

SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM

11/13

PART 1 GENERAL

1.1 REFERENCES

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 (2023; ERTA 7 2023; TIA 23-15) National Electrical Code

NFPA 780 (2020) Standard for the Installation of Lightning Protection Systems

JAPANESE STANDARDS ASSOCIATION (JSA)

JIS A 4201 (2003) Protection of Structures Against Lightning

JIS C 60364-5-54 (2006; R 2015) Building Electrical Equipment-Part 5-54: Selection Of Electrical Equipment and Contruction-Grounding Equipment, Protective Conductor and Protective Bonding Conductor

JIS Z 9290 (2014) Protection Against Lightning

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 (2022) UL Standard for Safety Grounding and Bonding Equipment

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

Provide a system furnished under this specification consisting of the latest UL or JIS Listed products of a manufacturer regularly engaged in production of lightning protection system components. Comply with NFPA 70, NFPA 780, UL 96, JIS A 4201, or JIS Z 9290.

For specific high-risk Air Force (AF) projects, such as explosives and communications facilities, the design shall reflect the more stringent NFPA/AFMAN requirements. Certification shall be executed by either third-party or AF-approved personnel in accordance with AFMAN standards.

1.2.3 Lightning Protection System Installers Documentation

Provide documentation showing that the installer is a company whose sole work is lightning protection in compliance with Japanese industry standards, 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

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

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 or JIS 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 or JIS Listed and Labeled

Submit proof of compliance that components are UL or JIS Listed and Labeled.

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

[Provide documentation from a commercial third-party inspection company whose sole work is lightning protection, stating that the lightning protection system complies with NFPA 780, JIS A 4201, or JIS Z 9290. Third party inspection company cannot be the system installer or the system designer.

][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.

] 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, JIS A 4201 or JIS Z 9290 classes as applicable.

2.1.1 Main and Bonding Conductors

NFPA 780, UL 96 or JIS A 4201 modified materials as applicable.

[2.1.2 Copper Only

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 in length by suitable brace, supported at not less than one-half the height of the terminal.

2.2.2 Ground Rods

Provide [ground rods made of [copper-clad steel] [solid copper] conforming to conform to UL 467 or JIS C 60364-5-54.] Provide ground rods that are not less than 20 mm in diameter and 3000 mm in length. Do not mix ground rods of copper-clad steel or solid copper on the job.

[2.2.3 Grounding Plates

Provide grounding plates made of [copper-clad steel][iron][stainless steel] [solid copper] conforming to UL 96, JIS A 4201 or JIS Z 9290.

12.2.4 Connections and Terminations

Provide connectors for splicing conductors that conform to UL 96, JIS A 4201, or JIS Z 9290 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, UL 96, JIS A 4201 or JIS Z 9290.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

Provide a lightning protection system that meets the requirements of NFPA 780, JIS A 4201[, including tie-ins to existing lightning protection systems], or JIS Z 9290. 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

[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) 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

[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

Protect exposed down conductors from physical damage as required by NFPA 780, JIS A 4201, JIS Z 9290. 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

Extend driven ground rods vertically into the existing undisturbed earth for a distance of not less 3000 mm. Set ground rods not less than 915 mm nor more than 2440 mm, 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 into the ground, a minimum of 3000 mm 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 nor more than 2440 mm 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. 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

Provide a grounding plate for each down conductor. Set grounding plates not less than 915 mm nor more than 2440 mm, 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 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.

[3.2.2 Personnel Ramps and Covered Passageways

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

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

]3.3.2 Exterior Overhead Systems

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.

]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

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 --