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|---|---|
| **USACE / NAVFAC / AFCEC / NASA** | **UFGS-26 41 00 (November 2013)** |
| | **----------** |
| **Preparing Activity: NAVFAC** | **Superseding** |
| | **UFGS-26 41 01.00 10 (November 2008)** |
| | **UFGS-26 41 00.00 20 (April 2006)** |

**UNIFIED FACILITIES GUIDE SPECIFICATIONS**

**References are in agreement with UMRL dated January 2021**

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DIVISION 26 - ELECTRICAL

SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM

**11/13**


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SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM
**11/13**

**********
**NOTE: This guide specification covers the requirements for lightning protection systems for non-ordnance facilities. Modify this guide specification as needed to address unique requirements for ordnance-related facilities. Follow requirements in UFC 3-575-01, "Lightning and Static Electricity Protection Systems" and contact the service-specific ordnance organization for guidance.**

**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).**
**********

**********
**NOTE: Show the following information on the project drawings:**

**1. Location and height of air terminals.**

**2. Location of down conductors, including locations where down conductors are subject to physical damage and require additional protection.**

**3. Location of ground rods.**

**4. Location of ground ring electrodes or alternate**

**methods for grounding electrodes (if any).**

**5. Location of test wells.**

**6. Fence and gate bonding details.**

**7. For additions to lightning protection systems on existing facilities, show locations of tie-in points.**

**********

PART 1 GENERAL

1.1 REFERENCES

**********

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

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

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

**********

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE 81 | (2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code |
| NFPA 780 | (2017) Standard for the Installation of Lightning Protection Systems |

U.S. AIR FORCE (USAF)

| | |
|---|---|
| AFI 32-1065 | (2017) Grounding Systems |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 96 | (2016) UL Standard for Safety Lightning Protection Components |
| UL 467 | (2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment |
| UL Electrical Construction | (2012) Electrical Construction Equipment Directory |

## 1.2 RELATED REQUIREMENTS

### 1.2.1 Verification of Dimensions

Confirm all details of work, verify all dimensions in field, and advise Contracting Officer of any discrepancy before performing work. Obtain prior approval of Contracting Officer before making any departures from the design.

### 1.2.2 System Requirements

**********

**NOTE: This specification is based on compliance with NFPA 780 as specified in UFC 3-575-01, "Lightning and Static Electricity Protection Systems".**

**NFPA 780 requires surge protective devices (SPDs) at all service entrances as part of a lightning protection system. Include Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM to specify SPD requirements.**

**********

Provide a system furnished under this specification consisting of the latest UL Listed products of a manufacturer regularly engaged in production of lightning protection system components. Comply with NFPA 70, NFPA 780, and UL 96.

### 1.2.3 Lightning Protection System Installers Documentation

Provide documentation showing that the installer is certified with a commercial third-party inspection company whose sole work is lightning protection, or is a UL Listed Lightning Protection Installer. In either case, the documentation must show that they have completed and passed the requirements for certification or listing, and have a minimum of 2 years documented experience installing lightning protection systems for DoD projects of similar scope and complexity.

## 1.3 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.**
**********

**********
**NOTE: For the Air Force, modify Division 1 paragraphs to require submission of lightning protection shop drawings, test reports and certificates to the Base Civil Engineer and to the Designer of Record via the Contracting Officer for approval. The Base Civil Engineer retains final site approval authority.**
**********

SD-02 Shop Drawings

Overall lightning protection system; G[, [_____]]

Each major component; G[, [_____]]

SD-06 Test Reports

Lightning Protection and Grounding System Test Plan; G[, [_____]]

Lightning Protection and Grounding System Test; G[, [_____]]

SD-07 Certificates

Lightning Protection System Installers Documentation; G[, [_____]]

Component UL Listed and Labeled; G[, [_____]]

Lightning protection system inspection certificate; G[, [_____]]

Roof manufacturer's warranty; G[, [_____]]

## 1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" or "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.

### 1.4.1 Installation Drawings

#### 1.4.1.1 Overall System Drawing

Submit installation shop drawing for the overall lightning protection system. Include on the drawings the physical layout of the equipment (plan view and elevations), mounting details, relationship to other parts of the work, and wiring diagrams.

#### 1.4.1.2 Major Components

Submit detail drawings for each major component including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions.

### 1.4.2 Component UL Listed and Labeled

Submit proof of compliance that components are UL Listed and Labeled. Listing alone in UL Electrical Construction, which is the UL Electrical Construction Directory, is not acceptable evidence. In lieu of Listed and Labeled, submit written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that items have been tested and conform to requirements and testing methods of Underwriters Laboratories.

### 1.4.3 Lightning Protection and Grounding System Test Plan

Provide a lightning protection and grounding system test plan. Detail both the visual inspection and electrical testing of the system and components in the test plan. Identify (number) the system test points/locations along with a listing or description of the item to be tested and the type of test to be conducted. As a minimum, include a sketch of the facility and surrounding lightning protection system as part of the specific test plan for each structure. Include the requirements specified in paragraph, "Testing of Integral Lightning Protection System"

in the test plan.

[1.4.4 Lightning Protection System Inspection Certificate

**********
**NOTE: Select the first bracketed option for Army and Navy facilities.**

**Select second bracketed option for Air Force facilities.**
**********

[ Provide certification from a commercial third-party inspection company whose sole work is lightning protection, stating that the lightning protection system complies with NFPA 780. Third party inspection company cannot be the system installer or the system designer. Alternatively, provide a UL Lightning Protection Inspection Master Label Certificate for each facility indicating compliance to NFPA 780.

][Provide certification from a commercial third-party inspection company whose sole work is lightning protection, stating that the lightning protection system complies with NFPA 780 and AFI 32-1065. Third party inspection company cannot be the system installer or the system designer. Alternatively, provide a UL Lightning Protection Inspection Master Label Certificate for each facility indicating compliance to NFPA 780 and AFI 32-1065. In either case, AFI 32-1065 takes precedence over NFPA 780, whether or not it is more stringent.

] Inspection must cover every connection, air terminal, conductor, fastener, accessible grounding point and other components of the lightning protection system to ensure 100% system compliance. This includes witnessing the tests for the resistance measurements for ground rods with test wells, and for continuity measurements for bonds. It also includes verification of proper surge protective devices for power, data and telecommunication systems. Random sampling or partial inspection of a facility is not acceptable.

]1.5 SITE CONDITIONS

Confirm all details of work, verify all dimensions in field, and advise Contracting Officer of any discrepancy before performing work. Obtain prior approval of Contracting Officer before changing the design.

PART 2 PRODUCTS

2.1 MATERIALS

Do not use a combination of materials that forms an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, provide conductors with protective coatings, such as tin or lead, or oversize conductors. Where a mechanical hazard is involved, increase conductor size to compensate for the hazard or protect conductors. When metallic conduit or tubing is provided, electrically bond conductor to conduit or tubing at the upper and lower ends by clamp type connectors or welds (including exothermic). All lightning protection components, such as bonding plates, air terminals, air terminal supports and braces, chimney bands, clips, connector fittings, and fasteners are to comply with

the requirements of UL 96 classes as applicable.

2.1.1 Main and Bonding Conductors

**********
**NOTE: NFPA 780 - Class I are ordinary building 23m 75 ft or less in height and Class II are ordinary buildings over 23m 75 ft in height.**
**********

NFPA 780 and UL 96 Class I, Class II, or Class II modified materials as applicable.

[2.1.2 Copper Only

**********
**NOTE: Include the optional copper requirement only if established by technical requirements of the project. Otherwise, code requirements will dictate where copper and aluminum can be used.**
**********

Provide copper conductors, except where aluminum conductors are required for connection to aluminum equipment.

]2.2 COMPONENTS

2.2.1 Air Terminals

Provide solid air terminals with a blunt tip. Tubular air terminals are not permitted. Support air terminals more than 600 mm 24 inches in length by suitable brace, supported at not less than one-half the height of the terminal.

2.2.2 Ground Rods

**********
**NOTE: The designer will determine the type and number of ground rods to be used based on local conditions and earth resistivity data. NFPA 780 allows copper-clad steel, solid copper, or stainless steel ground rods for multiple ground rod applications.**

**Specify copper clad steel rods for normal conditions. The use of other materials such as galvanized coated steel will require written authorization in accordance with the MIL-STD-3007F, Paragraph 5.1.7, "Waivers and Exemptions".**

**In high resistivity soils, 3000 mm 10 foot sectional rods may be used to obtain the required resistance to ground; however, where rock is encountered, additional rods, a ground ring electrode, or ground grid may be necessary. Coordinate and standardize rod selection for individual facilities with other specification sections.**
**********

Provide [ground rods made of [copper-clad steel] [solid copper] conforming to conform to UL 467.] Provide ground rods that are not less than 20 mm 3/4 inch in diameter and 3000 mm 10 feet in length. Do not mix ground rods of copper-clad steel or solid copper on the job.

[2.2.3 Grounding Plates

**********
**NOTE: The use of grounding plates is an allowed alternative to ground rods in areas where excessive rock and surface ledge is encountered.**
**********

Provide grounding plates made of [copper-clad steel][iron][stainless steel] [solid copper] conforming to UL 96.

]2.2.4 Connections and Terminations

Provide connectors for splicing conductors that conform to UL 96, class as applicable. Conductor connections can be made by clamps or welds (including exothermic). Provide style and size connectors required for the installation.

2.2.5 Connector Fittings

Provide connector fittings for "end-to-end", "Tee", or "Y" splices that conform to NFPA 780 and UL 96.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

**********
**NOTE: This specification is based on compliance with NFPA 780 as specified in UFC 3-575-01, "Lightning and Static Electricity Protection Systems".**

**Include bracketed option in first sentence for tie-ins to existing lightning protection systems. Include second bracketed option if ground ring electrodes are required. Include additional bracketed options as appropriate for the lightning protection system design.**
**********

Provide a lightning protection system that meets the requirements of NFPA 780[, including tie-ins to existing lightning protection systems]. Lightning protection system consists of air terminals, roof conductors, down conductors, ground connections, [and] grounding electrodes[ and ground ring electrode conductor]. [Expose conductors on the structures except where conductors are required to be in protective sleeves.] Bond secondary conductors with grounded metallic parts within the building. Make interconnections within side-flash distances at or below the level of the grounded metallic parts.

3.1.1 Roof-Mounted Components

Coordinate with the roofing manufacturer and provide certification that

the roof manufacturer's warranty is not violated by the installation methods for air terminals and roof conductors.

3.1.1.1 Air Terminals

**********
**NOTE: Select bracketed options based on roof type and location.**
**********

[Use adhesive shoes with adhesive approved by the roof manufacturer when installing air terminals on "rubber" (EPDM) type roofs.] [In areas of snow or constant wind, ensure that a section of roofing material (minimum dimensional area of 92,900 square mm 1 square foot) is first glued to the roof and then the air terminal is glued to it unless the roof manufacturer recommends another solution.] [Use a standing seam base for installation of air terminals on a standing seam metal roof that does not produce any roof penetrations.]

3.1.1.2 Roof Conductors

**********
**NOTE: Select bracketed options based on roof type and location. Delete the last bracketed option for concealing roof conductors for Air Force and Navy projects.**
**********

[Use adhesive shoes with adhesive approved by the roof manufacturer when installing roof conductors on "rubber" (EPDM) type roofs.] [Use a standing seam base for installation of roof conductors on a standing seam metal roof that does not produce any roof penetrations.] [Roof conductors are to be concealed within the ceiling cavities as much as practicable.]

3.1.2 Down Conductors

**********
**NOTE: Select bracketed option if down conductors are to be concealed. Delete the bracketed option for Air Force and Navy projects.**
**********

Protect exposed down conductors from physical damage as required by NFPA 780. Use Schedule 80 PVC to protect down conductors. Paint the Schedule 80 PVC to match the surrounding surface with paint that is approved for use on PVC. [Down conductors are to be concealed within the wall cavities.]

3.1.3 Ground Connections

Attach each down conductor [and ground ring electrode] to ground rods by welding (including exothermic), brazing, or compression. All connections to ground rods below ground level must be by exothermic weld connection or with a high compression connection using a hydraulic or electric compression tool to provide the correct circumferential pressure. Accessible connections above ground level and in test wells can be accomplished by mechanical clamping.

3.1.4 Grounding Electrodes

**********

**NOTE: Where soil conditions indicate definitely that a ground ring electrode will not be required, all references to a ground ring electrode should be deleted from the specifications.**

**If required by soil conditions, select an alternate method for grounding electrodes in shallow soil. Utilize NFPA 780 or an alternate method meeting the intent of NFPA 780. Validate by calculations or historical data for site conditions. Modify the wording below as necessary to specify the system design.**

**********

Extend driven ground rods vertically into the existing undisturbed earth for a distance of not less 3000 mm 10 feet. Set ground rods not less than 915 mm 3 feet nor more than 2440 mm 8 feet, from the structure foundation, and at least beyond the drip line for the facility. After the completed installation, measure the total resistance to ground using the fall-of-potential method described in IEEE 81. Maximum allowed resistance of a driven ground rod is [25] [_____] ohms, under normally dry conditions [when a ground ring electrode is not used]. Contact the Contracting Officer for direction on how to proceed when two of any three ground rods, driven not less than 3000 mm 10 feet into the ground, a minimum of 3000 mm 10 feet apart, and equally spaced around the perimeter, give a combined value exceeding 50 ohms immediately after having driven. [For ground ring electrode, provide continuous No. 1/0 bare stranded copper cable. Lay ground ring electrode around the perimeter of the structure in a trench not less than 915 mm 3 feet nor more than 2440 mm 8 feet from the nearest point of the structure foundation, and at least beyond the drip line for the facility. Install ground ring electrode to a minimum depth of 765 mm 30 inches. Install a ground ring electrode in earth undisturbed by excavation, not earth fill, and do not locate beneath roof overhang, or wholly under paved areas or roadways where rainfall cannot penetrate to keep soil moist in the vicinity of the cable.]

[_____]

[3.1.5 Grounding Plates

**********

**NOTE: The use of grounding plates is an allowed alternative to ground rods in areas where excessive rock and surface ledge is encountered.**

**********

Provide a grounding plate for each down conductor. Set grounding plates not less than 915 mm 3 feet nor more than 2440 mm 8 feet, from the structure foundation, and at least beyond the drip line for the facility. Grounding plate is to be buried as deeply in the existing dirt as local conditions allow, without exceeding 3000 mm 10 feet in depth.

]3.2 APPLICATIONS

3.2.1 Nonmetallic Exterior Walls with Metallic Roof

Bond metal roof sections together which are insulated from each other so that they are electrically continuous, having a surface contact of at least 1935 square mm 3 square inches.

[3.2.2 Personnel Ramps and Covered Passageways

**********
**NOTE: Personnel ramps and covered passageways that are in the zone of protection of a lightning protection system, as defined by NFPA 780, do not need additional lightning protection. Protect personnel ramps and covered passageways that are outside the zone of protection with lightning protection conforming to the requirements for buildings of similar construction. Select the bracketed option if lightning protection is required.**
**********

Place a down conductor and a driven ground at one of the corners where the ramp connects to each building or structure. Connect down conductor and driven ground to the ground ring electrode or nearest ground connection of the building or structure. Where buildings or structures and connecting ramps are clad with metal, separately bond the metal of the buildings and ramps to a down conductor as close to grade as possible.

]3.3 INTERFACE WITH OTHER STRUCTURES

[3.3.1 Fences

**********
**NOTE: Select this bracketed option if metal fence and gate systems are located within 6 feet of the lightning protection system.**

**Coordinate with Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION for additional electrical distribution system requirements. Coordinate with Section 32 31 13 CHAIN LINK FENCES AND GATES, for fence grounding requirements.**
**********

Bond metal fence and gate systems to the lightning protection system whenever the fence or gate is within 1830 mm 6 feet of any part of the lightning protection system in accordance with ANSI C2.

][3.3.2 Exterior Overhead Systems

**********
**NOTE: Select this bracketed option whenever overhead systems entering the facility are outside the zone of protection.**
**********

Bond to the nearest down conductor as close to grade as possible. This includes overhead pipes, conduits, cable trays, or any other metallic

objects on the exterior of the building that enter a building. In addition, bond pipes, conduits, and cable trays to any metallic objects (such as steel structural support of air handling units or cooling towers) that are within 1830 mm 6 feet.

]3.4 RESTORATION

Where sod has been removed, place sod as soon as possible after completing the backfilling. Restore, to original condition, the areas disturbed by trenching, storing of dirt, cable laying, and other work. Overfill to accommodate for settling. Include necessary topsoil, fertilizing, liming, seeding, sodding, sprigging or mulching in any restoration. Maintain disturbed surfaces and replacements until final acceptance.

3.5 FIELD QUALITY CONTROL

3.5.1 Lightning Protection and Grounding System Test

**********
**NOTE: Use 25 ohms in the bracketed option unless the specific facility, such as a telecommuunications facility, requires a lower value.**
**********

Test the lightning protection and grounding system to ensure continuity is not in excess of 1 ohm and that resistance to ground is not in excess of [25] [_____] ohms. Provide documentation for the measured values at each test point. Test the ground rod for resistance to ground before making connections to the rod. Tie the grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Include in the written report: locations of test points, measured values for continuity and ground resistances, and soil conditions at the time that measurements were made. Submit results of each test to the Contracting Officer.

-- End of Section --