

## SECTION 16B

## LIGHTNING PROTECTION SYSTEM

## PART 1 - GENERAL

1. **APPLICABLE PUBLICATIONS:** The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

**Federal Specifications (Fed. Spec.):**

W-S-610C                      Splice Conductor  
and Am-1

**National Fire Protection Association (NFPA) Publications:**

No. 70-1984                      National Electrical Code

No. 78-1983                      Lightning Protection Code

**Underwriters Laboratories, Inc. (UL) Publications:**

Electrical Construction Materials Directory (May 1984 with Quarterly Supplements)

UL 96                              Lightning Protection Components (May 25, 1981, 2nd Ed.; Rev May 26, 1981)

UL 96A                             Installation Requirements for Lightning Protection Systems (Apr 9, 1982, 9th Ed.; Rev thru Oct 5, 1983)

UL 467                             Grounding and Bonding Equipment (Nov 22, 1984, 6th Ed.; Rev Nov 23, 1984)

2. **GENERAL REQUIREMENTS:**

2.1 **Verification of Dimensions:** The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work. No departures shall be made without the prior approval of the Contracting Officer.

2.2 **System Requirements:** The system furnished under this specification shall consist of the standard products of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest UL approved design. The lightning protection system shall conform to NFPA Nos. 70 and 78, UL 96 and UL 96A, except where requirements in excess thereof are specified herein.

### 3. SUBMITTALS:

3.1 Shop Drawings: Shop drawings shall be submitted in accordance with the SPECIAL CLAUSES and shall consist of a complete list of materials, including manufacturer's descriptive and technical literature; catalog cuts; drawings; and installation instructions. Shop drawings shall contain details to demonstrate that the system has been coordinated and will function as a unit. Drawings shall show proposed layout and mounting and relationship to other parts of the work.

3.2 Proof of Compliance: Where materials or equipment are specified to comply with requirements of the UL, proof of such compliance shall be submitted. The label of or listing in the UL Electrical Construction Material Directory will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of Underwriters Laboratories.

3.3 Certificate: A certificate shall be submitted certifying UL approval of all lightning protection systems provided on buildings used for handling or storing explosives, ammunition, or explosive ingredients.

## PART 2 - PRODUCTS

### 4. MATERIALS:

4.1 General Requirements: No combination of materials shall be used that form 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, conductors with protective coatings or oversize conductors shall be used. Where a mechanical hazard is involved, the conductor size shall be increased to compensate for the hazard or the conductors shall be protected by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is used, the conductor shall be electrically connected at the upper and lower ends.

4.2 Main and Secondary Conductors: Conductors shall be in accordance with NFPA No. 78 and UL 96 for Class I, Class II, or Class II modified materials as applicable.

4.2.1 Copper: Copper conductors used shall weigh not less than 215 pounds per thousand feet, and the size of any wire in the cable shall be not less than No. 17 AWG. Counterpoise shall be copper conductors not smaller than 98,500 circular mils.

4.2.2 Aluminum: Aluminum shall not be used on this project.

4.3 Air Terminals: Terminals shall be in accordance with UL 96 and NFPA No. 78, except Class II shall be used for Class I and Class II applications, and shall be tapered to a point. The tip of air terminals shall be a

minimum of 2 feet above the wing wall or ventilator cap. Air terminals shall be supported by a suitable brace, with guides, not less than one-half the height of the terminal.

4.4 Ground Rods: Rods shall conform to UL 467 and shall be made of copper-clad steel. Except where otherwise specified, ground rods shall be not less than 3/4 inch in diameter and 10 feet in length.

4.5 Clamp-Type Connectors: Connectors for splicing conductors shall conform to UL 96, class as applicable, and Fed. Spec. W-S-610, Class 2, style and size as required for the installation.

Bonding Plates: UL 96, class as applicable.

Supports and Braces for Air Terminals: UL 96, class as applicable.

Clay pipe per SECTION: FOUNDATION DRAINAGE SYSTEM.

### PART 3 - EXECUTION

#### 5. INTEGRAL SYSTEM:

5.1 General Requirement: The lightning protection system, except as specified herein, shall consist of air terminals, roof conductors, down conductors, ground connections, and grounds, electrically interconnected to form the shortest distance to ground without passing through any nonconducting parts of the structure. All conductors on the structures shall be exposed except where conductors are in protective sleeves exposed on the outside walls. Secondary conductors shall interconnect with grounded metallic parts within the building.

5.1.1 Air Terminals: Air terminals shall be rigidly connected to, and made electrically continuous with, roof conductors by means of pressure connectors or crimped joints of T-shaped malleable metal and connected to the air terminal by a dowel or threaded fitting. The air terminals at the ends of the structure shall be set as shown on the drawings. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces permanently and rigidly attached to the building or structure. Air terminals shall be mounted on metal vent pipes where vents are required.

5.1.2 Down Conductors: Down conductors shall be electrically continuous from air terminals and roof conductors to grounding electrodes. Down conductors shall be coursed over extreme outer portions of the igloos. Each igloo shall have not less than two down conductors located as widely separated as practicable, at diagonally opposite corners. Down conductors shall be protected where necessary, to prevent mechanical injury to the conductor.

5.1.3 Interconnection of Metallic Parts: Metal doors shall be connected directly to the down conductors using not smaller than No. 6 copper conductor, or equivalent. Conductors placed where there is probability of

unusual wear, mechanical injury, or corrosion shall be of greater electrical capacity than would normally be used, or shall be protected. The ground connection to metal doors shall be by means of mechanical ties under pressure, or equivalent.

5.1.4 Ground Connections: Ground connections comprising continuations of down conductors from the structure to the grounding electrode shall securely connect the down conductor and ground in a manner to ensure electrical continuity between the two. All connections shall be of the clamp type. There shall be a ground connection for each down conductor. Metal pipes and other large underground metallic objects shall be bonded together with all grounding mediums. Ground connections shall be protected from mechanical injury. In making ground connections, advantage shall be taken of all permanently moist places where practicable, although such places shall be avoided if the area is wet with waste water that contains chemical substances, especially those corrosive to metal.

5.1.5 Grounding Electrodes: A grounding electrode shall be provided for each down conductor located as shown. A driven ground rod shall extend into the earth for a distance of not less than 10 feet. Ground rods shall be set not less than 3 feet, nor more than 8 feet, from the structure. The complete installation shall have a total resistance to ground of not more than 10 ohms (if a counterpoise is not used). When two of any three ground rods, driven not less than 10 feet into the ground, a minimum of 10 feet apart, and equally spaced around the perimeter, give a combined value exceeding 50 ohms immediately after driving, a counterpoise shall be used. A counterpoise, where required, shall be of 98,500 circular mils copper cable or equivalent material having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 2 feet deep at a distance not less than 3 feet nor more than 8 feet from the nearest point of the structure. All connections between ground connectors and grounds or counterpoise, and between counterpoise and grounds shall be electrically continuous. When required by soil conditions and approved by the Contracting Officer in writing, an alternate method for grounding electrodes in shallow soil shall be provided by digging trenches radially from the building. The lower ends of the down conductors (or their equivalent in the form of metal strips are then buried in the trenches.

5.2 Steel Arch Magazines: In earth-covered steel arch magazines, the reinforcing steel and steel arch shall be made electrically continuous. Electrical continuity may be provided by clipping or brazing, unless a specific method is noted on the drawings. The air terminals and roof conductors shall be securely connected to, and made electrically continuous with, the reinforcing steel. One air terminal shall be located on the top of the front wall and one on or adjacent to the ventilator in the rear. The air terminals shall extend vertically at least 2 feet above the top of the front wall and the highest point on the ventilator. Down conductors and grounding electrodes shall be provided at diagonally opposite corners of the magazine and shall be connected together. Grounding electrodes shall be connected to the horizontal reinforcing rods below the floor line of the wall system. The steel door frame shall be made electrically continuous with the reinforcing steel. The steel door shall be connected to the steel

frame by means of a flexible copper strap or cable unless the steel hinges make the door and frame electrically continuous.

6. INSPECTION: The lightning protection system will be inspected by the Contracting Officer or his Authorized Representative to determine conformance with the requirements of this specification. No part of the system shall be concealed until so authorized by the Contracting Officer or his Authorized Representative.