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UFGS-26 54 21.00 10 (October 2007)
UFGS-26 56 20.00 10 (October 2007)
UFGS-34 43 00.00 20 (February 2010)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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DIVISION 26 - ELECTRICAL

SECTION 26 56 20

AIRFIELD AND HELIPORT LIGHTING AND VISUAL NAVIGATION AIDS

02/19

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USACE / NAVFAC / AFCEC / NASA	**UFGS-26 56 20 (February 2019)**

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

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SECTION 26 56 20

AIRFIELD AND HELIPORT LIGHTING AND VISUAL NAVIGATION AIDS
02/19

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NOTE: This guide specification covers the requirements for lighting and visual navigation aids for airfields and heliports. When editing this specification, follow the requirements of UFC 3-535-01. For Navy projects NAVAIR 51-50AAA-2 is the governing design document and is referenced in UFC 3-535-01.

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

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

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

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NOTE: Show locations of all lights, signs, markers, and other visual navigation aids on the contract drawings.

****

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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 must 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 must 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 must 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. For Navy or Marine Corps airfields the designer should refer to the NAVAIR 51-50AAA-2, "General Requirements for Shore Based Airfield Marking and Lighting." Electrical Designer must 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 must 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.
****

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 A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A447/A447M	(2011; R 2021) Standard Specification for Steel Castings, Chromium-Nickel-Iron Alloy (25-12 Class), for High-Temperature Service
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM D1248	(2016) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D1535	(2014; R 2018) Standard Practice for Specifying Color by the Munsell System

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2023) National Electrical Safety Code
IEEE C62.11	(2020) 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/NEMA WC 71/ICEA S-96-659	(2014; R 2022) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy
NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA C119.1	(2016) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts
NEMA ICS 2	(2000; R 2020) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V

NEMA ICS 4	(2015) Application Guideline for Terminal Blocks
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA PB 1	(2011) Panelboards
NEMA WC 70	(2021) Power Cable Rated 2000 Volts or Less for the Distribution of Electrical Energy
NEMA WC 74/ICEA S-93-639	(2022) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code
NFPA 70B	(2023) 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)

REA Bull 1753F-205	(1993) Filled Telephone Cables (PE-39)

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-L-26764	(2018; Rev C) Light, Marker, Airport Approach, High Intensity, Type MB-2
MIL-L-29575	(1989) Light, Wave-Off, Flashing, Capacitance-Discharge
MIL-STD-108	(1966; Rev E; Am 1 1985; Notice 2 1990; Notice 3 2020) Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment
UFC 3-535-01	(2017; with Change 3, 2021) Visual Air Navigation Facilities

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(2016; Rev L; Change 2) Obstruction Marking and Lighting
FAA AC 150/5345-3	(2007; Rev F) Specification for L-821

	Panels for Control to Airport Lighting
FAA AC 150/5345-5	(2006; Rev B) Specification for Airport Lighting Circuit Selector Switch
FAA AC 150/5345-7	(2013; Rev F) Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
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	(2021; Rev E) FAA Specification for L-823 Plug and Receptacle, Cable Connectors
FAA AC 150/5345-27	(2021; Rev F) FAA Specification for Wind Cone Assemblies
FAA AC 150/5345-28	(2005; Rev F) Precision Approach Path Indicator (PAPI) Systems
FAA AC 150/5345-42	(2019; Rev J) Specification for Airport Light Bases, Transformer Housings, Junction Boxes and Accessories
FAA AC 150/5345-43	(2019; Rev J) Specification for Obstruction Lighting Equipment
FAA AC 150/5345-44	(2015; Rev K; Errata 2022) Specification for Runway and Taxiway Signs
FAA AC 150/5345-45	(2007; Rev C) Low-Impact Resistant (LIR) Structures
FAA AC 150/5345-46	(2016; Rev E; Errata 1 2023) 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 150/5345-51	(2005; Rev A) Specification for Discharge-Type Flashing Light Equipment
FAA AC 150/5345-53	(2012; Rev D) Airport Lighting Equipment Certification Program
FAA AC 150/5345-56B	(2011; Rev B) Specification for L-890 Airport Lighting Control and Monitoring System (ALCMS)
FAA AC 150/5370-10	(2018; Rev H; Errata 1 2019) Standard

	Specifications for Construction of Airports
FAA E-982	(2003; Rev J) PAR-56 Lampholder
FAA E-2159	(2004; Rev E) Runway End Identifier Lighting System (REIL)
FAA E-2519	(1972; Rev A) Types I and II
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 FO 6850.19	(1978) Frangible Coupling

UNDERWRITERS LABORATORIES (UL)

UL 6	(2022) UL Standard for Safety Electrical Rigid Metal Conduit-Steel
UL 44	(2018; Reprint May 2021) UL Standard for Safety Thermoset-Insulated Wires and Cables
UL 50	(2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 83	(2017; Reprint Mar 2020) UL Standard for Safety Thermoplastic-Insulated Wires and Cables
UL 360	(2013; Reprint Apr 2023) UL Standard for Safety Liquid-Tight Flexible Metal Conduit
UL 486A-486B	(2018; Reprint May 2021) UL Standard for Safety Wire Connectors
UL 773	(2016; Reprint Jul 2020) UL Standard for Safety Plug-In, Locking Type Photocontrols for Use with Area Lighting
UL 773A	(2016; Reprint Jun 2020) UL Standard for Safety Nonindustrial Photoelectric Switches for Lighting Control
UL 797	(2007; Reprint Apr 2023) UL Standard for Safety Electrical Metallic Tubing -- Steel
UL Electrical Construction	(2012) Electrical Construction Equipment Directory

1.2 DEFINITIONS

****
NOTE: Provide definitions for specific project related terms not included in this guide specification.
****

[_____].

1.3 SYSTEM DESCRIPTION

Provide airfield [and heliport] lighting and visual navigation aids as indicated.

1.4 SUBMITTALS

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

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

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

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

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in

accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

****
NOTE: Modify submittals paragraphs to ensure that an appropriate submittal is required for each item in the project.
****

SD-01 Preconstruction Submittals

Protection plan; G

Training; G

SD-02 Shop Drawings

Lighting and visual navigation aids; G

Composite drawings showing coordination of work of one trade with that of other trades and with structural and architectural elements of the work. Provide sufficient detail to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Indicate where conflicts or clearance problems exist between the various trades.

[Wave-off system; G]

[Landing signal officer (LSO) control panel; G]

[Approach Lighting Frangible Towers; G]

[Wind Cone Indicator Assembly Connection; G]

Posted instructions; G

SD-03 Product Data

When equipment or materials are specified to conform to the standards or publications and requirements of AASHTO, ANSI, ASTM, AEIC, ETL, IEEE, IES, NEMA, NFPA, or UL, or to an FAA, FS, or MS, include proof that the items furnished under this section conform to the specified requirements. The label or listing in UL Electrical Construction or ETL or the manufacturer's certification or published catalog specification data statement that the items comply with applicable specifications, standards, or publications and with the manufacturer's standards will be acceptable evidence of such compliance. Provide manufacturer prepared certificates when the manufacturer's published data or drawings do not indicate conformance with other requirements of these specifications.

Simulated carrier deck lighting system components, complete; G

Pilot relay panel; G

Control transfer panel; G

Airfield lighting control and monitoring system components, complete; G

Approach lighting systems components, complete; G

Type L-823 Connectors; G

Precision approach path indicator system; G

Chase helicopter approach path indicator system

Runway edge lights; G

Runway threshold and end lights; G

Runway centerline lights, tailhook operations; G

Runway centerline lights, non-tailhook operations; G

Runway touchdown zone lights, tailhook operations; G

Taxiway edge lights; G

Taxiway centerline lights, each type; G

Runway hold position lights, each type; G

Guidance signs; G

Runway distance remaining signs; G

Arresting gear markers; G

Obstruction lighting; G

Wheels-up system components, complete; G

Wave-off system components, complete; G

Light bases, each type; G

Wind direction indicator; G

Airfield rotating beacon; G

Helipad/heliport beacon

List of airfield lighting materials and equipment with the FAA AC 150/5345-53 Appendix C review date.

Airfield identification/code beacon; G

Isolation transformers; G

Encapsulated isolation transformers; G

Isolation transformers for frangible towers; G

Constant current regulators, each size; G

Circuit selector switch; G

Control cable; G

Frangible couplings; G

Type P-605 Sealant; G

Type P-606 Sealant; G

Materials and equipment; G

SD-06 Test Reports

Visual inspection; G

[Photometric testing; G]

[Airfield guidance signs; G]

Discharge-type flashing light equipment; G

[PAPIs; G]

Progress testing for series lighting circuits; G

Counterpoise system test and inspection; G

Operating test; G

Distribution conductors, 600-volt class; G

Electrical acceptance tests; G

Low-voltage continuity tests; G

High-voltage insulation resistance tests; G

Constant current regulators, each size; G

SD-07 Certificates

Qualifications of contractor; G

Certified documentation of qualifications, as specified.

[Qualifications of photometric tester; G]

Special tools; G

List of special tools and test equipment required for installation, maintenance and testing of the products supplied by the Contractor. Items to be listed include, but are not limited to, the following:

4-Jack positioning jig, for in-pavement light bases.; G

Elevated light level; G

Crimping tool; G

Cable penciler

List of parts; G

A list of parts and components for the system by manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair necessary to ensure continued operation with minimal delays.

SD-08 Manufacturer's Instructions

Posted instructions; G

Submit proposed disgrams, instructions, and other sheets prior to posting.

SD-10 Operation and Maintenance Data

Constant current regulators, Data Package 5; G

Airfield rotating beacon, Data Package 3; G

Approach lighting systems components, Data Package 3; G

[Wave-off system, Data Package 5; G]

Maintenance and repair instructions; G

Instructions necessary to check out, troubleshoot, repair, and replace components of the systems, as specified.

Posted operations and maintenance instructions

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

SD-11 Closeout Submittals

As-built drawings

[1.5 MAINTENANCE MATERIAL SUBMITTALS

1.5.1 Spare Parts

Provide spare parts as indicated in this specification as part of this contract. The spare parts must be provided at the end of construction. They must be in addition to any items consumed during construction or in testing.

]1.6 QUALITY CONTROL

1.6.1 Regulatory Requirements

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "must" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

1.6.1.1 Code Compliance

Comply with the requirements and recommendations of NFPA 70 and IEEE C2 and local codes where required.

1.6.2 Standard Products

****

NOTE: For a monthly listing of approved equipment (by manufacturer) go to website and refer to the latest Addendum to AC 150/5345-53, Airport Lighting Equipment Certification Program

****

a. Use only approved equipment listed in FAA AC 150/5345-53 with addendum for the date of delivery the exception of Air Force threshold lights and Army heliport fixture colors and intensities. Inspect wire and cable for date of manufacture. Materials must be certified and listed as "Approved Airport Lighting Equipment" downloadable from: http://www.faa.gov/arp/pdf/534553ad.pdf. Do not use wire and cable manufactured more than one year before delivery to job site.

b. Provide materials and equipment listed by FAA, UL, or ETL, when such equipment is listed or approved. Do not use askarel, tetrachlorethylene and insulating liquids containing polychlorinated biphenyls (PCBs) in equipment.

c. Material and equipment must be a standard product of a manufacturer regularly engaged in the manufacture of the product and essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

d. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be products of the same manufacturer unless stated in this section.

1.6.3 Qualifications of Contractor

a. Provide documentation that the aviation lighting equipment contractor and installation electricians are experienced in installing, testing and maintaining aviation lighting systems of a similar complexity. Similar complexity, in increasing complexity, are the following: elevated edge lights and signs, in-pavement lights, and approach light systems. Include 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. Provide a list of airfield lighting schools or seminars attended in the last 5 years.

b. Submit certification containing the names and the qualifications of persons recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. Indicate that any person recommended to perform actual splicing and termination has been adequately trained in the proper techniques and has had at least 3 recent years of experience in splicing and terminating the same or similar types of cables approved for installation. Any person recommended by the Contractor may be

required to perform a dummy or practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage power or series lighting cables. If that additional requirement is imposed, provide short sections of the approved types of cables with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.

[1.6.4 Qualifications of Photometric Tester

****

NOTE: Photometric testing is highly recommended for all runway lighting construction. The designer should verify with the airfield manager that the cost of testing has been included in project funding.

Photometric testing is not required for Navy projects.

****

Submit [three][_____] copies of certification containing the names and the qualifications of persons recommended to perform Field Photometric Testing of Airfield Lighting Fixtures. The general goal of the field photometric testing is to test the airfield lighting fixtures in the field as constructed with respect to FAA AC 150/5345-46. Perform testing utilizing an independent, third-party firm unaffiliated with any lighting manufacturer or construction contractor. This firm must have demonstrated capability for the field measurement of the photometric performance of airfield lighting fixtures in comparison to FAA and UFC standards by having performed work similar to this contract successfully at no less than ten (10) air carrier airports (in the United States) in the past five (5) years.

Submit a list of equipment to be used for the photometric testing with a record of experience of similar projects with references for contact. Additionally, submit a list of equipment used to calibrate the photometric sensors as well as proof of the last date of calibration. The equipment must be calibrated within six months prior to commencement of testing.

]1.6.5 Protection Plan

Submit detailed procedures to prevent damage to existing facilities or infrastructures. If damage does occur, the procedures must address repair and replacement of damaged property at the Contractor's expense.

1.6.6 Prevention of Corrosion

1.6.6.1 Metallic Materials

Protect metallic materials against corrosion as specified. Do not use aluminum in contact with earth or concrete. Do not use aluminum conductors.

1.6.6.2 Ferrous Metal Hardware

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

1.7 DELIVERY, STORAGE, AND HANDLING

The Contractor must deliver, store and secure all airfield lighting materials an equipment in accordance with the manufacturers' requirements.

1.8 PROJECT/SITE CONDITIONS

Items furnished under this section must be specifically suitable for the following unusual service conditions:

1.8.1 Altitude

Any equipment must be suitable for operation up to an altitude of[3,000 m 10,000 feet][_____].

1.8.2 Other

Material or equipment to be installed [underground]; [in handholes, manholes, or underground vaults]; [or] [in light bases], [_____] must be suitable for submerged operation.

1.8.3 Environmental Requirements

The airfield for this project has the following requirements:

Location - [_____]
Altitude - [_____] m[_____] feet above mean sea level.
Maximum Exterior Temperature - [_____] degrees C[_____] degrees F.
Minimum Exterior Temperature - [_____] degrees C[_____] degrees F.
Maximum Relative Humidity - [_____] percent non-condensing.
Maximum Indoor Temperature - [_____] degrees C[_____] degrees F.
Minimum Indoor Temperature - [_____] degrees C[_____] degrees F.

1.8.4 Existing Airfield Lighting Systems

****

NOTE: When modification, additions, or any other work is be performed on an existing airfield lighting system, the designer must 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 must remain in operating condition and interruptions must be held to a minimum. Where interruptions are ncessary, they must be scheduled as approved in writing by the Contracting Officer. Prior to the scheduled time for each interruptions, all necessary materials and a sufficient labor force must be assembled to permit completing the work within the scheduled time interval. Under no circumstances must 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 must be replaced in such a manner that they will be operational at dusk each day. The

Contractor must submit to the Contracting Officer a plan for outages and maintaining lighting and lighting control."

****

[_____].

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide airfield lighting and visual navigation aids as indicated on contract drawings.

2.1.1 Design Requirements

****

NOTE: Various FAA requirements are described in this specification and are a part of the requirements of this project.

****

2.2 AIRFIELD LIGHTING CONTROL AND MONITORING SYSTEM (AFLCMS)

****

NOTE: For Navy projects, coordinate with Activity and Space and Naval Warfare Systems Command (SPAWAR). If SPAWAR system is used delete the following paragraph. Normally, airfield lighting control systems are provided by SPAWAR Charleston. Designer must indicate on drawings for contractor and Construction Manager to coordinate with SPAWAR.

****

****

NOTE: For conventional control systems refer to FAA AC 150/5345-3 for type, class, and style. For PC or PLC based control and monitoring systems refer to FAA AC 150/5345-56B for type. Edit and retain one of the following paragraphs.

Provide security clearance requirements of certified installers for termination to DoD networks.

****

The FAA has determined that acceptable airfield lighting control and monitoring systems can be configured in three levels of features. They include personal computer (PC) based systems, programmable logic controller (PLC) based systems, and systems configured with pilot relay panels or basic PLC systems.

2.2.1 Pilot Relay Panel

****

NOTE: Type I pilot relay panel has 24 double-pole, single-throw relays and is used for systems including the approach lighting systems. 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.
****

[Utilize one of more pilot relay panels as indicated or compliant with NEMA 250, NEMA ICS 2, and NEMA PB 1 for 120-volt control systems;] or [FAA AC 150/5345-13, Type L-841, for 48-V dc control systems.]

2.2.2 Control Transfer Panel

[Transfer panel, 120-volt, 60 Hz, with eight-pole, double-throw, continuous-duty, industrial control type relays, in NEMA Type 1 enclosure. Provide relay contacts with a rating of not less than 10 amp for continuous non-inductive loads.] [Transfer panel, 48-volt, dc, with double-pole, double throw relays in accordance with FAA AC 150/5345-13, Type L-841.]

2.2.3 Control Panel

****
NOTE: Specify class for airfield lighting systems indicated 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. Use Type I for conventional panels, Type II for facsimile panels and Type III for mimic or PLC based panels. Use Class F for flush mounted panels, Class S for surface mounted panels or Class W for a wall mounted panel. Use Style 1 for an unlighted panel, Style 2 for a backlighted panel and Style 3 for a touchscreen. Refer to FAA AC 150/5345-3 for type, class, and style.
****

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

2.2.4 Airfield Lighting Control and Monitoring System

2.2.4.1 Computer Based (PC) Technology

Utilize computer based (PC) technology control systems as indicated on the drawings, compliant with FAA AC 150/5345-56B, L-890 Type [_____]. Include touchscreen type control panel. For the essential system PCs provide the following characteristics: 483 mm19 inch rack mount form factor, fully enclosed metal housing, redundant hot-swappable solid state software and data storage devices, redundant hot-swappable cooling system, redundant hot-swappable power supplies. Incorporate uninterruptible power supplies (UPS) for primary power to all system components required for normal operation for a duration of fifteen minutes.

2.2.4.2 Programmable Logic Controller (PLC) Technology

[Utilize Programmable Logic Controller (PLC) technology, compliant with FAA AC 150/5345-56B, L-890, Type [_____]. Include touchscreen type control panel.]

2.3 APPROACH LIGHTING SYSTEMS

****
NOTE: Design the Approach Lighting System to include an emergency power supply to transfer lighting load within fifteen seconds of a power outage for a CAT I runway and one second for a CAT II runway.
****

2.3.1 High Intensity Approach Lighting System

****
NOTE: High-intensity approach systems may be either ALSF-1, ALSF-2, SALS or SSALSR lights.
****

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

2.3.1.1 Elevated High-Intensity Steady Burning Fixtures

****
NOTE: Light Plane Elevation Limits for the slope of this plane must not exceed 2 percent up or 1.5 percent down.
****

Provide FAA E-982 unidirectional frangible mounted lights with PAR-56 [200 W] [300 W] [and] [500 W] lamps, and [without] [with aviation red] filters at cross bar, centerline bars, and side row barrettes.

2.3.1.2 In-Pavement, High-Intensity Steady Burning Approach Lights

Use in-pavement, high-intensity, base-mounted lights in the overrun area and paved areas with traffic. Use fixtures conforming to FAA AC 150/5345-46 [Type L-850E for unidirectional quartz lights with lamps,] [Type L-850E(L) for unidirectional LED lights] with filters and transformers as indicated. Mounting must 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.

[2.3.1.3 Hook Resistant Lights for Simulated Carrier Deck Lighting System

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

]2.3.1.4 [Voltage][Current] Powered Sequenced Flashing Light (SFL) for High Intensity Approach 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. Include master timer cabinet that provides timed flashing signals to 21-lamp power supplies. System must 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. Provide the system with major components that are the product of a single manufacturer. Install junction boxes as indicated on concrete foundations and on the platform of elevated structures. Install conduit tappings in the bottom and top of the junction boxes 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. [Provide current transformers for current powered system.]

2.3.1.5 Economy Approach REIL

FAA AC 150/5345-51[Type L-849V voltage powered][Type L-849V current powered].

2.3.2 Medium-Intensity Approach Lighting Systems with Runway Alignment Indicator Lights (MALSR)

2.3.2.1 Elevated, Medium-Intensity, Steady-Burning Fixtures

Utilize FAA E-2325 PAR 38 lampholders with [150 watt] [_____] PAR-38 spotlight lamps frangibly mounted on [light bases] [steel stakes] [and/or] [low-impact-resistant supports] [frangible supports]. The peak intensity of the main beam, at 120V input, must not be less than 5,000 candelas and the intensity must not be less than 1,000 candelas at any angle up to 15 degrees from the beam axis.

2.3.2.2 In-Pavement, Medium-Intensity, Steady-Burning Fixtures

****

NOTE: In-pavement fixtures are only authorized for installation in pavement subject to aircraft operations.

****

The peak intensity must be not less than 5,000 candelas within the main beam, and not less than 2500 candelas +/-5 degrees horizontally and +/-3.5 degrees vertically from the main beam axis, and not less than 500 candelas at +/-7 degrees horizontally and +/-5.5 degrees vertically from the main beam axis.

2.3.2.3 Encapsulated Stepdown Transformer

Provide 200-watt, 240-volt/30.3-volt transformer approved by the fixture manufacturer. Use connectors that comply with Type L-823 as indicated.

2.3.2.4 Voltage Powered Sequence Flashing Lights (SFL) for Medium Intensity Lights

These elevated SFL fixtures (RAIL) must meet the requirements of [FAA E-2159] [FAA AC 150/5345-51, Type L-849] with [eight] [_____] lights and must be as indicated on the contract drawings as an integrated part of the approach system. The SFL system must include the fixtures, the individual power supplies, master timer and power supply, remote control [and monitor] [support structures], and interconnecting wiring. The SFL must flash twice per second in sequence towards the runway threshold.

2.3.3 Omnidirectional Approach Lighting System (ODALS)

The ODALS fixtures must meet the requirements of FAA AC 150/5345-51, Type L-859 Style F. The ODALS must include the [7] [_____] fixtures, the individual power supplies, the master timer and power supply, remote control, [support structures] and interconnecting wiring. The ODALS must flash twice per second in sequence towards the runway threshold.

2.3.4 Glide Slope Indicator System

[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.

]2.3.4.1 Precision Approach Path Indicator System (PAPI)

FAA AC 150/5345-28 [Type L-880 non-LED][Type L-880(L) LED]. Connect the four light units to [6.6 ampere series current circuit (Style B) via appropriate isolation transformers][240 volts ac constant voltage circuit (Style A)]. Provide tilt switches and relays to de-energize all light units when one unit exceeds tilt requirements.

2.3.4.2 Chase Helicopter Approach Path Indicator System (CHAPI)

FAA AC 150/5345-28 [Type L-881 non-LED][Type L-881(L) LED] with a filter that will provide a two-degree wide green sector in the center of the white over red beam. Connect the two light units to [6.6 ampere series current circuit (Style B) via appropriate isolation transformers][240 volts ac constant voltage circuit (Style A)]. Provide tilt switches and relays to de-energize all light units when one unit exceeds tilt requirements.

2.3.5 Low-Impact-Resistant (LIR) Frangible Supports

****

NOTE: Designer to provide structural foundation design by registered professional engineer.

****

Fiberglass reinforced conforming to [FAA E-2702] [FAA AC 150/5345-45]. Provide anchor bolts, lowering devices and fixture mounting accessories as required by tower manufacturer.

2.4 RUNWAY LIGHTING SYSTEM

****

NOTE: The designer must insure compatibility if FAA listed LED type fixtures are to be served by existing regulators. In such cases, indicate the

existing regulator manufacturer and model number on the drawings.
****

[Include runway edge lights, runway threshold lights, [runway centerline lights,] [runway touchdown zone lights,] [runway distance remaining signs [and arresting gear] markers], mounting structures, controls, and the associated equipment and interconnecting wiring to provide complete runway lighting systems as indicated.] Use in-pavement light fixtures that withstand a minimum static single wheel load of 22,680 kg 50,000 pounds. [Where LED fixtures are used, provide fixtures that are compatible with the associated constant current regulators.] [Existing regulator manufacturer and model number is as indicated on drawings.]

2.4.1 Runway Edge Lights

FAA AC 150/5345-46, [[Type L-862][Type L-862(L) LED], elevated high-intensity] [[Type L-861][Type L-861(L) LED], elevated medium-intensity, airfield and heliport] [[Type L-850C][Type L-850C(L) LED], in-pavement, high-intensity] [[Type L-852E][Type L-852E(L) LED], in-pavement medium-intensity,] white lights.

2.4.2 Runway Threshold and End Lights

[FAA AC 150/5345-46, [[Type L-862][Type L-862(L) LED], elevated high-intensity, bidirectional]], [[Type L-861 SE][Type L-861(L) LED], elevated, medium-intensity, bidirectional] [[Type L-861][Type L-861(L) LED], elevated, medium-intensity, omnidirectional] [[Type L-852E][Type L-852(L) LED], in-pavement, medium-intensity, omnidirectional] [[Type L-850D][Type L-850D(L) LED], in-pavement, high-intensity, bidirectional] [[Type L-850C][Type L-850C(L) LED], in-pavement, high-intensity, unidirectional] [FAA E-982, PAR-56, elevated unidirectional outboard of runway edges,] [airfield and heliport lights as indicated]. For threshold lights use aviation green filter and for end lights use aviation red filters. Combine these lights in a single bidirectional fixture with the appropriate color filters as indicated.

2.4.3 Runway Centerline Lights, Tailhook Operations

****
NOTE: Runway centerline lights for tailhook operations are medium intensity and are spaced at 7.5 m 25 feet on center. The fixtures are identified as compliant with NAVAIR 51-50AAA-2 and conform to FAA AC 150/5345-46 Type L-852. These fixtures have an extra strength stainless steel top conforming to Rockwell hardness of C40 to resist damage from aircraft tailhooks.
****

****
NOTE: Type V is a fixture that is very shallow and is glued directly into the pavement that has been cored to make an 200 mm8 inch diameter by 29 to 32 mm 1.125 to 1.25 inch deep opening. The low voltage wires are installed in saw kerfs and are directly connected to fixture leads before setting the fixture. If the pavement is re-surfaced, it appears that new fixtures are needed, unless they can be

un-glued.

Type VI is a fixture that is shallow and is bolted down to a shallow base. The shallow base is glued directly into the pavement that has been cored to make an 200 mm8 inch diameter opening as deep as the shallow base. The wires are installed in saw kerfs and are routed into the shallow base and then connected to fixture leads before setting the fixture. If the pavement is re-surfaced, the fixture can be removed, spacer rings added and the fixture re-installed.

Type VII is a fixture that is bolted down to a 250 mm 10 inch diameter L-868 base can that has standard conduit and cable connections. The fixture has an L-823 secondary connector to connect to the isolation transformer in the base can. Spacer rings can be used for pavement re-surfacing.

Type VIII is a fixture that is bolted down to a 300 mm12 inch diameter L-868 base can that has standard conduit and cable connections. The fixture has an L-823 secondary connector to connect to the isolation transformer in the base can. Spacer rings can be used for pavement re-surfacing.

****

Provide fixtures similar to FAA AC 150/5345-46, [Type L-852][Type L-852(L) LED], and identified as Class N (Navy). Use unidirectional, narrow beam, Type VIII, [with shorting device for failed lamp,] fixtures modified to resist damage from aircraft tailhooks. The stainless steel top assembly must conform to ASTM A447/A447M with a Rockwell hardness of C40 plus or minus 5. Height of fixture must be 12.7 mm 1/2 inch above pavement in lieu of 9.5 mm 3/8 inch. Secure optical assembly with ceramic/metallic/fluorocarbon polymer coated steel bolts.

2.4.4 Runway Centerline Lights, Non-Tailhook Operations

FAA AC 150/5345-46, [Type L-850A][Type L-850A(L) LED], Class 2. Provide filters as indicated and that conform to the requirements of fixture specifications.

2.4.5 Runway Touchdown Zone Lights, Tailhook Operations

FAA AC 150/5345-46, [Type L-852][Type L-852(L) LED], 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 must 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 must be 12.7 mm 1/2 inch above pavement in lieu of 9.52 mm 3/8 inch. Light channel width must be 25 mm 1 inch at the lens, with a divergence of 14 degrees on each side. Secure optical assembly with ceramic/metallic/fluorocarbon polymer coated steel bolts.

2.4.6 Runway Touchdown Zone Lights, Non-Tailhook Operations

[FAA AC 150/5345-46, [Type L-850B][Type L-850B(L) LED], with top casting having extra rib for protection against damage from aircraft tailhooks.]

2.5 TAXIWAY LIGHTING SYSTEMS

Include edge lights, [centerline lights], hold position lights, and all associated equipment, power supplies and controls, mounting devices, and interconnecting wiring to provide complete systems. If LED fixtures are used, provide fixtures that are compatible with the associated constant current regulators. [Existing regulator manufacturer and model number is as indicated on drawings.]

2.5.1 Taxiway Edge Lights

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

****

NOTE: The designer must insure compatibility if FAA listed LED type fixtures are to be served by existing regulators. In such cases, indicate the existing regulator manufacturer and model number on the drawings.

****

2.5.2 Taxiway Centerline Lights

****

NOTE: Taxiway centerline lights are required only for Category III operation. They are optional for Category II and should only be installed with Activity concurrence. Delete this paragraph if not required.

****

FAA AC 150/5345-46, Type [L-852][L-852(L) LED], in-pavement fixtures.

2.5.3 Straight Centerline Sections

FAA AC 150/5345-46, [Type L-852C][Type L-852C(L) LED] with green/green or green/yellow filters as indicated.

2.5.4 Curved Centerline Sections

FAA AC 150/5345-46, [Type L-852D][Type L-852D(L) LED] with green/green or green/yellow filters as indicated.

2.5.5 Taxiway Intersections

FAA AC 150/5345-46, [Type L-852F][Type L-852F(L) LED] with yellow filter.

2.5.6 Taxiway Hold Lights

FAA AC 150/5345-46, [Type L-852G][Type L-852G] unidirectional with yellow

filter toward the taxiway.

2.5.7 Runway Hold Position Lights

FAA AC 150/5345-46, [Type L-804][Type L-804(L) LED], elevated, or [Type L-852G][Type L-852G(L) LED], in-pavement, unidirectional, with aviation yellow filter and aimed toward the taxiway approach to the runway.

2.5.8 Limit Lights

FAA AC 150/5345-46, [Type L-861][Type L-861(L) LED] with red globes and 45-watt lamps or LEDs. Frangibly mount the lights on FAA AC 150/5345-42, Type L-867 light bases.

2.6 AIRFIELD GUIDANCE SIGN SYSTEMS

****
NOTE: The designer must insure compatibility if FAA listed LED type signs are to be served by existing regulators. In such cases, indicate the existing regulator manufacturer and model number on the drawings.
****

[2.6.1 General

****
NOTE: For most applications select Mode 3, 483 kph 300 mph rated markers. For bases that do not serve C-17 aircraft select Mode 2, 322 kph 200 mph rated markers. If not known verify with airfield manager.
****

Provide guidance signs compatible with all L-828/L-829 regulators.

]2.6.2 Photometric Requirements

Guidance signs must meet FAA minimum luminance requirements.

2.6.3 Taxiway Guidance Signs

FAA AC 150/5345-44, [[Type L-858Y][Type L-858Y(L) LED] for information] [and] [[Type L-858R][Type L-858R(L) LED] for mandatory signs]. Provide signs of the size and with the information indicated. Sign must operate on a [multistep 6.6 amp circuit][5.5 amp single stopcircuit].

2.6.4 Runway Distance Remaining Signs

****
NOTE: It is recommended that runway distance remaining signs be Style 5 (5.5A) and connected to a dedicated runway sign circuit. Style 3 signs are designed for 5-step 2.8 to 6.6 ampere CCRs. The associated L-828 or L-829 constant current regulator is adjusted to operate at 5.5A and as one-step (on-off). The signs are less expensive and operate more efficiently if they do not have to operate at the lower current levels of the runway circuit. Signs must have white numerals. Existing

installations may have yellow numerals and it is recommended that the panels be changes to conform to FAA standards.
****

FAA AC 150/5345-44, Type L-858B, Size 4, Style [3][5], with white numerals on a black background. Provide internally illuminated markers with illumination of the face not less than 50 percent of that at rated current when the series lighting circuit is operated at the lowest brightness step.

2.6.5 Arresting Gear Markers

****
NOTE: This is not a standard FAA sign configuration. Markers are similar to L-858B except the legend is yellow (instead of white) on a black background.
****

Provide arresting gear markers that are the same as Runway Distance Remaining Signs, except arresting gear markers must have a 990.6 mm 39 inch translucent yellow circle in place of numerals as specified above.

2.7 HELIPAD LIGHTING SYSTEMS

2.7.1 Helipad Perimeter Lights

****
NOTE: The standard configuration uses yellow lights as shown in Figure 7-1, in UFC 3-535-01. The hospital configuration uses yellow and green lights as shown in Figure 7-2.
****

2.7.1.1 Elevated Lights

FAA AC 150/5345-46, [Type L-861][Type L-861(L) LED] with aviation yellow [or green] globes, as indicated. Frangibly mount lights on FAA AC 150/5345-42, Type L-867 bases.

2.7.1.2 In-Pavement Lights

FAA AC 150/5345-46, [Type L-852E][Type L-852E(L) LED] with aviation yellow [or green] filters. Mount fixtures on FAA Type L-868 bases.

2.7.2 Helipad Floodlighting

****
NOTE: Reference UFC 3-535-01 Chapter 7 for Air Force and Army helipad flood lights and NAVAIR 51-50AAA-2 Work Package 007 06 for Navy helipad flood lights information.
****

Use helipad floodlights as indicated.

2.7.3 Helipad Landing Direction Lights

FAA AC 150/5345-46, [Type L-861][Type L-861(L) LED] with aviation yellow

globes. For landing direction lights located in paved areas subject to aircraft or vehicular surface traffic, use FAA AC 150/5345-46, [Type L-852E][Type L-852E(L) LED] fixtures with aviation yellow filters.

2.7.4 Helipad Approach Direction Lights, Visual Meteorological Conditions

FAA AC 150/5345-46, [Type L-861][Type L-861(L) LED] fixtures with aviation white globes. For approach direction lights located in paved areas subject to aircraft or vehicular surface traffic, use FAA AC 150/5345-46, [Type L-852E][Type L-852E(L) LED] fixtures without filters.

2.7.5 Helipad Approach Direction Lights, Instrument Meteorological Conditions

FAA E-982 lampholder for Type PAR-56 lamps without filters.

2.8 HOVERLANE LIGHTS

[FAA AC 150/5345-46, [Type L-861][Type L-861(L) LED] for elevated lights with aviation yellow or aviation green globes] [as indicated on the contract drawings]. For hoverlane lights located in paved areas subjected to aircraft or vehicle traffic, the fixtures must be [FAA AC 150/5345-46, [Type L-852E][Type L-852E(L) LED] with aviation yellow or aviation green filters].

2.9 RUNWAY END IDENTIFIER LIGHTS (REIL)

FAA AC 150/5345-51, [Type L-849][Type L-849(L) LED], Style E-Unidirectional, three brightness steps. Include the master and slave fixture, the power supply, remote control, frangible mounts, and interconnecting wiring. The REIL units must flash in unison twice per second.

2.10 OBSTRUCTION LIGHTING AND MARKING

****

NOTE: At the time of this writing, questions are being raised about the ability of a pilot, using night vision goggles, to see LED-based obstruction lights. For the time being, do not use LED-based obstruction lights on military facilities.

Do not use the first bracketed option for Navy projects.

****

2.10.1 Obstruction Lights

[Mark obstructions on or near the [airfield] [heliport] and/or lighted as indicated.]Use obstruction marker lights emitting aviation red [flashing] [steady burning] [flashing and/or steady burning] light. Use [multiple-socket assembly] [series socket assembly] FAA AC 150/5345-43, [Type L-810] [Type L-864] light fixtures. For multiple flashing lights on a circuit, flash the lights in unison. Use [single-unit type] [double-unit type] [single- or double-unit type] obstruction marker lights as indicated. Energize the obstruction lights [multiple] [series] [series or multiple] circuits as indicated.

Do not use LED-based obstruction lights on military facilities.

2.10.2 Solid State Flasher

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

[2.11 WHEELS-UP SYSTEM

****
NOTE: The Wheels-Up Light Fixtures are for some Navy airfields. Reference NAVAIR 51-50AAA-2 Work Package 006 03 for information on this 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.

2.11.1 Wheels-Up Light Fixtures

FAA E-982 or MIL-L-26764 Type MB-2 for 120-volt, 500-watt lamp (Q500-PAR56/MFL). 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.

2.11.2 Light Dimmer

As indicated and as specified below. Provide a single NEMA Type 4X housing for assembly, above-ground on frangible supports to a 0.9 m 3 foot head. Enclosure must have limiting dimensions of 0.76 by 0.76 by 1.22 m 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 104 degrees F. Dimmer must 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 must 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 must handle a short circuit on load terminals without failure or degradation of components. Use a dimmer that employs 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.

2.11.3 Wheels Watch Control Panel

Construct as indicated on drawings and conform to UL 50. Provide cabinet and hinged cover of 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 on drawings. Where controls are on the face of the panel, provide clearly identified engraved

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

][2.12 WAVE-OFF SYSTEM

****
NOTE: The Wave-off strobe light fixtures are for some Navy airfields. Reference NAVAIR 51-50AAA-2 Work Package 006 03 for information on this system.
****

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

2.12.1 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

2.12.2 Wave-Off Control Cabinet

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

a. Enclosure

a. UL 50

b. 14 gage, sheet steel, NEMA [3R][_____], enclosure per NEMA ICS 6, with hinged cover

c. Hot-dip, zinc coated

d. Solvent clean per SSPC SP 1. If the galvanized metal has been "passivated" or "stabilized", the coating must be completely removed by brush-off abrasive blast or other treatment, or the surface must be primed with a primer which is specifically recommended by the paint manufacturer for use on passivated or stabilized galvanized steel.

e. Immediately after cleaning, coat surfaces with a pretreatment coating or a crystalline phosphate coating.

f. 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 must be [Munsell 7GY3.29/1.5 green per ASTM D1535][_____].

b. Nameplates

1. Provide nameplates for controls as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

c. Terminal Board

1. 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.

2.12.3 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, LIQUID-FILLED PAD-MOUNTED TRANSFORMERS.]

2.12.4 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.

2.12.5 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.

2.12.6 Equipment Pad

Provide as indicated on construction drawings.

][2.13 SIMULATED CARRIER DECK LIGHTING SYSTEM

****

NOTE: The Simulated Aircraft Carrier Deck Lighting System is for some Navy airfields. Reference NAVAIR 51-50AAA-2 Work Package 006 04 for information on this 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 on drawings.

2.13.1 Light Fixtures

****

NOTE: Type L-852N fixture shorting device is only used where multiple fixtures will be on a single isolation transformer. See description of Type V, VI, VII, and VIII light fixtures in designer note for runway centerline lights, tailhook operations.

****

FAA AC 150/5345-46, Type L-852, Class N (Navy), unidirectional, narrow beam, Type [VIII][VII][VI][V], [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 must conform to SAE AMS5351 with Rockwell hardness of C40 plus or minus 5 with casting thickened from 9.53 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 9.53 m 3/8 inch. Provide light channel width one inch at the lens, with a divergence of 14 degrees on each side. Secure the optical assembly with ceramic-metallic/fluorocarbon polymer coated bolts.

2.13.2 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 3.18 mm 1/8 inch aluminum alloy 5052-H32 conforming to 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 must contain components and controls necessary for complete operation of lighting systems indicated. Provide receptacles as indicated and in accordance with the referenced Military Standards. Provide panel in close-fitting cabinet, removable from front.

2.13.3 Encapsulated Stepdown Transformer

Provide 200-watt, 6.6A/6.6A transformer approved by the fixture manufacturer. Connectors must comply with Type L-823 as specified.

]2.14 LIGHT BASES

****

NOTE: Use FAA AC 150/5345-42 Type L-867 bases for applications not subject to aircraft or vehicle loading. Use Type L-868 for applications subjected to aircraft or vehicle loading.

****

FAA AC 150/5345-42 Type L-867 or L-868 [_____]. Use steel bases, Class 1, Size [B] [C] [D] [A] as indicated or as required to accommodate the fixture or device installed. Use Size C where more than one distributed control module is installed in the light base. Where used as pull boxes in
(single or multiple) can plazas use L-867D bases. Provide base plates,

cover plates, and adapter plates to accommodate various sizes of fixtures.

Furnish each base with internal and external one-hole ground lugs for attaching ground or counterpoise cables.

****
NOTE: For Navy projects delete the following sentences.
****

[Furnish each base with a 1.2 m 4 foot braided, 25 square mm #6 AWG equivalent ground strap with one-hole lug compression fittings. Utilize straps made for the purpose of grounding the light fixture to the base can interior grounding lug.]

2.15 SNOW PLOW RINGS

Provide cast ductile iron [unidirectional] [bi-directional] snow plow rings for in-pavement light fixtures, as indicated. The rings must be suitable for the light fixture and L-868 light base cans indicated. Rings must have [four stainless steel spring pins and] black powder coat finish. Ring must be provided with a silicone rubber O-ring and six ceramic fluoropolymer coated bolts and 2-piece locking washers.

2.16 WIND DIRECTION INDICATOR

FAA AC 150/5345-27, Type [L-806, low mass supporting structure, size 1, 2438 mm 8 feet] [L-807, rigid supporting structure], [size 1, 2438 mm 8 feet][size 2, 3657 mm 12 feet], [Style (I-lighted] [II-unlighted], Size [0.3 to 2.44 m 1 to 8 feet] [0.61 to 3.66 m 2 to 12 feet]. Provide wind cones of the size and color as indicated, including wind cone indicator assembly connection, including wind cone indicator assembly connection..

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, must be Type L-806.

2.17 BEACON

The rotating beacons for airfield and heliport beacons are omnidirectional and color coded and are provided by rotating the beams in sequence to provide the color and intensity. For military facilities the beacon has a double-peaked white beam. Use beacons with flashes visible through 360 degrees.

2.17.1 Airfield Rotating Beacon

****
NOTE: For operation down to 30 degrees C -22 degrees F, a Class 1 beacon must be provided. For operation down to 50 degrees C -58 degrees F, specify a Class 2 beacon with a low temperature heater package.
****

FAA AC 150/5345-12F, Type L-802M, Class [1] [2] for fixed wing aircraft. Provide a duplex type beacon with double-peaked white beam in a repeating white/white/green pattern. Use NEMA ICS 6 Type [3R] [_____] enclosure of

zinc-coated steel. [Provide beacon with a low temperature heater package for use in temperatures below minus 30 degrees C 86 degrees F.]

2.17.1.1 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. Locate panelboard at working height at ground level. Provide disconnect switches at the maintenance platform level

2.17.2 Helipad/Heliport Beacon

FAA AC 150/5345-12, Type L-801H, Class 2, with double-peaked white flash. The beacon must flash the colors [white, aviation green, and aviation yellow for a non-medical facility helipad] [white, aviation green, and aviation red for a medical facility helipad.] The beacon flashes must be visible throughout 360 degrees horizontally, and the effective intensity of the flashes must be not less than 25,000 candelas for vertical angles between 2 and 8 degrees and not less than 12,500 candelas for vertical angles between 0 and 10 degrees. The flashes must be uniformly spaced with the three-color sequence flashing 10 to 15 times per minute.

[2.17.3 Airfield Identification/Code Beacon

****
NOTE: This type of beacon is very seldom used. Validate requirement with airfield manager.
****

FAA AC 150/5345-43, Type L-866 with green filters and code flashing device. Use beacons with flashes visible through 360 degrees. The effective intensity of the green flash must be not less than 2,000 candelas. Use the code as indicated and flash 6 to 8 codes per minute.

]2.18 LAMPS AND FILTERS

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

2.19 EXPLOSION-PROOF FIXTURES FOR HAZARDOUS LOCATIONS

****
NOTE: Only fixtures that are listed by U.L. or an equivalent lab are authorized for use in explosion-hazardous locations. The listing must reflect the installed configuration.
****

For explosive hazardous locations, use fixtures that meet the requirements of and be listed by UL Electrical Construction or ETL as defined in NFPA 70 for the hazard and application.

2.20 ISOLATION TRANSFORMERS

2.20.1 Encapsulated Isolation Transformers

FAA AC 150/5345-47, Type (G) L-830. 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 C 131 degrees F to plus 65 degrees C 149 degrees F. 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.

2.20.2 Isolation Transformers for Frangible Towers

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

2.21 SURGE ARRESTERS

Provide surge arresters in accordance with IEEE C62.11, IEEE C62.41.1 and IEEE C62.41.2 as applicable with ratings as indicated. Provide surge arresters on the line side of the constant current regulator (CCR). Provide series circuit surge arresters for locations with a lightning flash density of 8 or more flashes per square kilometer per year.

2.22 SURGE PROTECTIVE DEVICES

As required in Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM.

2.23 CONSTANT CURRENT REGULATORS

****

NOTE: The following FAA L-828/929 regulators are not allowed for new construction:
1. 20 A output current in sizes 50 and 70 KW.
2. 2400 V input regulators.
However, with Activity concurrence, they may be permitted for minor additions or upgrade for existing installations. Additionally, 240V input regulators also require Activity concurrence.

For Navy regulators check control voltage with SPAWAR.

****

2.23.1 Regulators

FAA AC 150/5345-10, [Type L-828, without monitoring] [Type L-829 with monitoring] dry-type system and with current rating or [6.6A][20A][6.6A and 20A][5.5A][_____]. Use regulators of ferroresconant design to reduce EMI, increase efficiency, and provide a power factor not less than 0.95. Provide regulators that operate on [60] [50] Hz, have internal primary switch [included] [excluded], have input voltage of [480][_____] and be controlled by [120 VAC][48VDC][_____] external control voltage. Provide [5][3][or][1] [_____] brightness steps, as indicated. [Provide monitors as indicated.] [Provide regulators with digital power meters.] [Provide regulators with insulation resistance monitoring systems.] [Provide

regulators with integral or unit-mounted series circuit cutouts.] [Use stackable switchgear style regulators with a series circuit cutout cabinet.] Insure that constant current regulators are compatible with signs, [LED light fixtures] and other connected loads.

2.23.2 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.

2.24 CIRCUIT SELECTOR SWITCH

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

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

2.25 MATERIALS AND HARDWARE

2.25.1 Wire and Cable

Use copper conductors installed in conduit. Do not provide or install wire and cable manufactured more than one year before delivery to the job site.

2.25.1.1 Conductor Sizes

Conductor size conforming to American Wire Gage (AWG) or metric trade size. Use stranded conductors for sizes larger 10 square mm #8 AWG. Unless otherwise indicated 10 square mm #8 AWG and smaller may be solid or stranded.

2.25.1.2 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 projects. Wire with "W" in the type is usually acceptable for wet locations. Revise to add guidance on when to use each type.
****

a. [UL 83, Type [_____][THWN-2] UL 44 Type XHHW-2 [_____].]

b. [UL 83, Type [_____][THWN-2]] [UL 44, Type [XHHW-2] [_____] must be used for secondary series lighting circuits to be installed in pavement.]

2.25.1.3 Wire and Cable for Series Lighting Circuits

****
NOTE: FAA AC 150/5345-7 covers Type B

ethylene-propylene) and Type C (crosslinked polyethylene) cable. Each type has 600 volt and 5000 volt ratings with single and multiple conductors. Type B has an overall jacket while Type C only has the overall jacket for the multiple conductor cables. Type C is recommended for single conductor cable.

****

a. FAA AC 150/5345-7, Type L-824 for [crosslinked polyethylene Type C] [Type B] [600] [5000]-volt cable. Use unshielded cable for series airfield and heliport lighting.

****

NOTE: Provide safety equipment ground per NEC.

****

2.25.1.4 Safety (Equipment) Grounding System

Safety (Equipment) Grounding System for constant voltage (parallel) circuits: minimum 16 square mm #6 AWG bare stranded copper, annealed or soft drawn.

2.25.1.5 Sequence Flashing Trigger Circuits

[REA Bull 1753F-205] [_____] compliant cables.

2.25.1.6 Control Cable

[Multiconductor type for 120 V ac control, rated 600 volts, 4 square mm #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 194 degrees F. Conductors must be color coded. An overall jacket of [heavy-duty neoprene][_____] rated for direct burial must be included. Cable must conform to NEMA WC 70for rubber insulation, ANSI/NEMA WC 71/ICEA S-96-659 for cross-linked polyethylene insulation, or NEMA WC 74/ICEA S-93-639 for ethylene-propylene rubber insulation.][Multiconductor type for 48 V dc control, rated 300 volts, 19 square mm #19 AWG, conforming to REA Bull 1753F-205.]

[2.25.1.7 Cable Tags

Install cable tags for each cable or wire at duct entrances entering or leaving manholes, handholes, and at each terminal within the lighting vault, and in all base cans. Use stainless steel, bronze or copper strip cable tags, approximately 1.59 mm 1/16 inch thick or hard plastic 3.18 mm 1/8 inch thick suitable for immersion in salt water and impervious to petroleum products. Use sufficient material length for imprinting the legend on one line using raised letters. Permanently mark or stamped with letters not less than 6.4 mm 1/4 inch in height as indicated. Two-color laminated plastic is acceptable. When providing plastic tags utilize white colored with markings of black color to provide contrast so that identification can be easily read. Use nylon or stainless steel ties must be of a type that will not deteriorate when exposed to water with a high saline content and to petroleum products.

]2.25.1.8 Cable Connectors and Splices

FAA AC 150/5345-26, Item L-823 for connections and splices appropriate for FAA Type L-824 cable.

2.25.2 Conduit, Conduit Fittings, and Boxes

2.25.2.1 Rigid Metal Conduit (RMC) or Electrical Metallic Tubing (EMT) and Fittings

UL 6 and UL 797.

2.25.2.2 Liquid-tight Flexible Metal Conduit (LFMC)

UL 360 liquid-tight flexible metal conduit. See Sections 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION and 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.25.2.3 Outlet Boxes for use with RMC, EMT, of LFMC

See 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.25.2.4 Plastic Duct for Concrete Encasement

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

2.25.2.5 Plastic Conduit for Direct Burial

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

2.25.2.6 High Density Polyethylene (HDPE) Electrical Conduit for Directional Bore

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

2.25.2.7 Frangible Couplings and Adapters

FAA FO 6850.19 and FAA E-2519. Provide upper section of frangible coupling with one of the following:

a. Unthreaded for slip-fitter connections.

b. 61.1 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 5.6 mm 7/32 inch nominal wall thickness to accept rigid conduit coupling.

d. Frangible Couplings for specialized applications as approved.

e. Electrical Metallic Tubing UL 797, where indicated for use with frangible couplings and adapters.

2.25.3 Electrical Tape

Provide as specified in Section 33 71 02 UNDERGROUND ELECTRICAL

DISTRIBUTION.

2.25.4 Ground Rods

As specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.25.5 Bolts and Hardware

2.25.5.1 Locking Type Washers

Use locking washers of the two-piece wedge-lock design to prevent damage to the fixture. Do not use split-ring, serrated or star type lock washers.

2.25.5.2 Anti-Seize Compound

Use anti-seize compounds for elevated light fixtures with stainless steel bolts but not for ceramic-metallic/fluorocarbon polymer coated bolts for in-pavement light fixtures. Use as recommended by the fixture manufacturer to provide the required clamping force except as indicated in Part 3 of this specification.

2.25.5.3 Ceramic-Metallic/Fluorocarbon Polymer Coated Bolts

Ceramic-metallic/fluorocarbon polymer coated bolts must be used for in-pavement light fixtures or may be used where recommended by the fixture manufacturer in lieu of using an anti-seize compound.

2.25.5.4 Stainless Steel Bolts for Elevated Fixtures

Use anti-seize lubricating compound.

2.25.6 Sealants for Fixtures and Wires in Drilled Holes or Saw Kerfs

****
NOTE: Keep this paragraphand only if paragraph "ENCLOSURES IN SAW KERFS AND DRILLED HOLES" in PART 3 is kept.
****

FAA AC 150/5370-10, Type P-605 and P-606, for use in asphaltic concrete (AC) or Portland cement concrete (PCC) pavement compatible with AC pavement and having a minimum elongation of 50 percent. Do not use formulations of Type P-606 which are compatible with PCC pavement only.

2.25.7 Manufacturer's Nameplates

Provide on each item of equipment a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.25.8 Field Fabricated Nameplates

Provide field fabricated nameplates as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.25.9 Spare Airfield Lighting Equipment Materials

[
****

NOTE: Spare materials are optional for Air Force and Army projects, and not recommended for Navy projects. Coordinate quantities of spare materials with users.

****

Contractor must provide the following equipment and materials:

a. Lamps - Type and Quantity

b. Isolation Transformers - Type and Quantity

c. Constant Current Regulators - Type and Quantity

d. FAA L-823 Connectors - Type and Quantity

e. Control Cable - Type and Quantity

f. FAA L-824 Cable - Type and Quantity

g. Lamps for Airfield Lighting Fixtures and Signs

h. Refractors and Filters for Airfield Lighting Fixtures - Type and Quantity

i. Light Bases - Type and Quantity

j. Frangible Couplings - Type and Quantity

k. Sequenced Flashing Light System - Provide a spare part trunk with parts.]

2.26 ACCESSORIES

2.26.1 Special Tools

List of special tools and test equipment required for installation, maintenance of testing of the products supplied by the Contractor. Items to be listed include, but are not limited to, the following:

4-Jack Positioning Jig, used to install the light base to ensure correct orientation and leveling of in-pavement fixtures.

Crimping Tool

Cable Penciler

Elevated Light Level

PART 3 EXECUTION

3.1 LIGHT FIXTURE INSTALLATION REQUIREMENTS

[3.1.1 Existing Airfield Lighting Systems

****

NOTE: When modifications, additions, or any other work is to be performed on an existing airfield lighting system, the designer must 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. The paragraph must be coordinated with Division 1 specifications. An example of this paragraph follows:

"Existing airfield lighting systems must remain in operating condition and interruptions must be held to a minimum. Where interruptions are necessary, they must 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 must be assembled to permit completing the work within the scheduled time interval. Under no circumstances must 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 must be replaced in such a manner that they will be operational at dusk each day. The Contractor must submit to the Contracting Officer a plan for outages and maintaining lighting and lighting control."

****

[_____].

]3.1.2 General Installation Requirements

[Conform to IEEE C2, NFPA 70, NFPA 70B, and requirements specified herein. Circuits installed underground must conform to the requirements of Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION], except as required herein. Steel conduits installed underground must be installed and protected from corrosion in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical metallic tubing (EMT) must not be installed underground or encased in concrete. Except as covered herein, perform excavation, trenching, and backfilling in accordance with the requirements of Section 31 00 00 EARTHWORK and Section 32 11 23.23 BASE COURSE DRAINAGE LAYERS.

3.1.3 Airfield Light Fixture Installation

****

NOTE: For all projects do not use anti-seize compounds on runway/taxiway centerline or runway touchdown zone lights.

****

Use 2-part locking type washers for the installation of all airfield light fixtures. Tighten bolts to washer manufacturers recommended torque based on bolt type used. Use only adjustable torque limiting tools.

Where stainless steel bolts are used for elevated fixture installation use an anti-seize lubricating compound.

Where ceramic-metallic/fluorocarbon polymer coated bolts are used for in-pavement fixture installation do not use anti-seize lubricating

compounds.

3.1.4 Light Base Installation

3.1.4.1 Installation in Cored Pavement

****

NOTE: Provide details on the project drawings showing the installed light fixture with reference to the finished pavement.

****

Wipe down the sides and bottom of each light base immediately prior to installation. For bored hole installations cover the inside faces of bored hole and bottom and sides of light base with a coating of compatible P-606 sealant that will completely fill the void between concrete and base. Use a jig or holding device when installing each light fixture to ensure positioning to the proper elevation, alignment, level control, and azimuth control. Orient the light fixture with the light beams parallel to the runway or taxiway centerline and facing in the required direction. Outermost edge of fixture must be level with the surrounding pavement. Remove surplus sealant or flexible embedding material. The holding device must remain in place until sealant has reached its initial set. Properly arrange fixture lead wires with respect to their connecting position. Block the wireway entrance into the light recess to retain the sealant material during curing.

3.1.4.2 Installation in Concrete Bed

Where light base can is partially embedded in concrete with jig or holding devices, leave device in place for minimum 24 hours. Let base can set for an additional 48 hours before remaining concrete is placed to the top of the light base.

3.1.5 Frangible Requirements

Install frangible supports, couplings, and adapters as indicated or specified. At the 300 m 1000 foot cross bar and beyond, mount approach lights up to 1.83 m 6 feet above concrete foundation on threaded frangible couplings and 53 mm 2 inch electrical metallic tubing (EMT). For mounting heights greater than 1.8 m 6 feet, mount approach lights on low-impact resistant frangible towers as indicated. The elevation of approach lights must be as indicated on drawings.

3.1.6 Elevated Light Fixtures

Elevated lights must be frangibly mounted, not to exceed 350 mm 14 inches in height except where higher mounting is permitted in snow accumulation areas. For equipment exceeding 350 mm 14 inches in height, frangibly mount as indicated. Use a 4-jack positioning jig to install the light base to ensure correct orientation and leveling. The individual setting the jig must fully understand reference marks that are provided by the surveyor. Check azimuth by survey before the concrete anchor is placed and again before paving. [A factory representative of the light base manufacture must be on-site when the first light base is being installed and verify that the installation crew understands proper azimuth and elevation required for the light base.]Do not place the near light base edge closer than two feet from a planned pavement joint. If conflict occurs, immediately notify the Contracting Officer Representative of the

conflict.

3.1.6.1 Elevated Light Level

Level elevated light fixture using manufacturers system required for fixture type.

3.1.7 In-Pavement Airfield and Heliport Lights

****
NOTE: Coordinate light fixtures with concrete joint to maintain the proper pattern. Reference Section 32 13 11 CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY-DUTY PAVEMENTS MORE THAN 10,000 CUBIC YARDS for PCC requirements. See UFC 3-535-01 Figure 4-11, Runway Centerline Light Configuration Note 2 for longitudinal tolerance that light bases my be offset from the pavement joint by up to 0.60 m2 feet.
****

Remove water, debris, and other foreign substances prior to installing in-pavement light base and light. Use a 4-jack positioning jig, obtained from the L-868 base manufacturer, to install the light base to ensure correct orientation and leveling. The individual setting the jig must fully understand reference marks that are provided by the surveyor. Check azimuth by survey before the concrete anchor is placed and again before paving. [A factory representative of the light base manufacture must be on-site when the first light base is being installed and verify that the installation crew understands proper azimuth & elevation required for the light base.]Do not place the near light base edge closer than two feet from a planned pavement joint. If conflict occurs, immediately notify the Contracting Officer Representative of the conflict.

3.1.7.1 In-Pavement Light Installation

For in-pavement installations, pavement around the light base must be level with the surrounding pavement; dished or mounded pavement near the light base is not acceptable.

3.1.7.2 Snow Plow Ring Installation

For in-pavement fixtures that require snow plow rings, coordinate the light base can, light fixture and snow plow ring to meet the installation tolerances shown in the paragraph Light Fixture Installation Tolerances. The Contractor may need to provide spacer rings to meet these tolerances. The top edge of the snow plow ring must be slightly higher than the top of the light fixture. Install the silicone rubber O-ring to seal the light base can. Install the ceramic fluoropolymer coated bolts to attach the light fixture and snow plow ring to the light base can.

3.1.8 Light Fixture Installation Tolerances

	IN-PAVEMENT	ELEVATED
ELEVATION (relative to finished pavement surface)	+0 mm+0 inch, -1.59 mm-1/16 inch (fixture edge on low side in snow areas or on high side in non-snow areas)	+6.35 mm, -0 mm+1/4 inch, -0 inch
AZMUTH (*) (w/respect to line parallel to RW/TW centerline)	+/- 1/2 degree	+/- 1/2 degree
LEVEL	+/- 1/2 degree	+/- 1/2 degree
STATIONING (in line parallel to RW/TW centerline)	+/- 2 inch	+/- 50.8 mm+/- 2 inch
OFFSET (perpendicular to RW/TW centerline)	+/- 1/4 inch	+/- 6.35 mm+/- 1/4 inch

(*)For omni-directional fixtures the Azimuth does not apply.

[3.1.9 Enclosures in Saw Kerfs and Drilled Holes

3.1.9.1 Holes for Light Fixtures

Bore holes in existing pavement to the dimensions indicated with a diamond-edged bit to provide a smooth, straight cut. Bottom of hole must be flat or slightly concave, except that an area at least 25 mm 1 inch wide around the perimeter must be flat. Fill surfaces deeper than the prescribed depth with sealant to the level of the flat area and allow sealant to cure before further placement.

3.1.9.2 Holes for Transformer Enclosures

Drill or excavate 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.

3.1.9.3 Saw Kerfs and Splice Chambers

Cut saw kerfs and splice chambers in pavements where indicated. Saw cuts must be in straight lines with vertical sides. Width and depth of saw cuts must be adequate for the required number of wires. Chamfer the vertical edges of saw kerfs at intersections. Where a saw kerf crosses a construction joint, increase the depth sufficiently to allow for slack wire under the joint. Enclose the wire in flexible tubing which extends not less than 0.60 m 2 feet each side of the joint.

3.1.9.4 Sandblasting

Sandblast saw kerfs, grooves, and holes to remove foreign or loose material. Use approved equipment maintained in good working order. Utilize the proper size and quality of sand necessary to perform the work. Use nozzles of the proper size in relation to the groove or holes to be cleaned. Replace nozzles enlarged by wear as necessary. Sandblast air
pressure must be not less than 620 kPa 90 psi.

3.1.9.5 Cleaning

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

]3.1.10 Isolation Transformers

Conform to FAA AC 150/5345-26 for transformer lead connections. Plug transformer secondary connectors directly into a mating connector on the transformer secondary leads. During installation, cover mating surfaces of connectors until connected and clean when plugged together. At joint where connectors come together, install heat shrinkable tubing with waterproof sealant or with two half-lapped layers of tape over the entire joint. Joint must prevent entrapment of air which might subsequently loosen the joint.

3.2 CABLES

3.2.1 Cable Installation

In addition to the requirements of Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION, use kit type connectors to splice 5 kV single-conductor series lighting cables. 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. [Alternately, provide two half lapped layers of tape over the entire joint.]Joint must prevent entrapment of air which might subsequently loosen the joint.

3.2.2 Low Voltage Cables

For splices in wires 10 square mm #8 AWG single conductor cable, use [FAA AC 150/5345-26 Type L-823 connectors] [noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A-486B, and covered with an insulation and jacket material equivalent to the conductor insulation and jacket.] Splices below grade or in wet locations must be sealed type conforming to NEMA C119.1 or must be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

Cable must be rated 600 volts, except that secondaries of isolation transformer to in-pavement lights installed in pavement saw kerf and 48 volt DC control cables may be 300 volts. Other parts of cable systems such as splices and terminations must be rated at not less than 600 volts. Splices in wires 16 square mm #10 AWG and smaller must be made with an insulated, solderless, pressure type connector, conforming to the

applicable requirements of UL 486A-486B. Splices in wires 10 square mm #8 AWG single conductor cable must be made with [FAA AC 150/5345-26 Type L-823 connectors] [noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A-486B. They must then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket.] Splices below grade or in wet locations must be sealed type conforming to NEMA C119.1 or must be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

3.2.3 Airfield 5kV Series Lighting Cables

3.2.3.1 Connectors

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

3.2.3.2 Crimping Tool

Use only splice kit manufacturer's crimping tool on splice connectors for all primary and secondary airfield cable splices. Crimping tool must have an embossed die with gauge marks for gauge of cable being used.

3.2.3.3 Cable Penciler

Airfield cable insulation must only be removed using cabling penciler made specifically for airfield cable.

[3.2.4 Installation of Circuit Wires in Saw Kerfs

****

NOTE: Wherever practical, install cables in approved underground duct. Direct installation in saw kerfs is only permitted in existing pavements. Ensure the cable is constrained below the pavement surface and protected from damage resulting from differential expansion or movement. Delete this paragraph if no shallow-based fixtures are being installed in existing pavement.

****

Place wires in saw kerfs and anchor them at bottom by means of rubber or plastic wedges or noncorrosive metal clips placed every 0.60 to 0.90 m 2 or 3 feet or as often as necessary to hold the wire down. Encase wires crossing existing joints in a 600 mm 24 inch length 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. Center flexible tubing on the joint and ensure the tubing is 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. The adjacent joint area must be packed 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.

3.2.4.1 Splicing Fixtures to the Wires in Pavement Saw Kerfs

****
NOTE: Delete this paragraph if paragraph "Installation of Circuit Wires in Pavement" is not kept.
****

Use preinsulated watertight connector sleeves crimped with a tool that requires a complete crimp before tool can be removed. Tape splice with plastic insulating tape.

]3.2.5 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. Provide not less than two tags per cable in in each manhole or handhole, one near each duct entrance hole. Immediately after cable installation, permanently attached tags to cables and wires so that they cannot be accidentally detached.

3.2.6 Maximum Allowable Non-Armored Cable Pulling Tension, Using Dynamometer

Cable	Tension LB Kg
2 - 1/C #8 solid	275 125
3 - 1/C #8 solid	367 167
4 - 1/C #8 solid	550 250
2 - 1/C #6 stranded	420 191
3 - 1/C #6 stranded	630 286
4 - 1/C #6 stranded	840 382
1 - 2/C #8 stranded	305 139
1 - 3/C #8 stranded	395 180
1 - 4/C #8 stranded	585 266
1 - 2/C #6 stranded	455 207
1 - 3/C #6 stranded	685 311
1 - 4/C #6 stranded	880 400
1 - 6/C #12 stranded	315 143
1 - 12/C #12 stranded	630 286
1 - 12 pair #19 solid	230 105
1 - 25 pair #19 solid	541 246
1 - 50 pair #19 solid	1061 482
1 - 100 pair #19 solid	2000 909

3.3 COUNTERPOISE

****

NOTE: For Navy projects connect the counterpoise to the external ground lug of each fixture base and the ground rod spacing is 600 m 2000 feet. For Army and Air Force projects only connect the counterpoise to in-pavement fixture bases in full strength pavement (i.e. where they are subject to routine air craft traffic). Edit the following paragraphs as required.
****

Install counterpoise above multiple conduits/duct banks for airfield lighting cables, with the intent being to provide a complete cone of protection over the airfield lighting cables. When multiple conduits and/or duct banks for airfield cable are installed in the same trench, the number and location of counterpoise conductors above the conduits must be adequate to provide a cone of protection measured 22 1/2 degrees each side of vertical. Install one continuous length of conductor, except where distance exceeds the length usually supplied. Install the counterpoise approximately 150 mm 6 inches above single duct lines that are not adjacent to pavement. Where trenches or duct lines intersect, electrically interconnect the counterpoise wires. Connect the counterpoise conductor to a ground rod at every 600 m 2,000feet of cable run, at lighting vault(s) (but not to vault equipment), and at feeder connection to light circuit(s). Install the counterpoise conductor in a separate duct under roads, railroads and paved areas, above the highest duct containing electrical or communications circuits.

****
NOTE: Retain this paragraph for Army and Air Force projects.
****

For in-pavement light fixtures, [connect the counterpoise to the exterior one-hole ground lug on fixture bases installed in pavement subject to routine aircraft traffic (runway touchdown zone lights, runway centerline lights, runway guard lights and taxiway centerline lights). Where fixture bases are installed in pavement not subject to routine aircraft traffic (runway and taxiway edge lights) do not connect the counterpoise to fixture bases. In such cases, install the counterpoise at a location half way between the fixture line and the defined runway or taxiway edge. Use exothermic welding for all counterpoise connections.] Provide counterpoise ground rods at maximum 600 m 2,000 foot spacing.

****
NOTE: Retain this paragraph for Navy projects.
****

[The counterpoise must be connected to the exterior one-hole ground lug on fixture bases. Use bolted ground clamps when bases are supplied with ground lug. Bolts and fasteners must be bronze or stainless steel. Torque to manufacturer's recommendation.]

3.4 SAFETY (EQUIPMENT) GROUNDING SYSTEM

****
NOTE: The Army and Air Force preferred method of grounding is to have safety (equipment) ground separate and not connected to the counterpoise. The light fixtures, equipment and buildings are connected to the safety ground.

****

The purpose of the safety ground is to protect personnel from possible contact with an energized light base that may result from a shorted power cable or isolation transformer. Install and connect a 16 square mm #16 AWG conductor by one of the following methods from base to a ground rod

a. Connect each fixture base to a dedicated ground rod located outside the base on the side opposite the counterpoise.

b. Bond a group of adjacent fixture bases to a common safety ground conductor.

Connect the safety ground conductor to ground rods by exothermic welding and bolted connections. A safety ground is not required for in-pavement fixture bases where a counterpoise is connected to the exterior ground lug. In all cases connect the light fixture, whether in-pavement or elevated, to the base interior ground lug by means of a braided ground strap specified in paragraph "Light Bases".

3.5 DUCT LINES

****

NOTE: For all projects with underground electrical work, use 33 71 02, UNDERGROUND ELECTRICAL DISTRIBUTION. When editing the appropriate, communication lines run elsewhere will be provided with the type of wall thickness that is in accordance with the appropriate communication agency's policy. Electrical metallic tubing will not be installed underground or encased in concrete.

****

Duct lines as required in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION and as indicated. Ducts must be installed in trench for 24 hours before trench is backfilled to allow ducts to reach final ground temperature.

3.6 MANHOLES AND HANDHOLES

****

NOTE: When editing the appropriate project specification, the designer will edit the guide specification as necessary to suit the specific airfield or heliport installation. Note that airfield type manholes, vaults, handholes, and their associated frames and covers, located in areas subject to aircraft operation (including paved shoulders), require a design for a maximum single wheel load of 75,000 pounds 34,000 kg at a contact pressure of 250 psi 1,724 kPa. Where located in unpaved shoulders require a design for a maximum single wheel load of 50,000 pounds 22,667 kg at a contact pressure of 250 psi 1,724 kPa. Use steel conforming to ASTM A 36/A 36M, for covers to airfield manholes, vaults, and handholes. Use ductile iron for frames conforming to ASTM A 536, grade 65-45-12.

****

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NOTE: For Navy projects use airfield rated handholes for low voltage and constant current circuits. Manholes can only be used with NAVFAC or FEAD approval. Delete references to manholes as required.

****

The manholes and handholes as required in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.6.1 [Manholes and]Handholes Within Paved Areas

[Manholes and h][H]andholes within paved areas must have their top surface flush with grade, -0 to +6.35 mm -0 to +1/4 inch.

3.6.2 [Manholes and]Handholes Within Unpaved Areas

[Manholes and h][H]andholes within unpaved areas must have their top surface +/-25.4 to +50.8 mm +1 to +2 inches above grade.

3.7 MARKING AND LIGHTING OF AIRWAY OBSTRUCTIONS

****

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 information on marking of obstructions.

****

Mark and light all towers, poles, smokestacks, buildings of certain shapes and sizes, and other obstructions in accordance with FAA AC 70/7460-1 and as indicated.

3.7.1 Painting of Airway Obstructions

Conform with FAA AC 70/7460-1 and as indicated for patterns and colors to mark obstructions.

3.7.2 Obstruction Marker Lights

Install obstruction marker lights on radio towers, elevated water tanks, smokestacks, buildings, and similar structures with 27 mm 1 inch zinc-coated rigid steel conduit stems using standard tees and elbows, except that lowering devices, when required, must be installed in accordance with equipment manufacturer's recommendations.

3.8 APPROACH LIGHTING SYSTEMS

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

3.8.1 Frangible Requirements

At the 300 m 1,000 foot crossbar and beyond, mount overrun lights up to 1.8 m 6 feet above concrete foundations on threaded frangible couplings and

53 mm 2 inch RMC or EMT conduit. For mounting heights greater than 1.8 m 6 feet, install light on low impact-resistant (LIR) frangible supports. When rigid towers, trestles, and similar structures are required, install the light unit at least 6 m 20 feet above the rigid structure with this support unit being frangible.

3.8.2 Alignment of Lights

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. In-pavement lights have a preset vertical aiming angle and require alignment in azimuth only.

3.9 ROTATING BEACONS

3.9.1 Airfield Rotating Light Beacon

****
NOTE: Provide foundation and supports drawings for the beacon.
****

Install beacon in accordance with the manufacturer's instructions and other contract requirements including cleaning, lubrication, adjustment, and other special instructions. Provide foundations and supports as indicated.

3.9.1.1 Beam Adjustment

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

3.9.1.2 Power Supply and Wiring

Install panelboard at working height at ground level with lockable panel cover and disconnects at top of structure to provide separately protected circuits for beacon lamps, heaters, motor, and obstruction lights. Install cabinet on side of platform opposite ladder. Conduit riser must be installed on tower in a corner angle and not near ladder.

3.9.2 Heliport Light Beacon

****
NOTE: Provide foundation and support drawings for the beacon.
****

Install beacon in accordance with the manufacturer's instructions and other contract requirements including cleaning, lubrication, and adjustment.

Provide foundations and supports as indicated.

3.9.2.1 Beam Adjustment

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

principal obstructions.

3.9.3 Power Supply and Wiring

Install panelboard at working height at ground level with lockable panel cover and disconnects at top of structure to provide separately protected circuits for beacon lamps, [heaters,]motor, and obstruction lights. Install cabinet on side of platform opposite ladder. Install conduit riser on tower in a corner angle and must not be located near ladder. The terminal cabinet must be in accordance with NEMA ICS 6 Type 3R or as indicated on drawings.

3.10 WIND DIRECTION INDICATORS

Include in the installation a black circle constructed on a concrete pad the ground with center at center of the base. Guy the wind cone direction indicator as indicated on drawings. Energize the wind cone illumination lights and obstruction lights from [multiple] circuits as indicated.

3.11 CONSTANT CURRENT REGULATORS

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

3.12 CIRCUIT SELECTOR SWITCHES

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

3.13 SIMULATED CARRIER DECK LIGHTING SYSTEM

****
NOTE: The following paragraph is specific to Navy training installations. Delete if not required.
****

[3.13.1 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.

3.13.2 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.

3.13.3 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.

3.13.4 Wire and Connectors

Provide THWN-2 insulation for secondary conductors between isolation transformers and simulated carrier deck fixtures. Provide two-pin connectors in accordance with FAA AC 150/5345-26.

]3.14 APPLICATION

3.14.1 Exothermic Welding

Utilize only personnel who are experienced in and regularly engaged in this type of work to make these connections. Prior to any installations in the field, provide documentation that the welding kits, materials and procedures to be used for welded connections are satisfactory. Comply with the manufacturer's recommendations and the following:

****
NOTE: Delete item c. for Navy projects.
****

a. Remove all slag from welds.

b. The light fixture base cans should be provided with internal and external one-hole ground lugs that are coated with hot dipped galvanizing, the same as the rest of the base cans. The external ground lug should be bolted to a separate ground lug that is exothermically welded to a 21 square mm #4 AWG stranded bare copper grounding cable. That is connected to a ground rod for Air Force or Army projects or the counterpoise for Navy projects.

[c. All direct buried welds must be thoroughly coated 6 mil of 3M "Scotchkote", or approved equivalent, or coated with coal tar bitumastic material to prevent surface exposure to corrosive soil or moisture.]

3.14.2 Field Fabricated Nameplate Mounting

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.

3.14.3 Equipment for Silicone Sealant

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

[3.14.4 Painting

As specified in Section 09 90 00 PAINTS AND COATINGS.

]3.14.5 Concrete

Concrete used in underground structures, such as manholes, handholes, pull boxes and foundations must have minimum 28-day strength of 27.56 MPa 4000 psi. Similar structures in areas where freeze/thaw conditions are common, must have minimum 28-day strength of 31.00 MPa 4500 psi. Concrete used for non-structural items, such as equipment pads, must have minimum 28-day strength of 13.78 MPa 2000 psi.

3.14.6 Grounding

Ground non-current carrying metallic parts associated with electrical

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

3.15 FIELD QUALITY CONTROL

Notify the Contracting Officer [five][_____] working days prior to [each] [_____] test. Correct all deficiencies and repeat tests. Field test reports must be written, signed and provided as each circuit or installation item is completed. Include resistance-to-ground and resistance between conductors field tests, and continuity measurements for each circuit. For each series circuit measure the input voltage and output current of the constant current regulator at each intensity. For multiple circuits measure the input and output voltage of the transformer for each intensity setting. Provide report documenting the visual inspection of the [lights operation] [markings appearance] [installed fixtures or units].

3.15.1 Visual Inspection

Inspection reports must be prepared and provided as each stage of installation is completed. Identify the activity by contract number, location, quantity of material placed, and compliance with requirements.

3.15.2 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.

Provide performance test reports, upon completion and testing of the installed system, in booklet form showing all field tests performed to adjust each component and all field tests performed to provide compliance with the specified performance criteria. For each test, indicate the final position of controls.

3.15.3 Distribution Conductors, 600-Volt Class

Using an instrument which applies a voltage of approximately 500 volts providing a direct reading in resistance, performing testing to verify that no short circuits or accidental grounds exist.

3.15.4 Counterpoise System Test and Inspection

At accessible locations, visually inspect counterpoise system to ensure continuity of counterpoise system. Test continuity of counterpoise system to the vault grounding system in manhole closest to the vault.

3.15.5 Progress Testing for Series Lighting Circuits

****

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

****

Conduct a megger test on each section of circuit or progressive combinations of sections as they are installed. Test each section or progressive combination of sections with a megohmmeter providing a voltage of approximately 1000 volts, a direct reading in resistance. Document all results. Eliminate faults found by these tests, and re-test before proceeding with the circuit installation.

3.15.6 Electrical Acceptance Tests

Perform acceptance tests for series and multiple airfield and heliport lighting circuits only on complete lighting circuits. Each series and multiple lighting circuit must receive a high voltage insulation test. Check that cable insulation resistance to ground is not less than 50 megohms per FAA-C-1391, Installation and Splicing of Underground Cable.

3.15.7 Low-Voltage Continuity Tests

Test each series circuit for electrical continuity. Eliminate faults indicated by this test and perform retest before proceeding with the high-voltage insulation resistance test.

3.15.8 High-Voltage Insulation Resistance Tests

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

a. Test Procedure: Disconnect both leads from regulator output terminals and support so that air gaps of at least 75 mm 3 inches or as defined by FAA AC 150/5345-7 Table 1 exists between bare conductors and ground. Clean and dry cable sheaths for a distance of 25 m 1 feet 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 test voltage applied as specified in the following tabulation between conductors and ground for a period of 5 minutes.

Test Voltage, DC		
	First Test on New Circuits	Test on Existing Circuits

Test Voltage, DC		
High Intensity Series Lighting Circuits (5,000 volt leads, 500 and 200 watt transformers)	9000	5000
Medium Intensity Series Lighting Circuits (5,000 volt leads, 30/45 watt transformers)	6000	3000
600-Volt Circuits	900	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 for each circuit after a 1 minute application of the test voltage. If leakage current exceeds values specified below, sectionalize the circuit and retest, and repair or replace defective parts. Leakage current limits include allowances for the normal number of connectors and splices for each circuit as follows:

1. Three microamperes for each 300 m 1000 feet of cable.

2. Two microamperes for each isolation transformer.

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

c. Resistance Values versus Cable Length

An alternate test procedure for circuit validation is to use a megohmeter. Use 5000V test for new circuits and 3000V test for existing circuits. If the minimum resistance values are not achieved then use the leakage current test indicated above.

Circuit Length in Feet Meters	Minimum Resistance to Ground (Megohms)
10,000<3,000	50
10,000-20,0003,000-6,000	40
>20,0006,000	30

3.16 PHOTOMETRIC TESTING

****

NOTE: Photometric testing of light fixtures is optional but highly recommended for all runway lighting. It is also highly recommended that all newly installed airfield guidance signs and PAPIs be tested. Verify with the Activity that the costs can be included in the project funding. If photometric testing is included see paragraph "Qualifications of Photometric Tester" for possible contacts.

Delete this paragraph for Navy project or if not required.

****

[3.16.1 Inspection

Provide test reports from an FAA approved, third-party, certification body to insure full compliance with the photometric requirements. Submit for approval for each type of light fixtures to the Contracting Officer prior to final acceptance of the installation. Include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.Items to be tested include, but are not limited to, the following:

a. Airfield Guidance Signs

b. Discharge-Type Flashing Light Equipment

c. LED Fixtures or PAPIs

3.16.2 Test Instrument Calibration

a. Use a photometric tester that has a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

b. The accuracy must be directly traceable to the National Institute of Standards and Technology.

c. Instrument calibration frequency schedule must not exceed 12 months.

d. Dated calibration labels must be visible on all test equipment.

e. Calibrating standard must be of higher accuracy than that of the instrument tested.

f. Up-to-date records which indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

    1. Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

2. Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

3.16.3 Pre-Testing Requirements

a. Verify Constant Current Regulator (CCR) Performance. When the CCR is energized at the highest brightness intensity and at the middle brightness intensity, measure the following electrical characteristics for each CCR powering the light fixtures:

1. Input Current.

2. Input Voltage.

3. Input Power Factor.

4. Input Voltage Harmonic Distortion.

5. Input Current Harmonic Distortion.

6. Output Voltage.

7. Output Current.

8. Output Power Factor.

9. Output Voltage Harmonic Distortion.

10. Output Current Harmonic Distortion.

Analyze the data, and perform any adjustments or calibration required.

b. Clean Light Fixture. Clean all of the light fixtures to be tested one day prior to commencement of photometric testing. Perform the photometric testing at night. At the end of each night the photometric testing firm must provide a list of the deficient fixtures to the Contractor for corrections. A minimum 10% spare lamps and/or fixtures, transformers, and other accessories required to correct possible deficiencies must be available so that any corrections can be made daily and retested the following night.

c. Use photometric testing equipment that has an array of photometric sensors capable of taking simultaneous readings along the main photometric beam of the light output in direct correlation with Tables 1, 2, and 3 of the current edition FAA AC 150/5345-46 and the appropriate UFC requirements. The number and angles of measurement as well as sensor location and placement must be in accordance with Paragraphs 4.3.1 and 4.3.3 and the above-mentioned tables of the current edition FAA AC 150/5345-46 which provide specific requirements for photometric testing. Compare the average photometric intensity to the horizontal and vertical requirements detailed in Tables 1, 2, and 3 of the current edition FAA AC 150/5345-46. Include the measurement of each light fixture in both directions. All of the sensor readings for the light fixture being evaluated must be displayed simultaneously for operator and Airport representative review and evaluation. All sensor readings must be recorded automatically through the computer. Hand written data recording will not be accepted. Measure the chromaticity (x, y) or color of 5 percent of the light fixtures to ensure compliance with MIL-C-25050A, "Aviation Colors". Measure the

chromaticity along one point in the center of the main photometric ellipse.

d. The testing firm must submit initial reports daily to the Contractor during the progress of the work so that corrective measures can be taken as required. A list of the deficient fixtures and the photometric output for each fixture must be provided in a field report to the Contractor prior to the testing firm leaving the job-site. Document the final results in a Final Report, with six (6 copies) submitted to the Airport. The final report must present an evaluation of each fixture tested, including proposed or performed corrective measures, such as cleaning or replacement of lenses, re-aiming of fixture, repair or replacement of fixture, for those fixtures that do not meet the performance requirements. Tabulate the photometric test data for each fixture with the following information:

Fixture Number - Provided by Airport.
Light Direction -Direction of light beam (ex. North, South, East, West).
Fixture type - FAA Fixture Type (ex. L-852C).
Lens Color - Color of lens on fixture being tested.
Max CD - Maximum candela output in a point along the main beam.
Avg CD - Average candela output of main beam.
Max/Avg - Ratio of max. candela output over the ave. output.
FAA Min Level - FAA specified output for type of fixture.
Chromaticity - x, y color coordinates of the sample fixture.

3.16.4 Photometric Testing of Airfield Guidance Signs

Evaluate the performance of the guidance signs with respect to RAA criteria (reference test methods in FAA AC 150/5345-44):

****
NOTE: Luminance requirements indicated below are higher than FAA minimum standards.
****

a. Uniformity: Make photometric measurements on a 75 mm 3 inches grid over the entire face of the sign, with no measurement being closer than 75 mm 3 inches to the sign frame. Adjacent measurements must not exceed a 1.5:1 ratio.

b. Discernability: The sign must be discernable from 240 m 800 feet away.

c. Contrast: For L-858R signs the ratio of average luminance between white legend and red background must be no greater than 10:1 and no less than 5:1.

Test all new airfield guidance panels or signs at night. Test the signs at their highest rated input current. Evaluate the photometric performance of the signs using digital color images. Convert these images to gray-scale images that can be analyzed directly for photometric output. To provide calibration and control for the evaluation of the gray-scale image, direct photometric readings of the light output in foot-lamberts (FL) must be taken at several locations on the face of the sign using a calibrated photometer. Only light emitted from the sign is permitted to reach the photometer.

To document compliance with FAA requirements, present the following

information and data for each color for each sign tested in the Final Report:

a. Sign Designation & Date Sign was tested.

b. Digital & Gray-Scale Image of Sign.

c. Step - The step intensity of the regulator controlling the sign.

d. Arithmetic average of luminance levels.

e. Maximum luminance level on sign face and/or message.

f. Minimum luminance level sign face and/or message.

g. Ratio of Maximum luminance to Minimum luminance.

h. Uniformity. The maximum ratio of the average luminance levels of adjacent 75 mm 3 inches areas over the face of the sign.

i. Visual Discernability of the Sign including comments.

j. Statements whether or not sign meets the specified luminance criteria.

Take photometric measurements of the red background on mandatory signs (white message on red background) to evaluate the sign's red to white contrast.

3.16.5 Photometric Testing of Discharge-Type Flashing Light Equipment

To evaluate the equipment performance with respect to the criteria in FAA AC 150/5345-51, paragraph 3.4, perform photometric testing of the discharge-type lights. Conduct tests per FAA-E-1100, Photometric Test Procedures for Condenser Discharge Lights. Include in test results a graph showing the isocandela curve of effective intensity for each brightness setting and oscilloscope photographs or digital image files (e.g., TIF, JPG, BMP) of the discharge pulse shape.

3.16.6 Photometric Testing of PAPIs

Using photometric testing, evaluate the photometric intensity of the PAPI system and verify that the center of the light beams are aimed at the appropriate vertical and horizontal angle. Provide support to adjust the PAPI while it is flight tested by the government.

a. Prior to performing the test measure the electrical characteristics of the CCR, if applicable, powering the PAPI or APAPI circuit. Include the measurement of the Volt-Amperes, Current, Voltage, and Harmonic Distortion for each intensity settings on the both the output and input to the CCR.

b. Sensors. Utilize sensors that are accurate to 5 percent as traceable to the National Institute of Standards and Technology (NIST) secondary standard or approved equal. Sensor must be color corrected to account for the different white and red lens associated with the system.

c. Measurement Points. Test on a one-degree horizontal interval and one-degree vertical interval inside the photometric ellipse indicated in Figure 3-12, UFC 3-535-01.

d. Measurement distance from lighting system. Take measurements at a minimum of 3 m 10 feet from the edge of the lenses.

e. Measurement Duration. Each measurement point must last a minimum of 30 seconds. To minimize stray light which may enter the lens, intentensity measurements at each point must be the average measurement over the 30 second time span.

f. Test Results. Compare measured light intensity values to the minimum values established in Figure 3-12, UFC 3-535-01. The angular difference for successive light units in a light bar must comply with paragraph 3-7.3.1, UFC 3-535-01.

]3.16.7 Constant Current Regulators

3.16.7.1 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.

3.16.7.2 Electrical 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 must 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 must 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.

3.17 FINISHING

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

3.18 CLOSEOUT ACTIVITIES

3.18.1 Demonstration

After completion of installations and the above tests, circuits, control equipment, and lights covered by the contract must be demonstrated to be in acceptable operating condition. Each switch in the control tower lighting panels must be operated so that each switch position is engaged at least twice. During this process, lights and associated equipment must be observed to determine that each switch properly controls the corresponding circuit. Telephone or radio communication must be provided between the operator and the observer. Tests must be repeated from the alternate control station, from the remote control points, and again from the local control switches on the regulators. Each lighting circuit must be tested by operating the lamps at maximum brightness for not less than 30 minutes. At the beginning and at the end of this test the correct number of lights must be observed to be burning at full brightness. [One][_____] day and [one][_____] night operating test must be conducted for the Contracting Officer.

3.18.2 Training

Submit requirements of training [four][_____] weeks before training is scheduled to begin. Submit information describing training to be provided, training aids to be used, samples of training materials, and schedules; instructions necessary to checkout, troubleshoot, repair, and replace components of the systems, including integrated electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting after acceptance of the system.

a. Provide training on the proper operation and maintenance procedures for the system. Submit a list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor.

b. Submit [six][_____] copies of operation for the equipment furnished. One complete set must be furnished prior to performance testing and the remainder must be furnished upon acceptance. Operating manuals must detail the step-by-step procedures required for system startup, operation, and shutdown. Operating manuals must include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features.

c. Submit [six][_____] copies of maintenance manuals listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals must include conduit and equipment layout and simplified wiring and control diagrams of the system as installed.

3.18.3 As-Built Drawings

Submit as-built drawings that provide current factual information including deviations from, and amendments to the drawings and changes in the work, concealed and visible, as instructed. The as-built drawings must show installations with respect to fixed installations not associated with the systems specified herein. Cable and wire must be accurately identified as to direct-burial or in conduit and must locate the connection and routing to and away from bases, housings, and boxes.

3.18.4 Posted Instructions

Submit a typed copy of the proposed posted instructions showing wiring, control diagrams, complete layout and operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system.

3.19 MAINTENANCE

3.19.1 List of Parts

A list of parts and components for the system by manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair necessary to ensure continued operation with minimal delays.

3.19.2 Maintenance and Repair Instructions

Instructions necessary to check out, troubleshoot, repair, and replace components of the systems, as specified.

3.19.3 Posted Operations and Maintenance Instructions

Submit proposed diagrams, instructions, and other sheets prior to posting.

3.20 SCHEDULES

Refer to Section 01 35 13 SPECIAL PROJECT PROCEDURES for construction outage plan requirements.

-- End of Section --