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Lightning and Static Electricity Protection Systems

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Module 1: Introduction

Learning Objectives

By the end of this section, you will be able to:

- **Identify** the core policy and design requirements for lightning and static electricity protection systems.
- **Evaluate** the minimum electrical design requirements necessary for standard and specialized construction contracts.
- **Select** the appropriate industry codes and standards required for compliant grounding and bonding.

Executive Summary: This section establishes the mandatory design framework and minimum criteria for static electricity and lightning protection systems across all Department of Defense (DoD) facilities and structures.

Design Purpose and Scope

This module establishes the comprehensive policy and design requirements for protecting facilities and other structures from **static electricity** and **lightning strikes**, including all related grounding systems.


Electrical engineers should implement these criteria when developing:

- **Project Plans** and technical specifications.
- **Engineering Calculations** to support system design.
- **Design/Build Request for Proposals (RFP).**

Application of Requirements

The standards presented here serve as the **minimum electrical design requirements**. They apply to:

- **Design-Bid-Build** traditional construction contracts.
- **Design-Build** construction contracts.

 **Design Tip:** Project-specific conditions or mission-critical requirements may necessitate a design that exceeds these baseline minimums to ensure operational continuity.

Technical References

Appendix A of this course provides a complete list of all source material and technical references. References that pertain to specific technical topics are embedded and described within their respective sections to ensure context-appropriate application.



Key Codes and Standards

Compliance is driven by a hierarchy of industry-standard codes. The following publications are mandatory for the design and maintenance of protection systems:

- **IEEE 142:** Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- **NFPA 70:** National Electrical Code.
- **NFPA 70B:** Recommended Practice for Electrical Equipment Maintenance.
- **NFPA 77:** Recommended Practice on Static Electricity.
- **NFPA 780:** Standard for the Installation of Lightning Protection Systems.
- **UL 96:** Lightning Protection Components.
- **UL 467:** Grounding and Bonding Equipment.

⚠ Safety Constraint: For communications facilities, you must integrate additional requirements for grounding, bonding, and shielding found in **MIL-HDBK 419A**, *Grounding, Bonding and Shielding for Electronic Equipment and Facilities*.

Checkpoint Quiz

- 1. Which document serves as the primary standard for the installation of Lightning Protection Systems (LPS)?**
 - a) NFPA 70
 - b) NFPA 780
 - c) IEEE 142
 - d) UL 467

Answer: (b). NFPA 780 is explicitly cited as the key standard for the installation of lightning protection systems.

- 2. When developing a Design/Build RFP, how should the requirements in this course be treated?**
 - a) As optional suggestions
 - b) As the maximum allowable complexity
 - c) As the minimum electrical design requirements
 - d) Only applicable to non-military structures

Answer: (c). The document states that the information provided may serve as the minimum electrical design requirements for RFPs.



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- 3. If you are designing a communications facility, which additional standard must be consulted for grounding and shielding?**
- a) NFPA 77
 - b) UL 96
 - c) MIL-HDBK 419A
 - d) NFPA 70B

Answer: (c). Specific additional requirements for communications facilities are contained within MIL-HDBK 419A.



Chapter 2: Static Electricity Protection

Learning Objectives

By the end of this section, you will be able to:

- **Identify** hazardous classified locations and specify grounding methods for fixed and portable equipment in accordance with NFPA 70 and NFPA 77.
- **Evaluate** resistance-to-ground requirements for various DoD facilities to ensure they meet the 10,000-ohm threshold for static dissipation.
- **Select** appropriate grounding hardware, such as static bus bars, Shepherd's Crooks, or grounding receptacles, based on specific facility applications.

Executive Summary: Static electricity protection in DoD facilities relies on a maximum resistance-to-ground of 10,000 ohms and strict below-grade interconnection of disparate grounding systems to prevent hazardous discharges.

Static Grounding and Bonding Requirements

Designers must identify hazardous classified locations per **NFPA 70**. Grounding and bonding for these areas must comply with **NFPA 77** to support intended operations.

Design Documentation

- **Hazardous Materials:** Include a listing of hazardous materials, containers, and operating units in the design.
- **Equipment Location:** Indicate fixed operating equipment locations on drawings.
- **Portable Equipment:** Identify portable and movable equipment requiring static grounding distinctively by location and specific grounding method.

Bonding and Grounding Conductors

Conductors must be large enough to withstand mechanical damage and meet the following:

- **Minimum Size:** Not smaller than **6 AWG copper**.
- **Flexibility:** Use **braided cable** or **flexible bonding straps** for static grounds on portable or movable equipment.
- **Redundancy:** Install at least two separate braided cables or flexible straps on items like doors, hinged shelves, or tables.
- **Surface Preparation:** Ensure electrical continuity by removing paint, oil, dirt, or rust on contact surfaces before securing any bond.



- **Resistance:** Bonds must have a resistance reading of **one ohm or less**.

Connections

⚠ Safety Constraint: Do **not** connect static grounds above grade to electrical equipment grounding systems, telecommunications grounds, utility lines (gas, steam, water), sprinkler systems, or any component of the lightning protection system (LPS).

- **Interconnection:** These systems must be interconnected **below grade**.
- **LPS Exception:** Above-grade connection to an LPS down conductor is authorized only if the down conductor is within the bonding distance calculated in **NFPA 780**.
- **UL 96A Exception:** As an alternative to NFPA 780 calculations, a **6-foot (1.83 m)** bonding requirement may be used.
- **Building Elements:** Steel framing and metal siding may be used as part of the grounding conductor system if electrically bonded, provided no penetrations into exterior finishes occur above ground level.

Static Bus Bars

Static bus bars are used exclusively for static grounding.

- **Standard Size:** Typically **2-inch x 1/4 inch (51 mm x 6 mm)** copper bars.
- **Isolation:** Bars must be isolated from other grounding subsystems, particularly for ordnance grounding and from LPS down conductors.
- **Connection:** The system is typically connected to the building grounding system below grade at a ground ring or rod.



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