye, 60 Hz. Governor shall provide speed regulation of 5 percent from no load to full load. Provide manual voltage control, electromagnetic interference suppression, batteries, battery charger, and repair parts.

Parallel operation and remote control speed adjustments are not required. Automatic transfer switch shall be specified for ratings needed for the airfield lighting installation. The generator and automatic transfer switch system shall accomplish a complete transfer to the emergency power supply within 15 seconds of interruption of the normal power supply for Category I airfields. Time delay to override momentary normal source outages to delay all transfer switch and engine starting signals shall be set at one second.

****

****

NOTE: Insert appropriate Section number and title in the blank below using format per UFC 1-300-02.

****

Provide as specified in [_____].[26 32 13.00 20 SINGLE OPERATION GENERATOR SETS]

2.21 CIRCUIT SELECTOR CABINETS

****

NOTE: Circuit selector cabinets were previously referred to as distribution boxes and may be provided to select one or a second circuit or to select any combination of up to four circuits.

****

FAA AC 150/5345-5, Type L-847, for (K) [one][two][three][four] circuit control[as indicated], Class [A, indoor][B, outdoor], Rating [1, for 6.6 amp][2, for 20 amp].

2.22 PILOT RELAY PANEL

****

NOTE: Type I relay panel has 24 double-pole, single-throw relays and is used for systems including the approach lighting system. Specify a Type II relay panel if 16 double-pole, single-throw relays and 8 double-pole, double-throw relays are required for a system. Specify L-841 panel only if 48 V dc control is required.

****

[MIL-P-8944 for 120-volt control (L) systems, [Type I, 24-circuit DPST] [Type II, 16-circuit DPST and 8-circuit DPDT].][FAA AC 150/5345-13, Type L-841, for 48-V dc control systems.

]2.23 CONTROL TRANSFER PANEL

Transfer panel, 120-volt, 60 Hz, with eight-pole, double-throw, continuous-duty, industrial control type relay, in NEMA Type 1 enclosure. Relay contacts shall have a rating of not less than 10 amp for continuous noninductive loads.

2.24 CONTROL PANEL

****

NOTE: Specify class for airfield lighting systems indicated for MIL-P-8944 as follows: Class I covers basic airfield lighting systems including beacons, obstruction lighting, wind direction indicators, approach, runway, and taxiway lights; Class II includes Class I plus runway centerline, touchdown zone, and taxiway centerline lighting; and Class III includes Class II plus optical landing system and approach flash monitor lights. Refer to FAA AC 150/5345-3 for type, class, and style.

****

[MIL-P-8944, Class [_____]] [or] [FAA AC 150/5345-3, Type L-821, Type [_____], Class [_____], Style [_____]]. Quantity and color of lenses shall conform to [MIL-P-8944] [or] [FAA AC 150/5345-3] and shall correspond to the actual circuits indicated.

2.25 LIGHTNING ARRESTERS

IEEE C62.11 and IEEE C62.41.1 and IEEE C62.41.2 as applicable with ratings as indicated.

2.26 WHEELS-UP SYSTEM

[Include wheels-up lights, handholes, equipment vault, control panel, and the associated equipment and interconnecting wiring to provide a complete system as indicated and as specified herein.

]2.26.1 Wheels-Up Light Fixtures

FAA E-982 or MIL-L-26764 Type MB-2 for 120-volt, 500-watt lamp (Q500-PAR56/MFL). Fixtures shall include a positioning arrangement to adjust light with a locked position after installation. Provide lamps as indicated. Provide a clear filter to protect lamp from direct contact with rain.

2.26.2 Light Dimmer

As indicated and as specified below. Provide a single NEMA Type 6 housing for assembly, submersible to a 915 mm 3 foot head. Enclosure shall have limiting dimensions of 760 by 760 by 1220 mm 2 1/2 by 2 1/2 by 4 feet in height. Provide enclosure finish in accordance with the manufacturer's standard practice for the intended service. Provide dimmer designed for continuous full-load operation in an ambient temperature of 40 degrees C. Dimmer shall control rated circuit load from full bright to blackout, 12 volts or less, on any load from 3 to 100 percent of rated circuit load. Provide output voltage not less than 120 volts at maximum controller setting and at maximum rated circuit load. For an input variation of plus or minus 10 percent, output voltage shall vary within plus or minus 5 percent. Provide dimmer capable of handling suddenly applied cold tungsten lamp loads of full circuit load rating at maximum dimmer output setting without failure or without degradation of components. When equipped with branch circuit protection, dimmer shall handle a short circuit on load terminals without failure or degradation of components. Dimmer shall employ the principle of a variable transformer with output voltage continuously adjustable from zero to maximum proportionately over the full

range. Provide motor driven unit with built-in limit switches, controlled from a lever action, spring return to "off" switch. Solid-state controls or equipment are prohibited.

2.26.3 Wheels Watch Control Panel

Construct as indicated and conform to UL 50. Provide cabinet and hinged cover of No. 14 gage sheet steel, zinc coated by the hot-dip process, and NEMA Type 4 suitable for outdoor use. Provide cabinet and cover treated, primed, and finish painted with color as directed and suitable for the intended service. Provide weatherproof receptacle on cabinet with threaded cap and chain as indicated. Controls on the face of the panel shall have clearly identified engraved nameplates. Provide panel with components necessary for complete operation of the lighting system as indicated.

2.27 WAVE-OFF SYSTEM

Include wave-off strobe lights (flashhead), equipment pad, control panel, transformers, safety switches, panelboard and the associated equipment and interconnecting wiring to provide a complete system as indicated and as specified herein.

2.27.1 Wave-off Strobe Lights

Provide capacitance-discharge, flashing lights (strobe) for wave-off lighting system. Each light includes a flash head (FH) optical assembly unit, a power converter unit (PCU), and the interconnecting cable.

a. MIL-L-29575

b. Acceptable Source:

(1) Flash Technology of America, 55-T Lake Street, Nashua, N.H., 03060, phone 603/883-6500

Flash Technology Beacon (FTB) 622

(2) Another Wave-Off Strobe Light System by another reputable manufacturer will be acceptable, subject to approval by the Contracting Officer.

2.27.2 Wave-Off Control Cabinet

Provide cabinet with components necessary for complete operation of the lighting system as indicated.

a. Enclosure

(1) UL 50

(2) 14 gage, sheet steel, NEMA [3R][_____], enclosure per NEMA ICS 6, with hinged cover

(3) Hot-dip, zinc coated

(4) Solvent clean per SSPC SP 1. If the galvanized metal has been "passivated" or "stabilized", the coating shall be completely removed by brush-off abrasive blast or other treatment, or the surface shall be primed with a primer which is specifically

recommended by the paint manufacturer for use on passivated or stabilized galvanized steel.

(5) Immediately after cleaning, coat surfaces with a pretreatment coating or a crystalline phosphate coating.

(6) As soon as practicable after the pretreatment coating has dried, prime treated surfaces with a coat of zinc-chromate primer and one coat of synthetic exterior gloss green enamel paint. The color shall be[Munsell 7GY3.29/1.5 green per ASTM D1535][_____].

b. Nameplates

Provide nameplates for controls as specified in Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS.

c. Terminal Board

NEMA ICS 4

d. Relays

(1) Provide as indicated.

(2) Coil: [120][277][_____] Volt, 60 Hz.

(3) Contacts: [10][_____] Amperes

e. Receptacle

(1) UL listed for use in wet locations

(2) Weatherproof on cabinet with threaded cap and chain as indicated.

2.27.3 Pad-mounted Transformer, [15][_____] kVA, [1][3]-Phase, Low Profile

[As specified in Section 26 12 21 SINGLE-PHASE PAD-MOUNTED TRANSFORMERS.]

[As specified in Section 26 12 19.10 THREE-PHASE PAD-MOUNTED TRANSFORMERS.]

2.27.4 Safety Switches, Panelboard, and Transformer

a. Provide as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

b. Provide enclosure as specified for Wave-Off Control Panel.

2.27.5 Photo-Electric Switch

a. UL 773 or UL 773A

b. Hermetically sealed cadmium-sulfide cell

c. Single-throw contacts

d. On below 3 footcandles, off 3 - 10 footcandles

e. Time delay to prevent switching from transient light sources

f. Directional lens to prevent turnoff condition from fixed lights.

2.27.6 Equipment Pad

Provide as shown on construction drawings.

2.28 APPROACH LIGHTING SYSTEM

Provide approach, centerline, crossbar, threshold bar, side row barrette, centerline barrette, bar lights, sequenced flashing lights, frangible towers, and associated equipment and interconnecting wiring to provide a complete system as shown on construction drawings.

a. centerline lights: FAA AC 150/5345-46 Type L-850

b. centerline barrettes: FAA E-982

c. sequence flashing: FAA E-982 or FAA AC 150/5345-51 Type L-849, Style E

d. 1000 ft crossbar: FAA E-982

e. terminating bar lights: FAA E-982

f. pre-threshold wingbar: FAA E-982

g. approach threshold center bar: FAA AC 150/5345-46 Type L-850, Style D or E

h. outer threshold bar: FAA E-982

i. economy approach REIL: FAA AC 150/5340-30

****

NOTE: Design the Approach Lighting System to include an uninterrupted power supply to transfer lighting load within one second of a power outage. FAA criteria.

****

2.28.1 Lighting Fixtures Except Flashing Units

MIL-L-26764, Type MB-2, or FAA E-982 unidirectional, for elevated mounting at cross bar, centerline bars, threshold and side row barrettes; FAA AC 150/5345-46, Type L-850, Class E or Class D bidirectional or unidirectional, for semiflush mounting; and MIL-L-26990, Type MB-1, for elevated mounting bidirectional lights. Provide class of light and lamp, filter, and transformer as indicated. Include lamps. Mounting shall conform to the details indicated. Mount bases level and recess as required by thickness of fixture to provide installation in accordance with manufacturer's instructions.

2.28.2 Sequenced Flashing Light System

FAA E-2628. [Provide as a complete and integrated part of the approach system including individual power supply units, elevated flashing units, master timer, remote control and monitor units, interconnecting wiring, and support structures. Master timer cabinet shall provide timed flashing signals to 21-lamp power supplies. System shall monitor individual lamp flashes and report via normally open contacts a condition of two, three, or more malfunctioning lamps or power supplies. The master timer cabinet can be a solid-state type. Major components of this system shall be the

product of a single manufacturer. Install junction boxes as indicated on concrete foundations and on the platform of elevated structures. Junction boxes shall have conduit tappings in the bottom and top as required to accommodate the incoming and outgoing power and control circuits for the flashing lights. Provide terminal strips in each junction box as indicated for termination and connection of the power and control circuits. Provide signal and monitor cables as recommended by the system manufacturer.]

2.28.2.1 Pad-Mounted Transformer

****
NOTE: Insert appropriate Section number and title in the blank below using format per UFC 1-300-02.
****

Provide as indicated on the drawings and as specified in [_____] [Section 26 12 19.10 THREE-PHASE PAD-MOUNTED TRANSFORMERS].

2.28.2.2 Surge Protection

Provide surge protection in the form of metal oxide varistors (MOV) for power and signal circuits with ratings as recommended by the system manufacturer.

2.28.3 Low-Impact-Resistant Towers

Provide fiberglass reinforced low-impact resistant (LIR) towers conforming to FAA E-2702. Provide anchor bolts, lowering devices and fixture mounting accessories as required by tower manufacturer.

2.28.4 Semi-Frangible Supports

For lights supported more than 12 meters 40 feet above the ground, provide a two-element structure; the lower element being a rigid structure and the upper element being a 6 meter 20 foot LIR structure in accordance with FAA E-2702.

2.29 RUNWAY AND TAXIWAY LIGHTING SYSTEMS

****
NOTE: Use FAA fixtures where appropriate. Fixtures in a unique airfield lighting system shall be of a similar type. Do not mix military and FAA fixture types in unique systems.
****

[Include runway edge lights, runway threshold lights, runway end identification lights, circling guidance lights, runway centerline lights, taxiway guidance signs at intersecting taxiway, intersecting runways and adjacent to arresting gears, runway touchdown zone lights, runway distance and arresting gear markers, taxiway edge lights, taxiway centerline lights, taxiway guidance signs, mounting structures, controls, and the associated equipment and interconnecting wiring to provide complete systems as indicated and specified herein. Provide inpavement light fixtures able to withstand a minimum static single wheel load of 22700 kg 50,000 pounds.

]2.29.1 Runway Edge Lights

[FAA AC 150/5345-46, Type L-862][MIL-DTL-5904, Type C-1], for elevated

mounting; and FAA AC 150/5345-46, Type L-850 Class C, for semiflush mounting at intersecting taxiways, at intersecting runways and adjacent to arresting gear. Provide filters as indicated conforming to requirements of fixture specifications.

2.29.2 Runway Threshold Lights

Elevated FAA E-982 for mounting outboard of edge lights; and MIL-L-26990, Type MB-1, for mounting inboard of edge lights.

2.29.3 Circling Guidance Lights

Fixtures shall have 503-watt, 20A/T20/3 lamps. Lens shall be glass aviation white, heat resistant.

2.29.4 Runway End Identification Lights

FAA AC 150/5345-51, Type L-849. Provide fixtures, power and control equipment [Style E unidirectional][and][Style F omnidirectional] fixtures. [Provide fixtures as indicated.]

2.29.5 Runway Centerline Lights

****

NOTE: Type L-852N is a restrictive fixture that has been granted proprietary approval by a Level I Contracting Officer.

****

FAA AC 150/5345-46, Type L-852, Class N (Navy), bidirectional, narrow beam, Type [V][VI][VII][VIII], [with shorting device for failed lamp,] modified to resist damage from aircraft tailhooks. Modify fixture as follows to resist damage from aircraft tailhooks. Stainless steel for top assembly shall conform to SAE AMS5351 with Rockwell hardness of C40 plus or minus 5. Provide casting thickened from 9.52 to 12.7 mm 3/8 to 1/2 inch, and optical plate thickened as required to maintain flushness. Height of fixture shall be 12.7 mm 1/2 inch above pavement in lieu of 9.52 mm 3/8 inch. Light channel width shall be 25 mm one inch at the lens, with a divergence of 0.24 rad 14 degrees on each side. Secure optical assembly with 410 or 416 stainless steel bolts.

[2.29.5.1 Standard Duty Centerline Lights

FAA AC 150/5345-46, Type L-850A, [Class 1 for insetting directly into pavement][Class 2 for installation on mounting bases]. Provide filters as indicated and conforming to requirements of fixture specifications.

]2.29.6 Runway Touchdown Zone Lights

[FAA AC 150/5345-46, Type L-850B] [or] [QPL-26202, Class BB25, with top casting having extra rib for protection against damage from aircraft tailhooks.

]2.29.7 Taxiway Edge Lights

[FAA AC 150/5345-46, Type L-861T for elevated taxiway edge lights with 45-watt, 6.6A lamp and blue lens or yellow lens as indicated][and][FAA AC 150/5345-46, Type L-852E, Class [1][2] for semiflush taxiway edge lights with a 115-watt, 6.6A lamp and blue filter.

]2.29.8 Taxiway Centerline Lights

FAA AC 150/5345-46, Type L-852.

2.29.8.1 Straight Centerline Sections

Provide Type L-852A with green/green filters. At hold bars, provide yellow filter facing the holding aircraft.

2.29.8.2 Curved Centerline Sections

Provide Type L-852B with green/green filters.

2.29.8.3 Taxiway Intersections

Provide Type L-852E with green filter.

2.29.8.4 Hook Resistant Lights

Provide fixtures as required for simulated carrier deck lighting system as specified except with 65-watt lamps and green filters.

2.29.9 Taxiway Hold Lights

FAA AC 150/5345-46, Type L-852A unidirectional with yellow filter toward the taxiway.

2.29.10 Taxiway Guidance Signs

FAA AC 150/5345-44. [Informational signs Type L-858Y][and][mandatory signs Type L-858R]. Provide size as indicated. Provide series circuit power supply adapters approved by the sign manufacturer.

2.30 SIMULATED CARRIER DECK LIGHTING SYSTEM

[Include deck edge lights, deck centerline lights, athwartship and ramp lights, isolating transformers, control panels, the associated equipment and interconnecting wiring to provide a complete system as indicated and specified herein.

]2.30.1 Light Fixtures

****
NOTE: Type L-852N is a restrictive fixture that has been granted proprietary approval by a Level I Contracting Officer.
****

FAA AC 150/5345-46, Type L-852, Class N (Navy), unidirectional, narrow beam, Type [V][VI][VII][VIII], [with shorting device for failed lamp,] modified to resist damage from aircraft tailhooks. Modify fixture as follows to resist damage from aircraft tailhooks. Stainless steel for top assembly shall conform to SAE AMS5351 with Rockwell hardness of C40 plus or minus 5 with casting thickened from 9.52 to 12.7 mm 3/8 to 1/2 inch, and optical plate thickened as required to maintain flushness. Provide fixture height of 12.7 mm 1/2 inch above pavement in lieu of 9.52 mm 3/8 inch. Provide light channel width 25 mm one inch at the lens, with a divergence of 0.24 rad</MET 14 degrees on each side. Secure the optical assembly with

410 or 416 stainless steel bolts.

2.30.2 Junction Boxes and Terminal Boxes in Manholes or Handholes

NEMA Type 6 submersible in accordance with NEMA ICS 6. Provide boxes with threaded hubs for conduit or watertight cable connectors.

2.30.3 Landing Signal Officer (LSO) Control Panel

Portable and suitable for use on paved area adjacent to the LSO handhole. Provide control panel, cabinet, and cover of 3 mm 1/8 inch aluminum alloy 5052-H32 conforming to ASTM B209M ASTM B209 and constructed as indicated. Rigidly construct entire assembly spraytight in accordance with MIL-STD-108. Provide a hinged cover with two or more positive closing latches to protect panel face when not in use, with cover arranged so that it can be opened to all positions. Identify controls on panel face clearly by engraved nameplates. Panel shall contain components and controls necessary for complete operation of lighting systems indicated. Provide receptacles as indicated and in accordance with the Military Standards indicated. Provide panel in close-fitting cabinet, removable from front.

2.31 CONNECTORS

FAA AC 150/5345-26, FAA Type L-823 connectors for use with FAA Type L-824 airfield lighting cable.

2.32 MEDIUM INTENSITY APPROACH LIGHTING SYSTEM

[Medium intensity approach lighting system with runway alignment indicator lights (MALSR) includes centerline light bars, a 305 meter 1000 foot light bar, sequenced flashing lights, control equipment and power supplies. Provide threshold lights as part of the runway lighting system.

]2.32.1 Semiflush Steady-Burning Lights

FAA AC 150/5345-46, Type L-850B. Clear fixture without toe-in. Provide 200-watt, 6.6A lamp.

2.32.1.1 Encapsulated Stepdown Transformer

Provide 200-watt, 240-volt/30.3-volt transformer approved by the fixture manufacturer. Connectors shall comply with Type L-823 as specified.

2.32.2 Elevated Fixtures

FAA E-2980. Provide 120-volt, 150-watt PAR-38 or 120-watt PAR-38 lamps meeting FAA photometric requirements of FAA E-2980.

2.32.3 Sequenced Flasher Units

FAA E-2980.

2.32.4 Accessory Equipment

FAA E-2980, power supplies, junction boxes, distribution panel, transformer, control cabinet and spare parts trunk.

2.32.5 Low Impact Resistant Towers

As specified.

2.33 HELIPAD LIGHTING SYSTEM

[Consists of perimeter lights, landing direction lights, approach direction lights, pad floodlights, and related facilities.

]2.33.1 Perimeter Lights and Landing Direction Lights

FAA AC 150/5345-46. [Provide Type L-861 elevated fixtures with yellow filters] [and] [Type L-852E semiflush fixtures with yellow filters.]

2.33.2 Approach Direction Lights

Provide elevated fixtures, Type L-861[, or semiflush fixtures, Type L-852E,] with clear lenses.

2.33.3 Floodlights

Provide outdoor heavy-duty type with baffles or hoods as applicable for uniform illumination and to reduce shadows.

2.34 PRECISION APPROACH PATH INDICATOR (PAPI)

[Consists of four light units mounted in the area of the ground point of intercept of the glide slope and aimed in the direction of the approach.

]2.34.1 Light Units

FAA AC 150/5345-28, Type L-880 or FAA E-2756. Connect light units to series current circuits via appropriate isolation transformers as recommended by the system manufacturer. Provide tilt switches and relays to de-energize all light units when one unit exceeds tilt requirements.

[2.35 PAINTING

As specified in Section 09 90 00 PAINTS AND COATINGS.

]PART 3 EXECUTION

3.1 ELECTRICAL REQUIREMENTS

Electrical installation shall conform to IEEE C2, NFPA 70, NFPA 70B and requirements specified herein. Underground electrical work shall be as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.1.1 Electrical Metallic Tubing

Do not install underground or encase in concrete.

3.2 CONCRETE

Unless otherwise specified, provide 20.67 MPa 3000 psi concrete for below grade and 27.56 MPa 4000 psi concrete for above grade use with 25 mm one inch maximum aggregate[conforming to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE].

3.3 AIRFIELD [MANHOLES][AND][HANDHOLES]

****

NOTE: For a project specification, the designer must edit Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION as necessary to suit the specific airfield installation. Note that airfield type manholes, vaults, handholes, and their associated frames and covers require a design for a maximum single wheel load of 22 675 kg 50,000 pounds 40 815 kg 90,000 pounds. Use steel conforming to ASTM A36/A36M, "Structural Steel," for covers to airfield manholes, vaults, and handholes. Use ductile iron for frames. Specify A-A-60005, "Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole," and ductile iron for frames, but not for covers.

****

Provide as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.4 EARTHWORK

Provide excavation, backfilling, and reconditioning of surfaces as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.5 GROUNDING

Ground non-current carrying metallic parts associated with electrical equipment as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.6 CABLE MARKERS

Provide cable markers or tags for each cable at duct entrances entering or leaving manholes or handholes and at each termination within the lighting vault. Tag cables in each manhole or handhole with not less than two tags per cable, one near each duct entrance hole. Immediately after cable installation, permanently attach tags to cables and wires so that they cannot be accidentally detached.

3.7 FRANGIBLE REQUIREMENTS

Install frangible supports, couplings, and adapters as indicated and specified. Install with the type conduit indicated.

3.7.1 Approach System Frangibility

At the 305 meter 1000 foot cross bar and beyond, mount approach lights up to 1830 mm 6 feet above concrete foundation on threaded frangible couplings and 53 mm 2 inch electrical metallic tubing (EMT). For mounting heights greater than 1830 mm 6 feet, install approach lights on low-impact resistant frangible towers.

3.8 ELEVATED AIRFIELD LIGHTS

Frangibly mount normally not exceeding 355 mm 14 inches in height unless higher mounting is permitted in snow accumulation areas. Frangibly mount equipment exceeding 355 mm 14 inches in height as indicated.

3.9 SEMIFLUSH AIRFIELD LIGHTS

Remove water, debris, and other foreign substances prior to installing semiflush light base and light.

3.10 WIRES, FIXTURES, AND ENCLOSURES IN SAW KERFS OR DRILLED HOLES

Sealant is specified in paragraph entitled "Sealing Fixtures and Wires in Drilled Holes or Saw Kerfs."

3.10.1 Holes for Light Fixtures

Bore holes in pavement to dimensions indicated. Use a diamond-edged bit to provide a smooth, straight cut. Bottom of hole shall be flat or slightly concave, except that an area at least 25 mm one inch wide around the perimeter shall be flat. Fill surfaces deeper than the prescribed depth with sealant to the level of the flat area and allow to cure before further placement.

3.10.2 Holes for Transformer Enclosures

Drill holes through concrete pavement and remove loose material. Fill hole with concrete to depth indicated. Provide a minimum of 75 mm 3 inches of concrete at bottom of hole.

3.10.3 Saw Kerfs and Splice Chambers

Cut saw kerfs and splice chambers in pavements where indicated. Provide saw cuts in straight lines and with vertical sides. Provide width and depth of saw cuts adequate for the required number of wires as indicated. Saw kerfs shall have the vertical edges chamfered at intersections. Where a saw kerf crosses a construction joint, increase the depth sufficiently to allow for slack wire under the joint.

3.10.4 Sandblasting

Sandblast saw kerfs, grooves, and holes to remove foreign or loose material. Accomplish sandblasting by using approved equipment maintained in good working order at all times. Provide sand used for blasting of the proper size and quality as necessary to perform the work. Provide nozzles used for sandblasting of the proper size in relation to the groove or holes to be cleaned. Replace nozzles enlarged by wear as necessary. Sandblast at an air pressure of not less than 0.62 MPa 90 psi.

3.10.5 Cleaning

Immediately prior to installation of wire or light fixtures, flush saw kerfs and holes with a high velocity water jet or steam, and clean and dry with a high velocity air jet to remove dirt and foreign material.

3.10.6 Lighting Fixture Installation

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NOTE: The designer shall provide details on the project drawings showing the installed light fixture with reference to the finished pavement.
****

Sandblast sides and bottom of each light fixture immediately prior to installation. Cover inside faces of bored hole and bottom and sides of light fixture with a coating of sealant that will completely fill the void between concrete and fixture. Use a jig or holding device for installing each light fixture to ensure positioning to the proper elevation, alignment, level control, and azimuth control. Orient light fixture with light beam parallel to flight deck centerline or runway centerline and facing in the particular direction required. Level outermost edge of fixture with the surrounding pavement. Remove surplus sealant or flexible embedding material. Leave the holding device in place until sealant has reached its initial set. Properly arrange fixture lead wires with respect to their connecting position. Block the wire way entrance into the light recess to retain the sealant material during curing.

3.10.7 Installation of Circuit Wires in Pavement

Place the wires in saw kerfs and anchor at bottom by means of rubber or plastic wedges or noncorrosive metal clips placed every 610 or 915 mm 2 or 3 feet or as often as necessary to hold the wire down. Where wires cross existing joints, encase wires in a 305 mm 12 inchlength of flexible tubing of polyethylene material conforming to ASTM D1248, Type II or Type III, to break the bond between the wires and the sealing material. Provide tubing centered on the joint and of sufficient size to accommodate the wires to allow for movement of the wires as the joint opens and closes. Wrap ends of tubing with tape to prevent entrance of sealing materials. Pack the adjacent joint area temporarily with roving material, such as hemp, jute, cotton or flax, to prevent sealing material from flowing into the open joint. Carefully mix and apply sealing materials in accordance with the manufacturer's instructions and at the recommended temperature. Remove surplus or spilled material.

3.11 SPLICES FOR AIRFIELD LIGHTING CABLE

3.11.1 Connectors

Use kit type connectors to splice 5 kV single-conductor series lighting cables. During installation and prior to covering with earth, keep mating surfaces of connectors covered until connected and clean when plugged together. At joint where connectors come together, install heat shrinkable tubing with waterproof sealant.[Alternately, the Contractor may provide two half lapped layers of tape over the entire joint.] Joint shall prevent entrapment of air which might subsequently loosen the joint.

3.11.2 Splicing Fixtures to the Wires in Pavement Saw Kerfs

Make splices with preinsulated watertight connector sleeves crimped with a tool that requires a complete crimp before tool can be removed.

3.12 GROUNDING SYSTEMS

3.12.1 Counterpoise Installation

Lay counterpoise wire for entire length of circuits supplying airfield lighting. Provide wire in one piece, except where distance exceeds the length usually supplied, and install on top of the envelope of concrete-encased duct and approximately 150 mm 6 inches above direct burial cables and duct lines. Where trenches or duct lines intersect, electrically interconnect counterpoise wires by exothermic welding. Connect counterpoise wires together and to existing counterpoise wires.

Connect counterpoise to earth ground at every [600][_____] meter [2,000][_____] feet of cable run, at lighting vault, and at feeder connection to light circuit by means of ground rods as specified.

3.12.2 Fixture Grounding

Ground each fixture or group of adjacent fixtures to the counterpoise system. Connect fixtures, steel light bases or grounding bushings on steel conduits to the counterpoise system by a No. 6 AWG bare-stranded copper wire. Semiflush (pancake) fixtures for direct mounting in pavement may not be grounded. Connect copper wire to the counterpoise by exothermic weld.

3.13 MARKING AND LIGHTING OF AIRWAY OBSTRUCTIONS

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NOTE: If Section 09 90 00 PAINTS AND COATINGS is included, painting requirements should be transferred to it. Local conditions may necessitate modification to the following paragraph. Refer to FAA AC 70/7460-1 for further marking of obstructions.
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Mark and light towers, poles, smokestacks, buildings of certain shapes and sizes, and other obstructions in accordance with FAA AC 70/7460-1 and as indicated.

3.13.1 Painting of Airway Obstructions

Patterns and colors to mark obstructions shall conform to FAA AC 70/7460-1 and be as indicated.

3.13.2 Obstruction Marker Lights

Install obstruction marker lights on radio towers, elevated water tanks, smokestacks, buildings, and similar structures with 25 mm one inch zinc-coated rigid steel conduit stems using standard tees and elbows, except that where lowering devices are required, install in accordance with equipment manufacturer's recommendations.

3.14 ROTATING LIGHT BEACON

Install with manufacturer's instructions, including those for cleaning, lubrication, adjustment, and other special instructions. Provide foundations and supports as indicated.

3.14.1 Beam Adjustment

Adjust beam during hours of darkness. Aim beam to provide a minimum of 0.095 rad 5.5 degrees above the horizontal, but not higher than necessary to clear principal obstructions.

3.14.2 Power Supply and Wiring

Install panelboard at top of structure to provide separately protected circuits for beacon lamps,[heaters,] motor, and obstruction lights. Locate cabinet on side of platform opposite ladder. Install conduit riser on tower in a corner angle and do not locate near the ladder.

3.15 HELIPORT LIGHT BEACON

Install in accordance with specifications and manufacturer's instructions, including those for cleaning, lubrication, adjustment, and other special instructions. Provide foundations and supports as indicated.

3.15.1 Beam Adjustment

Adjust beam during hours of darkness. Aim beam to provide a minimum of 0.095 rad 5.5 degrees above the horizontal, but not higher than necessary to clear principal obstructions.

3.15.2 Power Supply and Wiring

Install panelboard at top of structure to provide separately protected circuits for beacon lamps,[heaters,] motor, and obstruction lights. Locate cabinet on side of platform opposite ladder. Install conduit riser on tower in a corner angle and do not locate near ladder.

3.16 WIND DIRECTION INDICATORS

Installation shall include a 7620 mm 25 foot black circle constructed on the ground with center at center of the base. Construct circle of an emulsified asphalt-sand mixture or of a cut-back asphalt sand mixture and not less than 125 mm 5 inches in thickness. Asphalt sand mixture shall contain not less than 6 percent bitumen. Provide well graded sand with not more than 10 percent material which will pass through a No. 200 mesh sieve. Compact asphalt-sand mixture thoroughly and slope for drainage from center to outer rim from one side to the other. [Guy wind cone direction indicator as indicated.]

3.17 ISOLATION TRANSFORMERS

Make connections of transformer primary leads to primary cables with connectors conforming to FAA AC 150/5345-26. Make connection to transformer secondary with connectors conforming to FAA AC 150/5345-26 and plug directly into a mating connector on the transformer secondary leads. During installation, keep mating surfaces of connectors covered until connected and clean when plugged together. At joint where connectors come together, install heat shrinkable tubing with waterproof sealant.[Alternatively, the Contractor may provide two half-lapped layers of tape over the entire joint.] Joint shall prevent entrapment of air which might subsequently loosen the joint.

3.18 RUNWAY AND TAXIWAY LIGHTING SYSTEMS

3.18.1 Runway and Taxiway Centerline Lights

Provide a transformer for each group of four 45-watt or three 65-watt centerline lights and install in a handhole as indicated. Connect lights to secondary circuit wires at fixture leads using preinsulated watertight connector sleeves crimped with tool that requires a complete crimp before tool can be removed. Make connection at staggered locations and wrap with one layer of half-lapped plastic electrical insulating tape. Install light fixtures in holes drilled in the pavement as indicated.

3.18.2 Touchdown Zone Lighting Installation

Provide a light base for traffic bearing areas specified for each light and

transformer as indicated. In making cable connections, provide sufficient slack cable in each base to permit connection to be made above ground, or as indicated.

3.18.3 Circuit Selector Cabinets

Install as indicated and in strict accordance with manufacturer's instructions.

3.19 SIMULATED CARRIER DECK LIGHTING SYSTEM

3.19.1 Light Fixtures

Install in runway pavement as indicated, with centerline of unidirectional light beam aimed toward the nearer runway threshold and parallel to runway centerline.

3.19.2 Isolation Transformers

Except where indicated otherwise, provide a transformer for each group of four 45-watt lights and install in handhole or manhole as indicated.

3.19.3 Equipment in Control Tower, Vault, Manhole, and Handholes

Provide nameplates to match and fit existing lighting control panels in locations as directed. Provide equipment, wiring, and nameplates in runway field lighting vault, in system brightness control manhole, and in handholes as indicated.

3.19.4 Wire and Connectors

Provide THWN insulation for secondary conductors between isolation transformers and simulated carrier deck fixtures. Provide two-pin connectors in accordance with FAA AC 150/5345-26.

3.20 APPROACH LIGHTING SYSTEM

Install approach lighting system as indicated and specified. Provide nameplates for equipment, controls, devices, and for each lighting circuit.

3.20.1 Frangible Requirements

At the 305 meter 1,000 foot crossbar and beyond, mount overrun lights up to 1830 mm 6 feet above concrete foundations on threaded frangible couplings and 53 mm 2 inch electrical metallic tubing (EMT). For mounting heights greater than 1830 mm 6 feet, install lights on LIR frangible supports. When rigid towers, trestles, and similar structures are required, mount the light unit at least 6100 mm 20 feet above the rigid structure with support unit between the two being frangible.

3.20.2 Alignment

Align lights in azimuth, with beams axes parallel to the approach lighting system centerline. Aim elevated lights vertically at a point on the glide path with the angular elevation of each light as indicated. Semiflush lights have a preset vertical aiming angle and require alignment in azimuth only.

3.21 FIELD QUALITY CONTROL

Give the Contracting Officer [5][_____] working days notice prior to [each][_____] test[s]. Correct deficiencies found and repeat tests.

3.21.1 Operating Test

After installation has been completed, conduct an operating test. Demonstrate equipment to operate in accordance with the requirements of this section. Conduct tests [one][_____] day and [one][_____] night for the Contracting Officer.

[3.21.2 Electromagnetic Interference

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NOTE: Electromagnetic interference tests are expensive and may not be practical in the field. Examine requirements for these tests very closely.
****

Conduct tests for electromagnetic compatibility in accordance with[MIL-STD-461][Section 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS]. Conduct tests for [_____] equipment.

]3.21.3 Distribution Conductors, 600-Volt Class

Test to verify that no short circuits or accidental grounds exist. Make tests using an instrument which applies a voltage of approximately 500 volts providing a direct reading in resistance.

3.21.4 Counterpoise System Test and Inspection

Make a visual inspection of continuity of counterpoise system at accessible locations. Test continuity of counterpoise system to the vault grounding system in manhole closest to the vault.

[3.21.5 Progress Testing for Series Airfield Lighting Circuits

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NOTE: Progress testing should be specified when replacing or modifying existing series airfield lighting circuits since interruption time is usually critical; however, progress testing on completely new series airfield lighting circuits is not normally necessary.
****

Conduct a megger test on each section of circuit or progressive combinations of sections as they are installed. Check each section or progressive combination of sections with a megohmmeter providing a voltage of approximately 1000 volts to provide a direct reading in resistance, and document results. Locate any faults indicated by these tests and eliminate before proceeding with the circuit installation.

]3.21.6 Electrical Acceptance Tests

Perform acceptance tests for series and multiple airfield lighting circuits only on complete lighting circuits. Subject each series and multiple lighting circuit to a high voltage insulation resistance test.

3.21.6.1 Low Voltage Continuity Tests

Test each series circuit for electrical continuity. Locate faults indicated by this test and eliminate before proceeding with the high voltage insulation resistance test.

3.21.6.2 High Voltage Insulation Resistance Test

Subject each series lighting circuit to a high voltage insulation resistance test by measurement of the insulation leakage current. Provide a suitable high voltage test instrument which has a steady, filtered direct current output voltage and limited current. High voltage tester shall include an accurate voltmeter and microammeter for reading voltage applied to the circuit and resultant insulation leakage current. Do not apply voltages in excess of test values specified below.

a. Test Procedure: Disconnect both leads from regulator output terminals and support so that air gaps of several millimeters inches exist between bare conductors and ground. Clean and dry cable sheaths, for a distance of 305 mm one foot from ends of cables and exposed insulation at ends of cables. Connect ends of both conductors of the circuit together and to high-voltage terminals of test equipment, and apply test voltage specified in the following tabulation between conductors and ground for a period of 5 minutes.

	Test Voltage, dc	
Series Lighting Circuits	First Test on New Circuits	Test on Existing Circuits
High intensity series lighting circuits (5000-volt leads, 500- and 200-watt transformers)	9000	5000
Medium intensity series lighting circuits (5000-volt leads, 30/45-watt transformers)	6000	3000
600-volt circuits	1800	600

When additions are made to existing circuits, test only new sections in accordance with "First Test on New Circuits" in table above. [To ensure reliable operation, test complete circuit at reduced voltages indicated above.]

b. Leakage Current: Measure and record insulation leakage current in microamperes for each circuit for each minute application of test voltage. Do not exceed the value of the insulation leakage current calculated on the basis of the following leakage current allowances for cable and connected equipment for each circuit:

(1) 3 microamperes for each 305 meters 1000 feet of cable.

(2) 2 microamperes for each 200-watt and each 500-watt 5000-volt series transformer.

(3) 2 microamperes for each 30/45-watt 5000-volt series transformer.

Note: The above values include allowances for the normal number of connectors and splices.

If measured value of insulation leakage current exceeds calculated value, sectionalize the circuit and repeat specified test for each section. Locate defective components and repair or replace until repeated tests indicate an acceptable value of leakage current for the entire circuit.

3.21.6.3 Operating Test

Upon completion of tests, show by demonstration in service that circuits, control equipment, and lights covered by the contract are in good operating condition. Operate each switch in the control tower lighting panels so that each switch position is engaged at least twice. During this process, observe lights and associated equipment to determine that each switch controls properly corresponding circuit. Provide telephone or radio communication between the operator and the observers. Repeat tests from the alternate control station, from the remote control points, and again from the local control switches on the regulators. Test each lighting circuit by operating the lamps at maximum brightness for not less than 30 minutes. Visually examine at the beginning and at the end of this test to ensure that the correct number of lights are burning at full brightness. Conduct [one][_____] day and [one][_____] night operating test for the Contracting Officer.

3.21.7 Constant Current Regulators

3.21.7.1 Visual Examination

Examine each constant current regulator to ensure that porcelain bushings are not cracked, no shipping damage has occurred, internal and external connections are correct, switches and relays operate freely and are not tied or blocked, fuses, if required, are correct, and oil level of oil-filled regulators is correct. Remove relay panel covers only for this examination; it is not necessary to open the main tank of oil-filled regulators. Accomplish the instructions on the plates attached to the regulators. Replace covers tightly after completing examinations and tests.

3.21.7.2 Electric Tests

Ensure that supply voltage and input tap correspond. With load disconnected, energize regulator and observe the open circuit protector to ensure that it de-energizes the regulator within 3 seconds. After testing circuits for open connections and grounds and after determining that lamps are good and in place, apply circuit load to the regulator and measure the voltage and current simultaneously on brightness taps. Voltmeter and ammeter shall have an accuracy of plus or minus one percent. Record readings and make readings during the day and night in order to obtain the average supply voltage. Output current on each brightness tap shall be within plus or minus 2 percent of the nameplate values after making necessary correction in the supply voltage. Late model regulators have automatic supply voltage correction in lieu of input taps, and output

current does not change as supply voltage varies. When output current on tap 5 deviates from nameplate value by more than 2 percent, and regulator is not overloaded, check internal adjustment as described on regulator instruction plate. Since adjustment may be rather delicate, allow a deviation of up to plus or minus 5 percent on taps 1 through 4 before attempting to readjust the regulator.

-- End of Section --