HARGER

LIGHTNING PROTECTION SYSTEM DESIGN

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ENGINEERING RCEP

REGISTERED CONTINUING EDUCATION PROGRAM

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Purpose and Learning Objectives

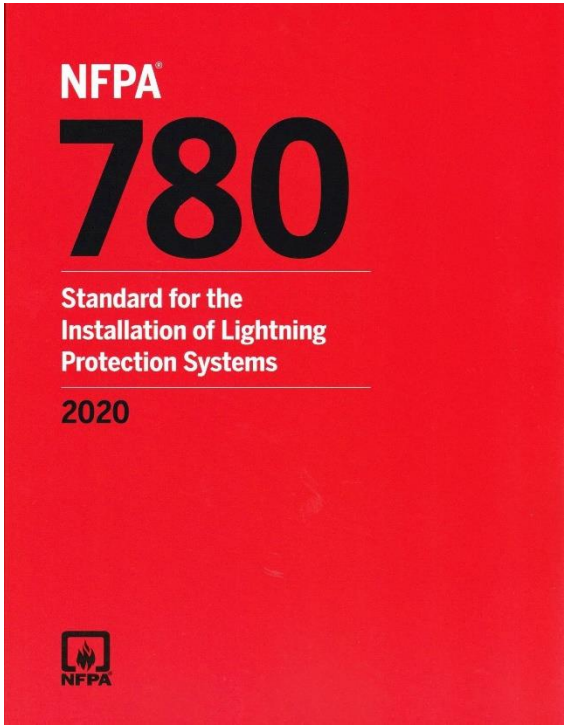
Seven topics will be covered, starting with exactly what is lightning and lightning protection. The basics of lightning protection will be discussed as well as maintenance of that system. Codes and standards will be referenced and designing lightning protection systems to meet these standards.

At the end of this presentation you will be able to:

- Define lightning and lightning protection
- Compare the applicable standards for lightning protection
- Describe lightning protection design basics
- Understand the inspections and maintenance of LP systems

Lightning Protection System Design

This presentation is based on the requirements of NFPA 780



Lightning Protection System Design

Outline

I. What is Lightning/Lightning Protection?
II. Basic Principles of Lightning Protection
III. Applicable Standards
IV. Lightning Protection Design Basics
V. "Zone of Protection"
VI. Inspections/Maintenance Programs
VII. Harger Engineering Support

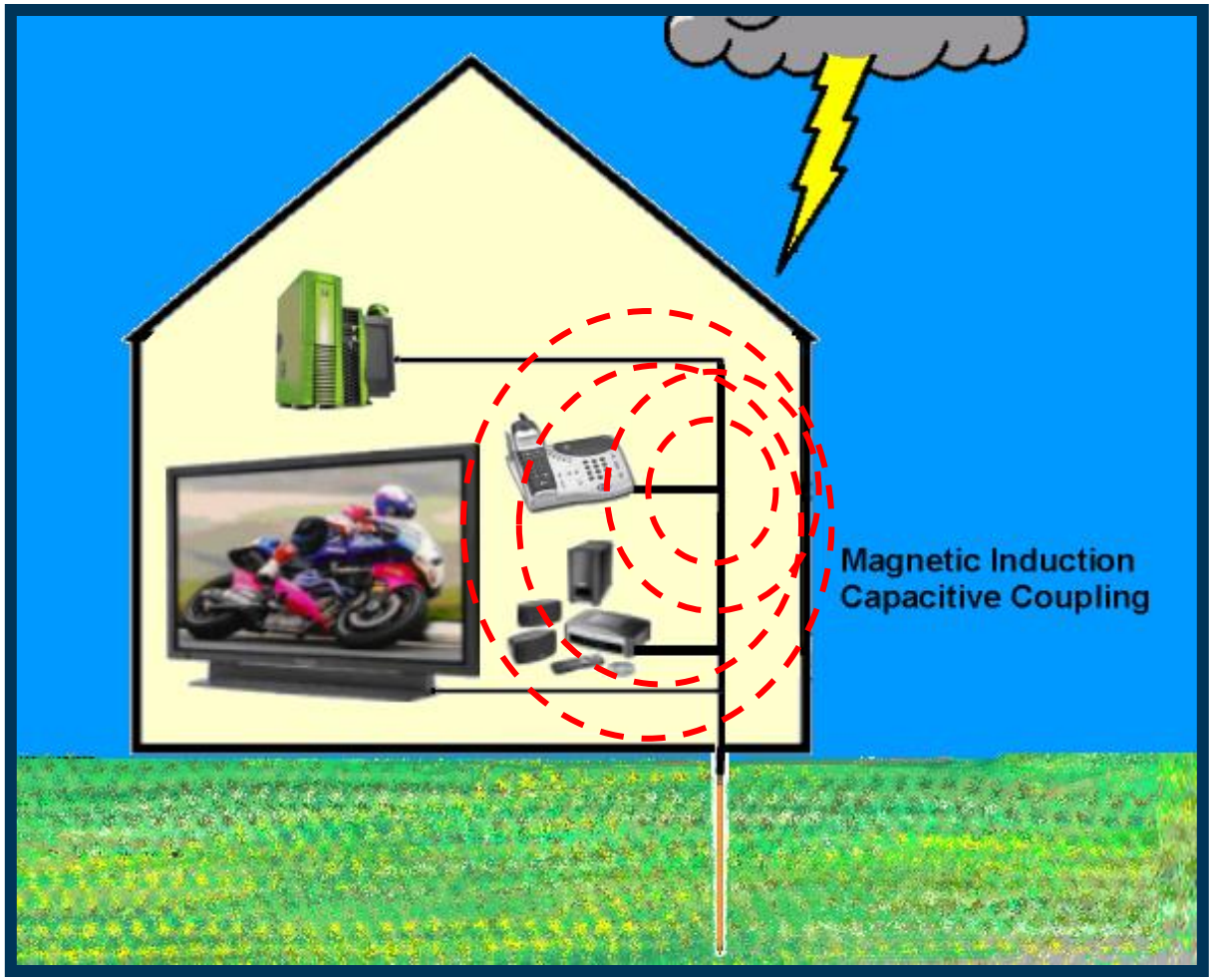
I. What is Lightning?

Lightning is a Gigantic Electrical Spark containing an average charge of 30 to 50 Million Volts and 18,000 Amps of current

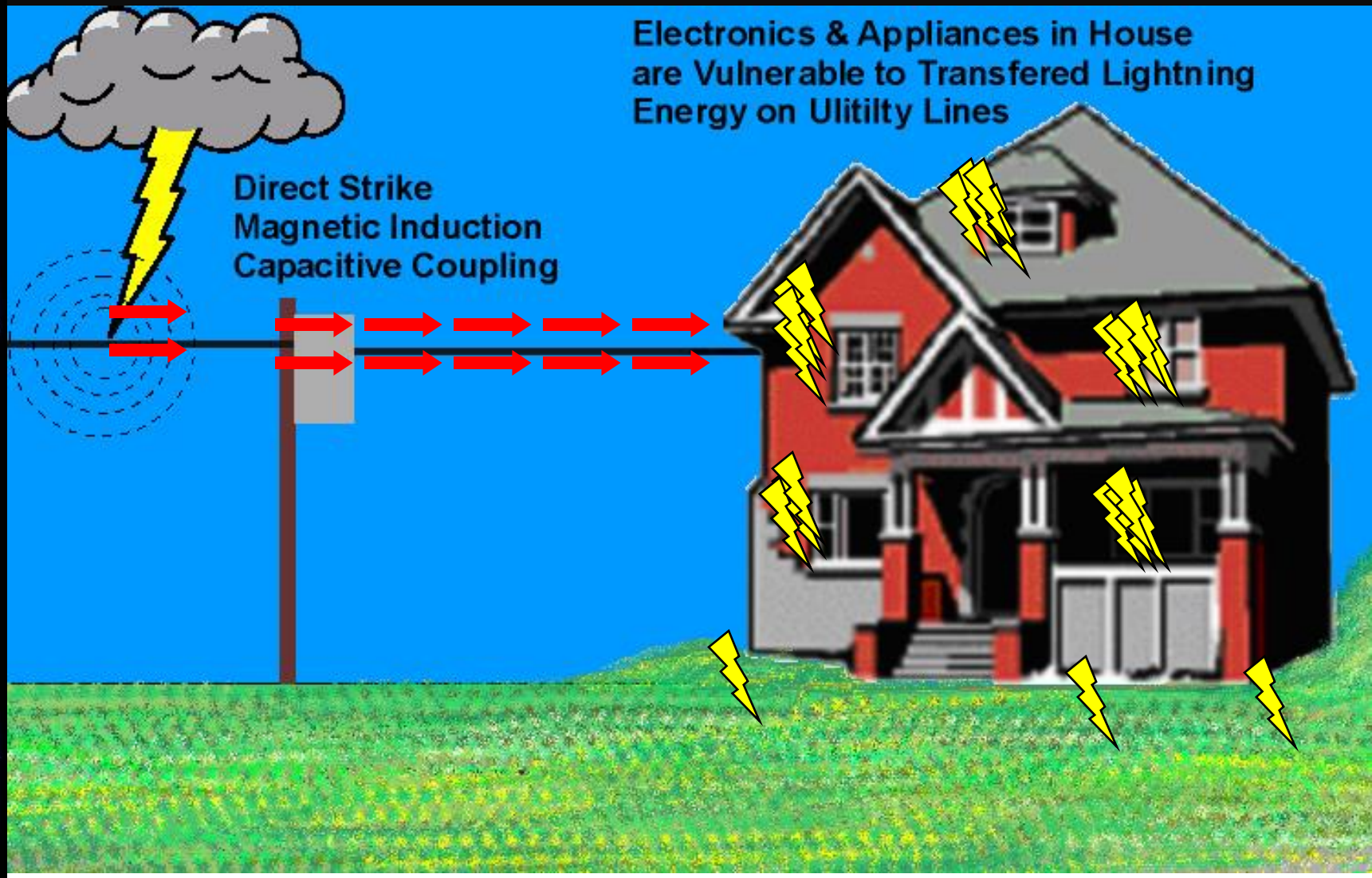
Damage from Lightning Can Be Traced To…

- Inadequate (or no) direct strike protection

Risks Posed from a Direct Strike

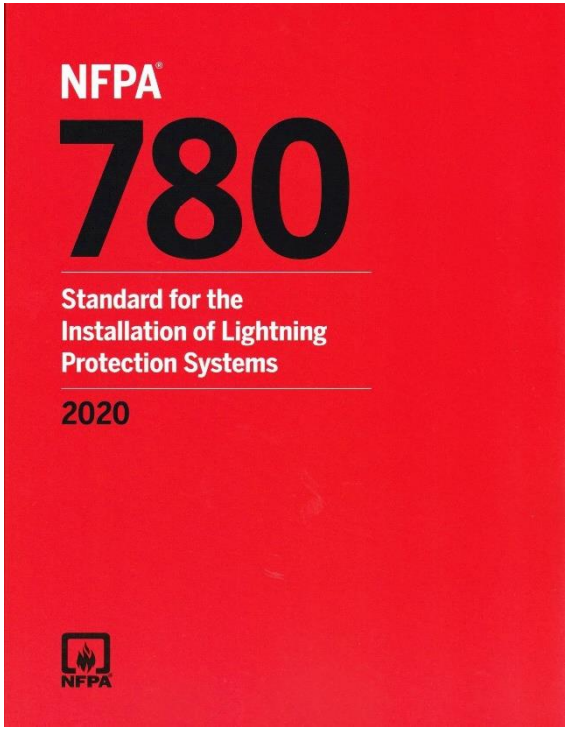


Risks Posed from an Indirect Strike



What is Lightning Protection?

A complete System of strike termination devices, conductors (which could include conductive structural members), grounding electrodes, interconnecting conductors, surge protective devices, and other connectors and fittings required to complete the system



What is *not* Lightning Protection?

- Early Streamer Emission – ESE
  - Radioactive
  - Pulsed Voltage
  - Sparking – Controlled Leader Trigger (CLT)

- Lightning Prevention
  - Dissipation Array Systems (DAS)
  - Charge Transfer Systems (CTS)
  - Bi-Polar

Non Conventional Lightning Protection Systems

These systems are not recognized by:

- National Fire Protection Association (NFPA)
- IEEE
- IEC
- US Military

Note: Specifying these systems may not be a defendable design. Is it worth the risk?

II. Basic Principles of Lightning Protection

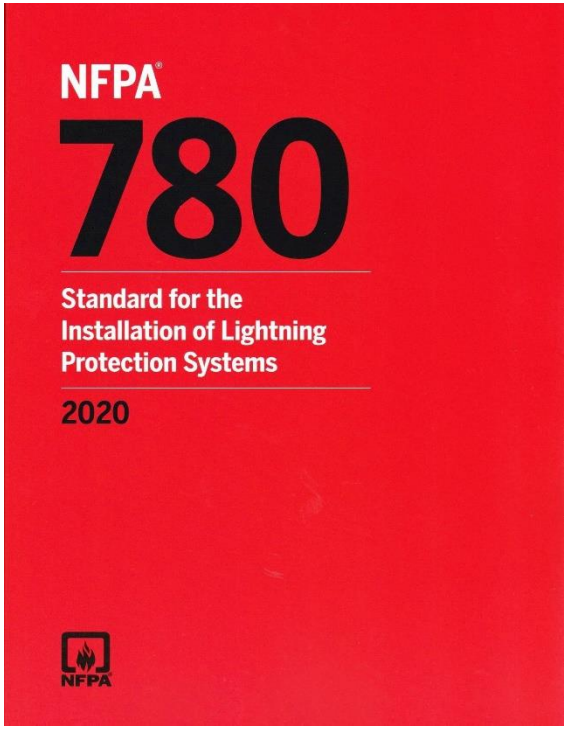
- Intercept the Lightning Discharge
- Safely Conduct the Lightning Currents and Dissipate into the Earth
- Minimize the Effects of Lightning Currents
  - Proper Bonding & routing of down conductors
  - Protect Incoming Power and Communications Circuits with Surge Protection Devices, (SPD's)

III. Applicable Standards

- NFPA 780
- UL 96
- UL 96A
- LPI 175
- IEC 62305
- FAA-STD- 019
- AFI 32-1065

NFPA 780

- Standard for the Installation of Lightning Protection Systems (2020)
- ANSI Accredited

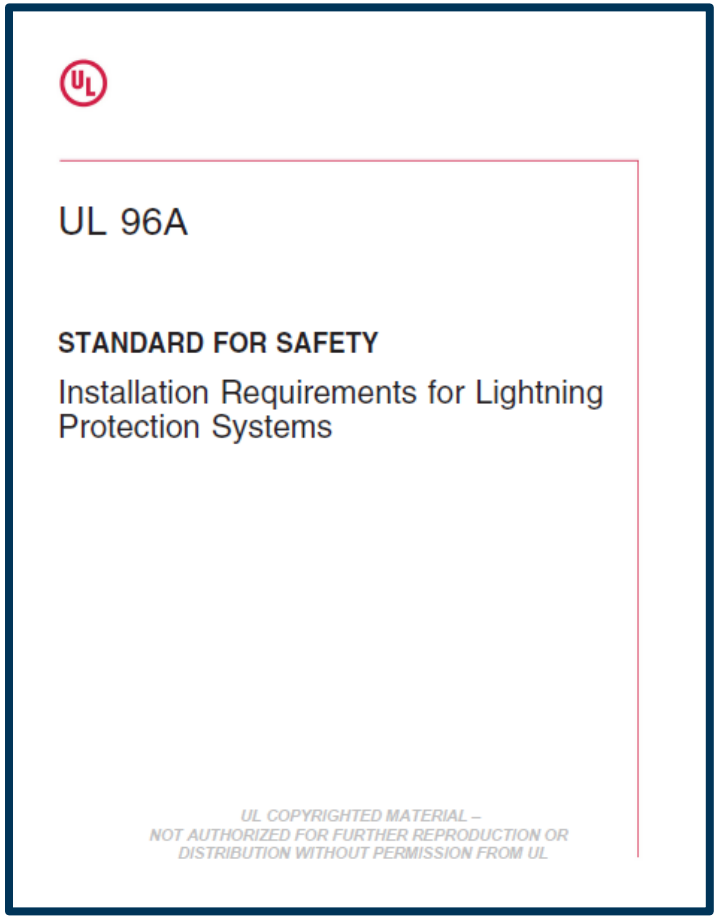


UL 96

- Provides the manufacturing requirements for lightning protection components

UL 96A

- Not ANSI Accredited
- Conflicts w/ 780
- Sporadically Updated



Certifications

- UL Certifications
  - Master Labels
  - Letter of Findings
- LPI Certifications
  - Master Installation Certificate Inspection
  - Limited Scope Inspection

UL Certifications

- A lightning protection system that has been installed in accordance with a nationally recognized standard such as NFPA 780 is eligible for a UL listing Certificate, known as the Master Label
- Master Labels are valid for 5 years and are displayed on UL's web site

Underwriters Laboratories
333 PFINGSTEN ROAD, NORTHBROOK, ILLINOIS 60062

Certificate Number
C4F7-31A5BF
Inspection Date
02/07/2012
Expiration Date
02/07/2017

Lightning Protection Services

MASTER LABEL®
CERTIFICATE OF INSPECTION
For
LIGHTNING PROTECTION SYSTEMS

This certificate reports the findings of an inspection by Underwriters Laboratories of a lightning protection system. The inspection was conducted using all applicable sections of NFPA780, 2011 edition, issued on 06/01/2010. The system was found to comply with these requirements at the time of inspection.

At the request of the installing company, the following item(s) were omitted from the scope of the inspection:

The communication surge protection system as outlined in UL 96A para 13.2 was not inspected. Surge protection devices are a required and integral component of a complete lightning protection system and should be provided for all conductive signal, data, and communication lines at the point of entrance.

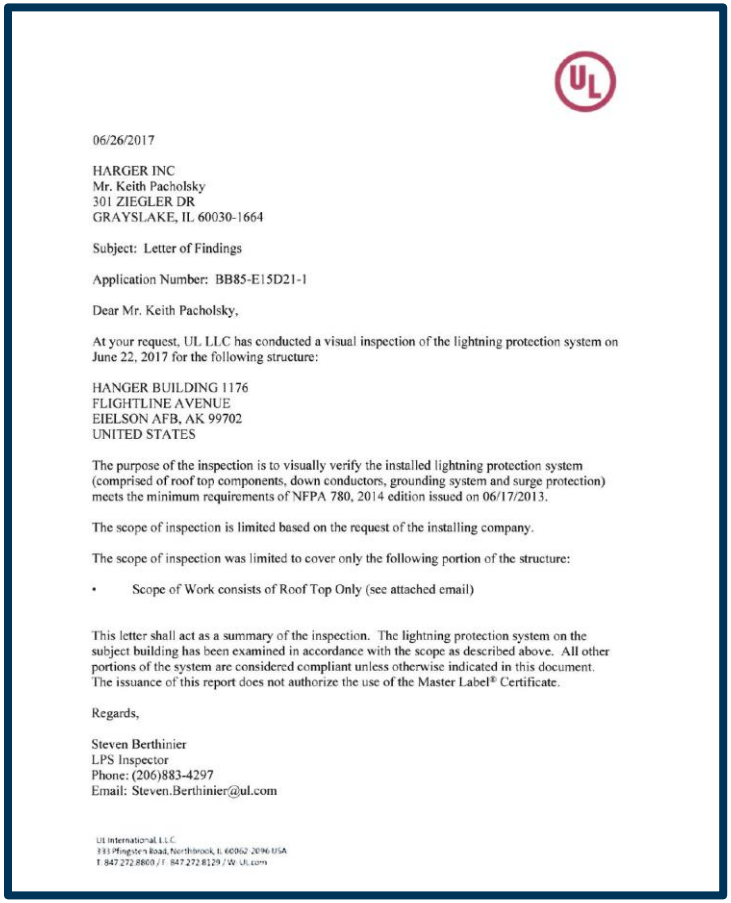
Structure: Fighting Creek Landfill Electric Building
Address: 22089 S Highway 95
Coeur d'Alene, ID 83814

Installing Company: HARGER INC
Address: 301 ZIEGLER DR
GRAYSLAKE, IL 60030

This certificate is only valid for five years based on UL's reasonable estimate that the system will remain unchanged. Any modifications to electrical, mechanical or communication systems of the structure will affect lightning protection devices and may render protection afforded by this system ineffective. These changes will invalidate our certificate earlier than the five year period.

UL Certifications

- Letters of Findings are issued for structures that are not eligible for a Master Label
- Examples are additions or partially protection structures
- LOF's have no expiration and are not found on UL's web site



06/26/2017

HARGER INC
Mr. Keith Pacholsky
301 ZIEGLER DR
GRAYSLAKE, IL 60030-1664

Subject: Letter of Findings

Application Number: BB85-E15D21-1

Dear Mr. Keith Pacholsky,

At your request, UL LLC has conducted a visual inspection of the lightning protection system on June 22, 2017 for the following structure:

HANGER BUILDING 1176
FLIGHTLINE AVENUE
EIELSON AFB, AK 99702
UNITED STATES

The purpose of the inspection is to visually verify the installed lightning protection system (comprised of roof top components, down conductors, grounding system and surge protection) meets the minimum requirements of NFPA 780, 2014 edition issued on 06/17/2013.

The scope of inspection is limited based on the request of the installing company.

The scope of inspection was limited to cover only the following portion of the structure:

- Scope of Work consists of Roof Top Only (see attached email)

This letter shall act as a summary of the inspection. The lightning protection system on the subject building has been examined in accordance with the scope as described above. All other portions of the system are considered compliant unless otherwise indicated in this document. The issuance of this report does not authorize the use of the Master Label® Certificate.

Regards,

Steven Berthinier
LPS Inspector
Phone: (206)883-4297
Email: Steven.Berthinier@ul.com

UL International, LLC.
333 Pfingsten Road, Northbrook, IL 60062-2096 USA
T. 847.272.8800 / F. 847.272.8129 / W. UL.com

LPI Certifications

- LPI has a division called LPI-IP that provides inspections services similar utilizing Intertek as their inspection force
- LPI-IP Master Installation Certificates are valid for 3 years or….
- LPI offers Limited Scope Inspections similar to….

Lightning Protection Institute – Inspection Program, Inc.
14048 W. Petronella Drive, Suite 104
Libertyville, Illinois 60048
Phone: 224-433-6680
www.lpi-ip.com

Master Installation Certificate

for Lightning Protection Certification

This is to certify that the lightning protection system, limited only to structural protection and not including surge suppression, installed on the following named property has been duly reviewed and found to be in compliance with the UL96A Standard current edition. All required documents, duly signed, and necessary inspections have been received and placed on file.

Raging Wire Data Center – VA2
44610 Guilford Drive
Ashburn, VA 20147

Installation Contractor:
Dillon Lightning Protection Systems, Inc.
4702 Fishers Hollow Road
Myersville, MD 21773

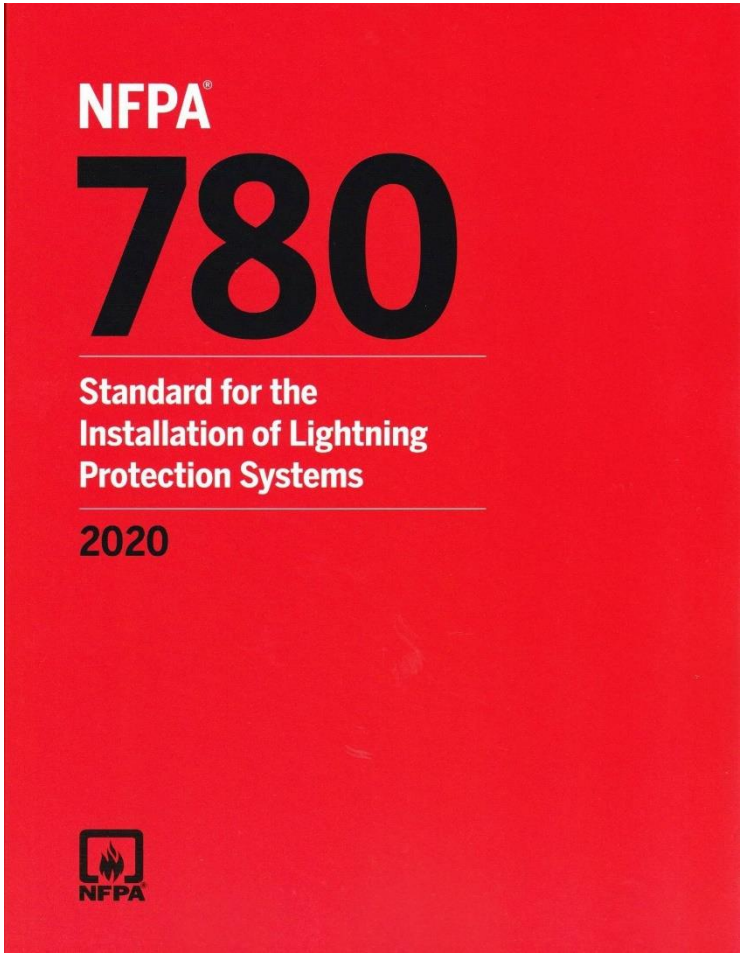
Signed and sworn to this 6th day of February, 2017

Program Manager

This certificate expires on the date below. Any changes to the lightning protection system and/or structure may compromise the integrity of the lightning protection system and may result in determination, at the sole discretion of the LPI-IP, that this certificate has been voided prior to the expiration date.

Certification Number	Engineering Review Date	Expiration Date
#17024659	01/31/2017	02/06/2020

IV. Lightning Protection Design Basics

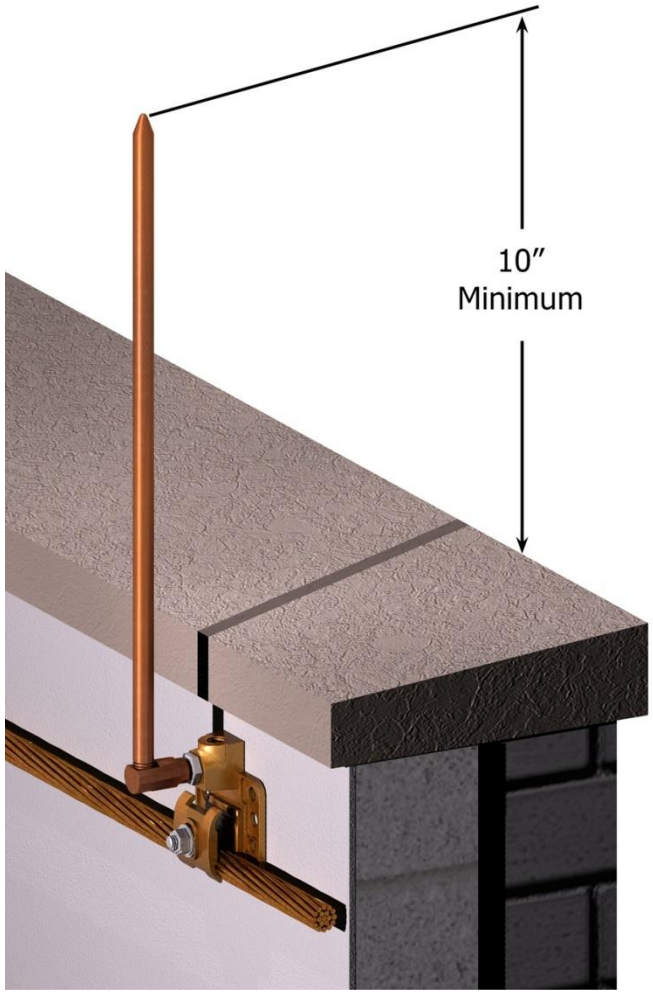


Design Basics Based on NFPA 780

- **Strike Termination Devices**
  - Strike termination devices include air terminals, metal masts, permanent metal parts of the structures and overhead ground wires
  - Combination of these strike termination devices shall be permitted
  - Strike termination devices shall be provided where required by other sections of this standard
  - Metal parts of a structure that are exposed to direct lightning flashes and that have a metal thickness of 3/16” or greater shall require only connection to the lightning protection system

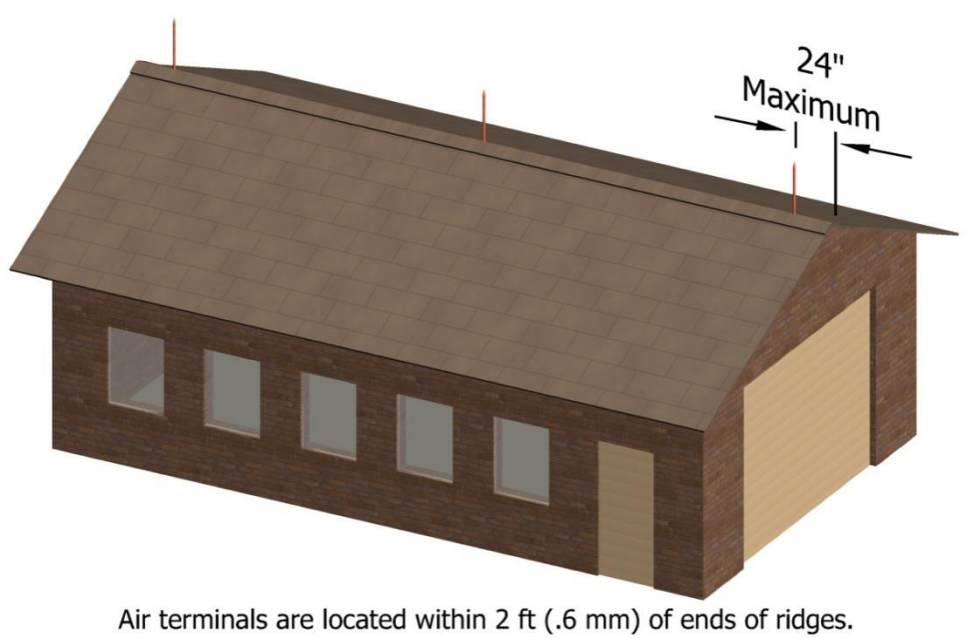
Design Basics Based on NFPA 780

- **Air Terminal Height**
  The tip of an air terminal shall be not less than 10” above the object or area it is to protect

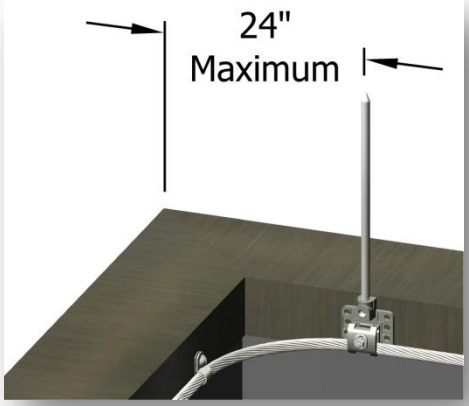


Design Basics Based on NFPA 780

- **Location of Devices** The distance between strike termination devices and ridge ends on pitched roofs, or edges and outside corners of flat or gently sloping roofs shall not exceed 2’

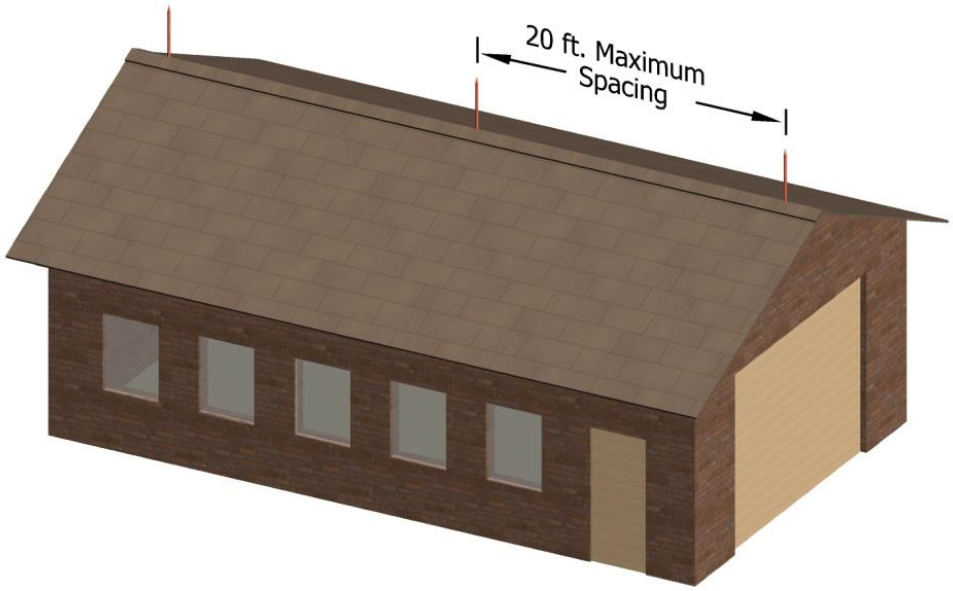


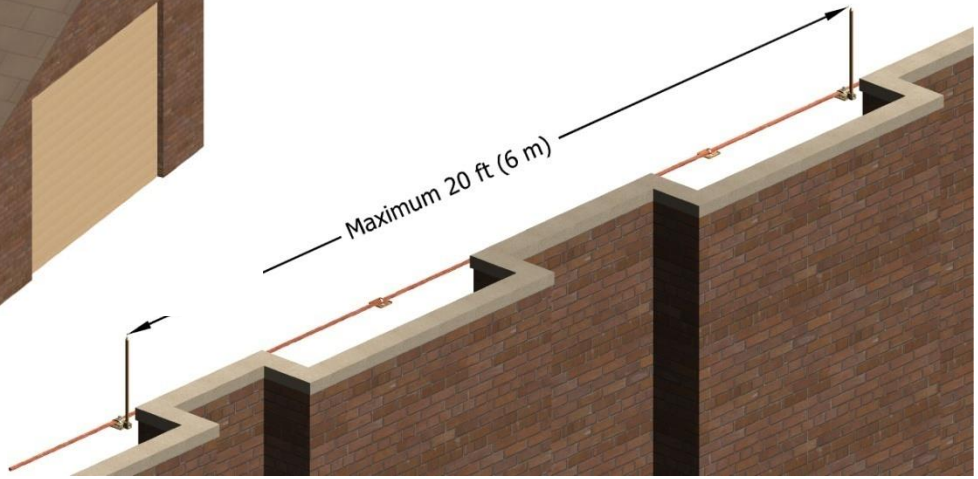
Air terminals are located within 2 ft (.6 mm) of ends of ridges.



Design Basics Based on NFPA 780

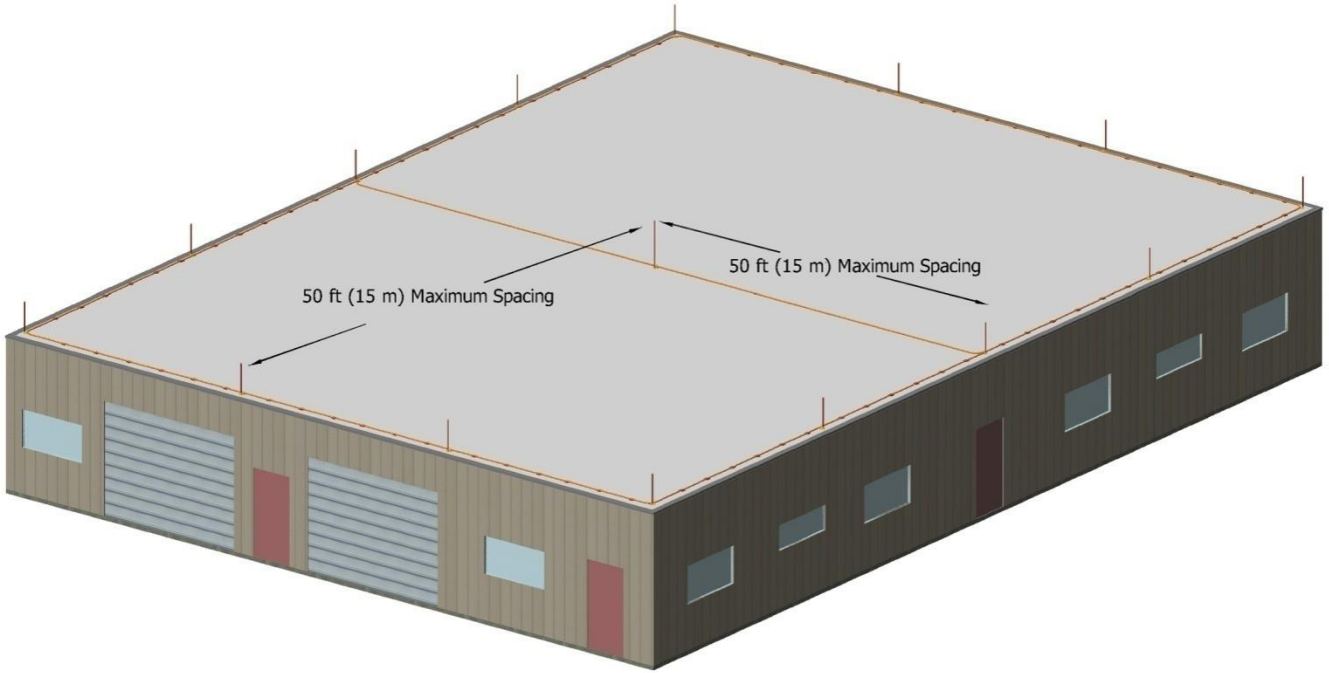
- **Strike termination devices** shall be placed on ridges of pitched roofs, and around the perimeter of flat or gently sloping roofs, at intervals not exceeding 20’





Design Basics Based on NFPA 780

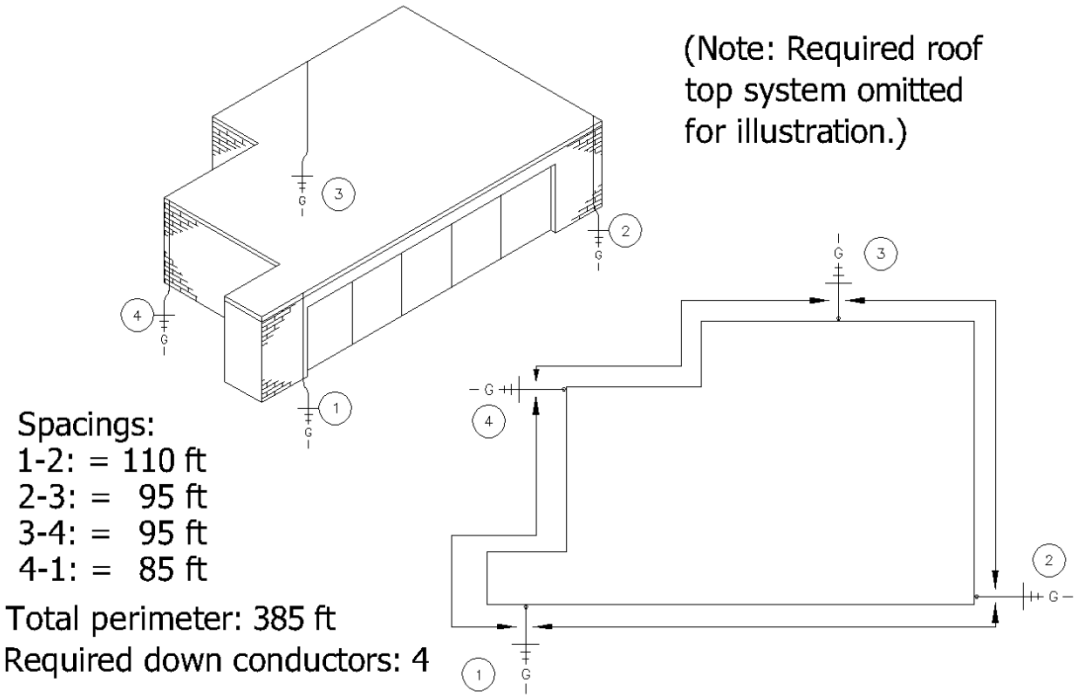
- **Flat or Gently Sloping Roof Area**
  Flat or gently sloping roofs that exceed 50’ in width or length shall have additional strike termination devices located at intervals not to exceed 50’ on the flat or gently sloping areas



Design Basics Based on NFPA 780

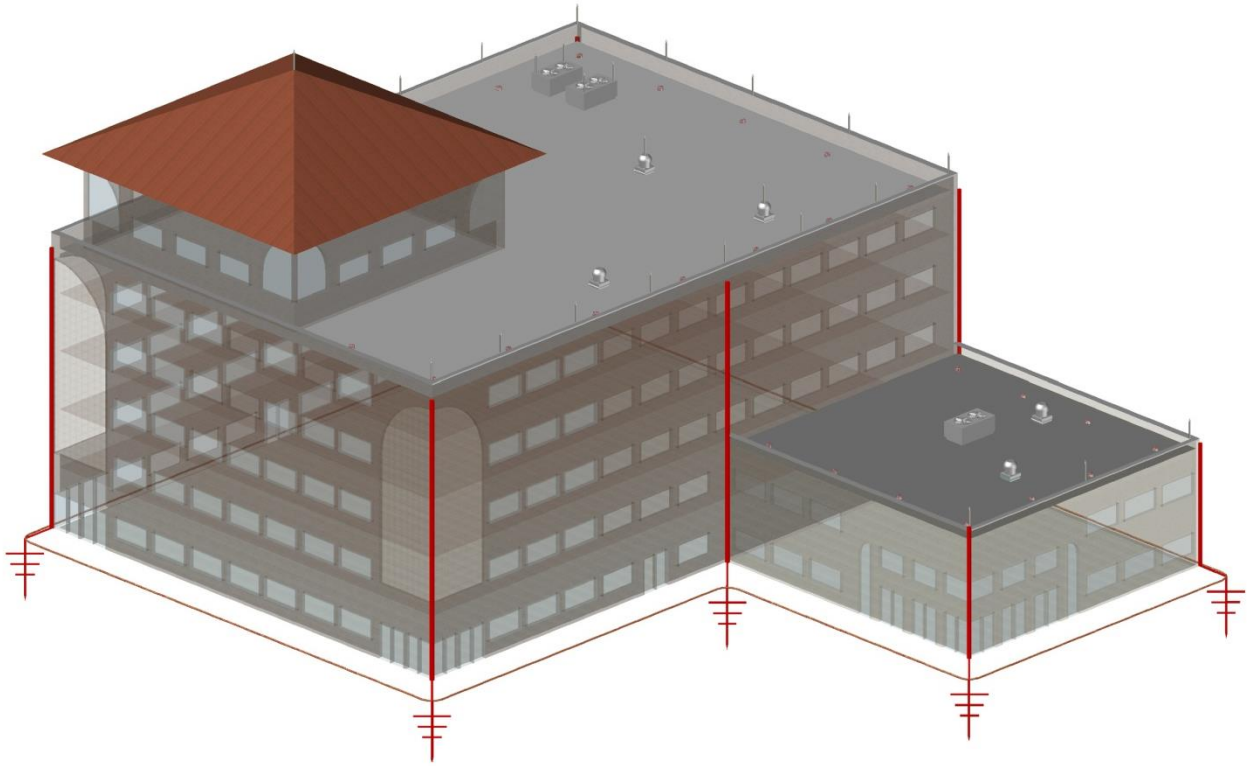
Down Conductor Placement

- At least two down conductors shall be provided
- Structures exceeding 250’ of perimeter shall have a down conductor every 100’ on average



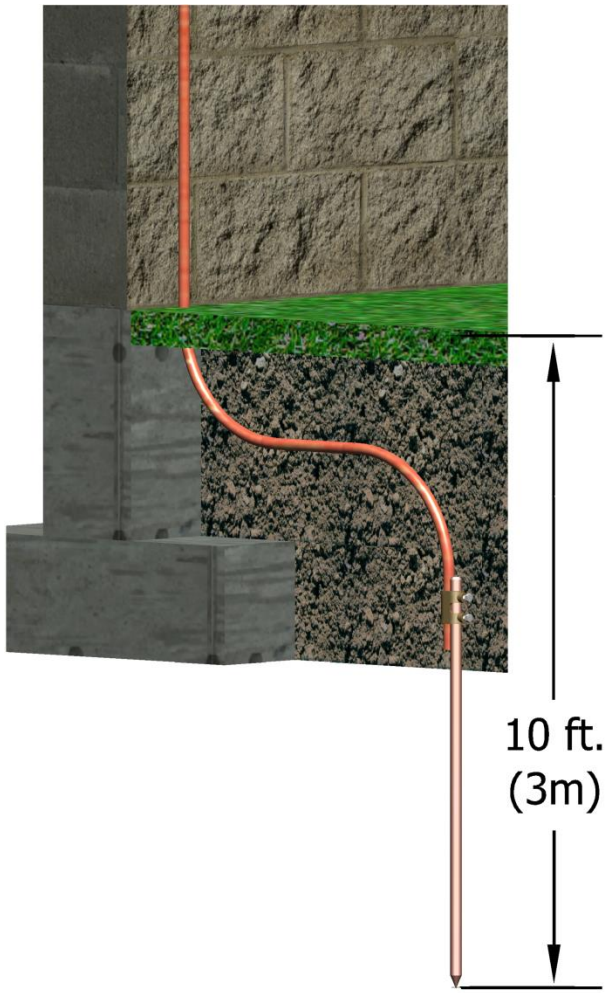
Design Basics Based on NFPA 780

- **Grounding Electrodes**
  - Each down conductor shall terminate at a grounding electrode dedicated to the lightning protection system



Design Basics Based on NFPA 780

- **Grounding Electrodes**
  - The down conductors shall be attached permanently to the grounding electrode system by bolting, brazing, welding or high-compression connectors listed for the purpose, and clamps suitable for direct burial
  - Ground rods shall be copper-clad steel, solid copper, or stainless steel

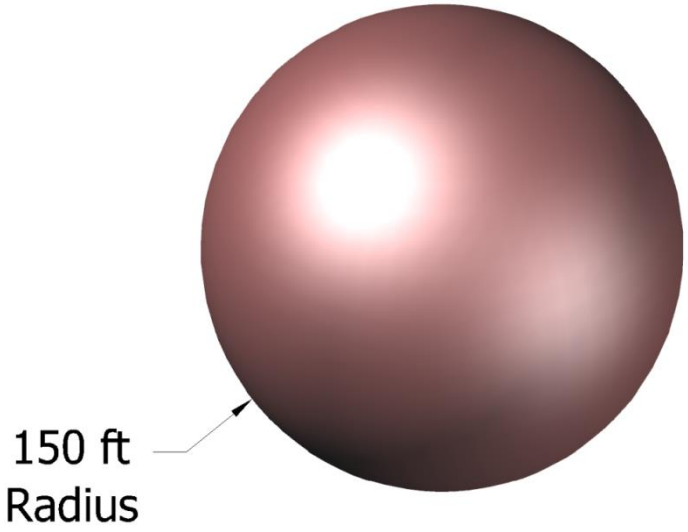


Design Basics Based on NFPA 780

- **Structural Metallic Systems**
  - Steel shall be cleaned to base metal
  - Conductors shall be connected to the steel by use of
    - Bonding plates shall have 8 in^2 minimum contact area.
    - Welding
    - Brazing

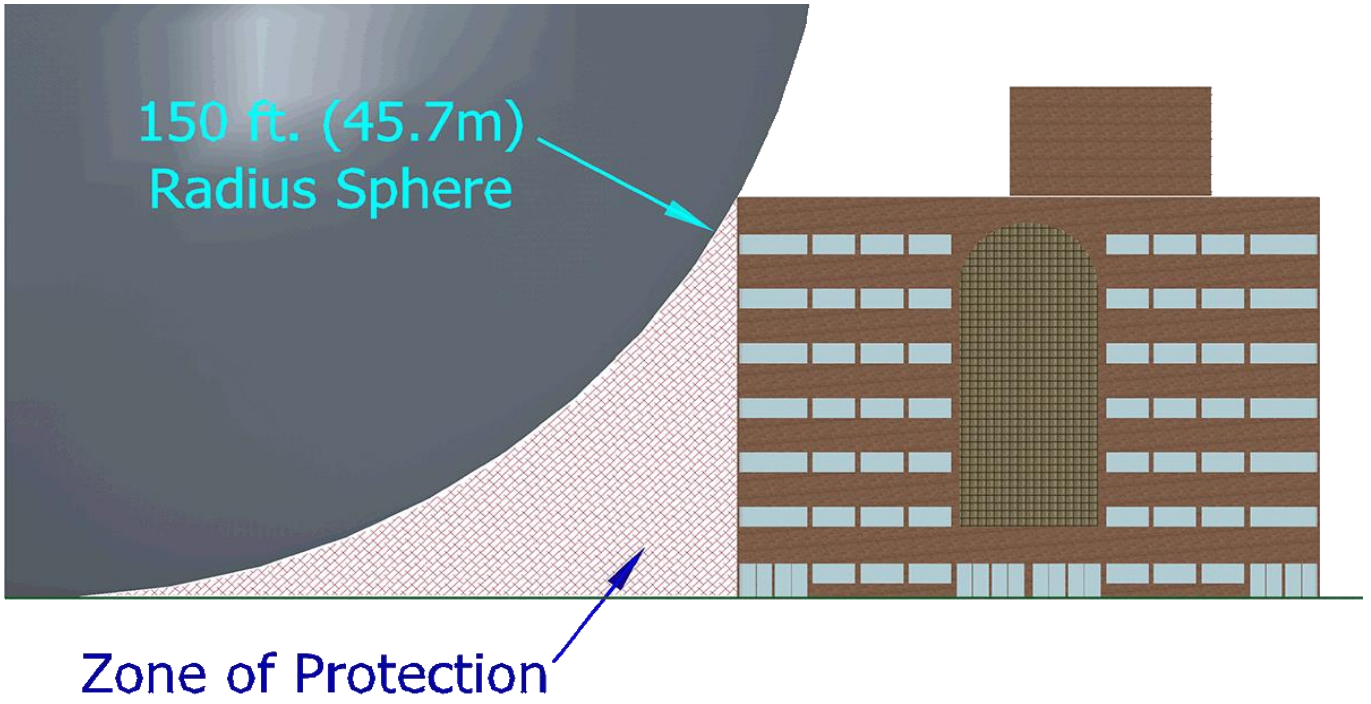
Zone of Protection

- The Zone of Protection shall include the space not intruded by a rolling sphere having a radius of 150’



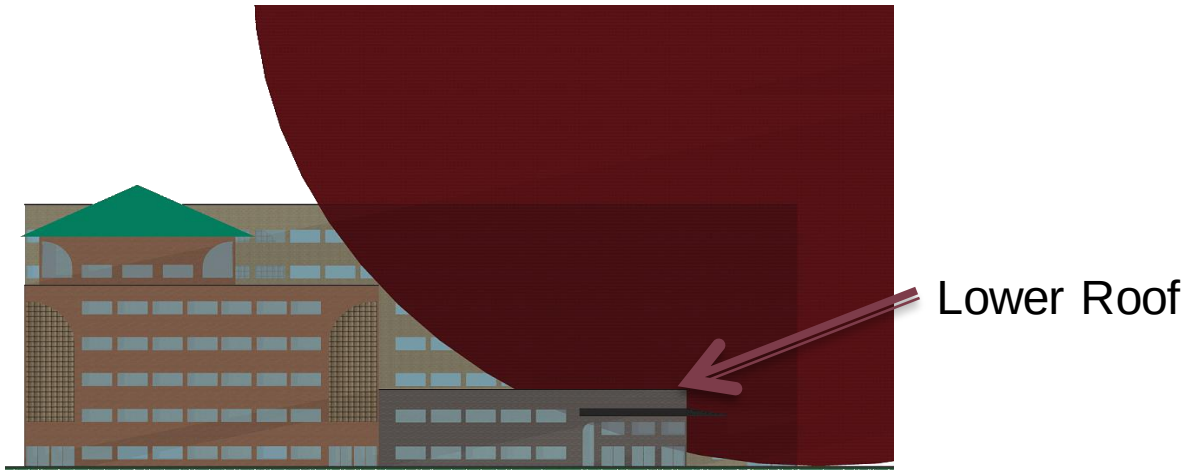
Zone of Protection

- The 150’ radius sphere must be either tangent to earth and resting against a strike termination device or resting on two or more termination devices

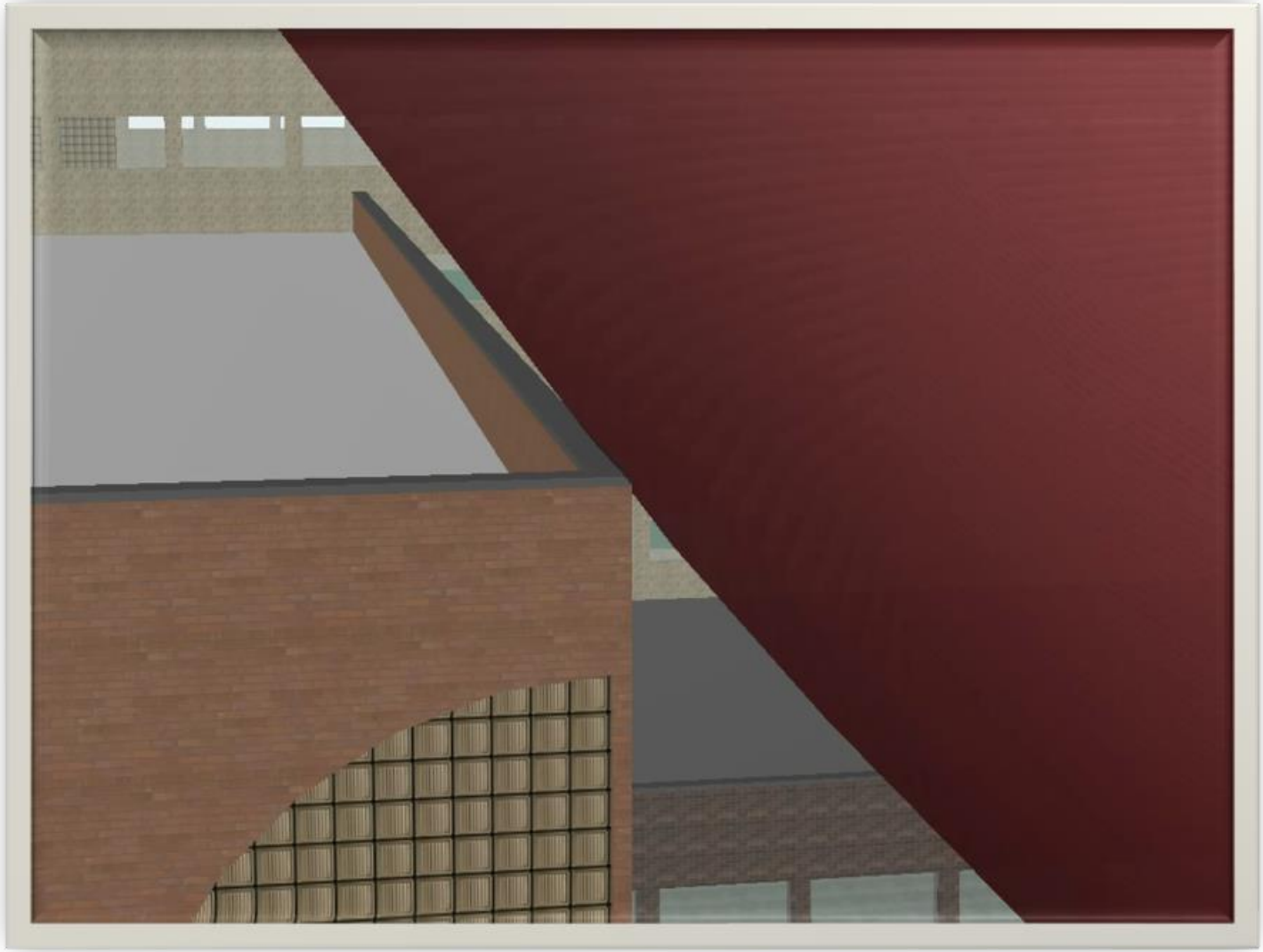


Zone of Protection

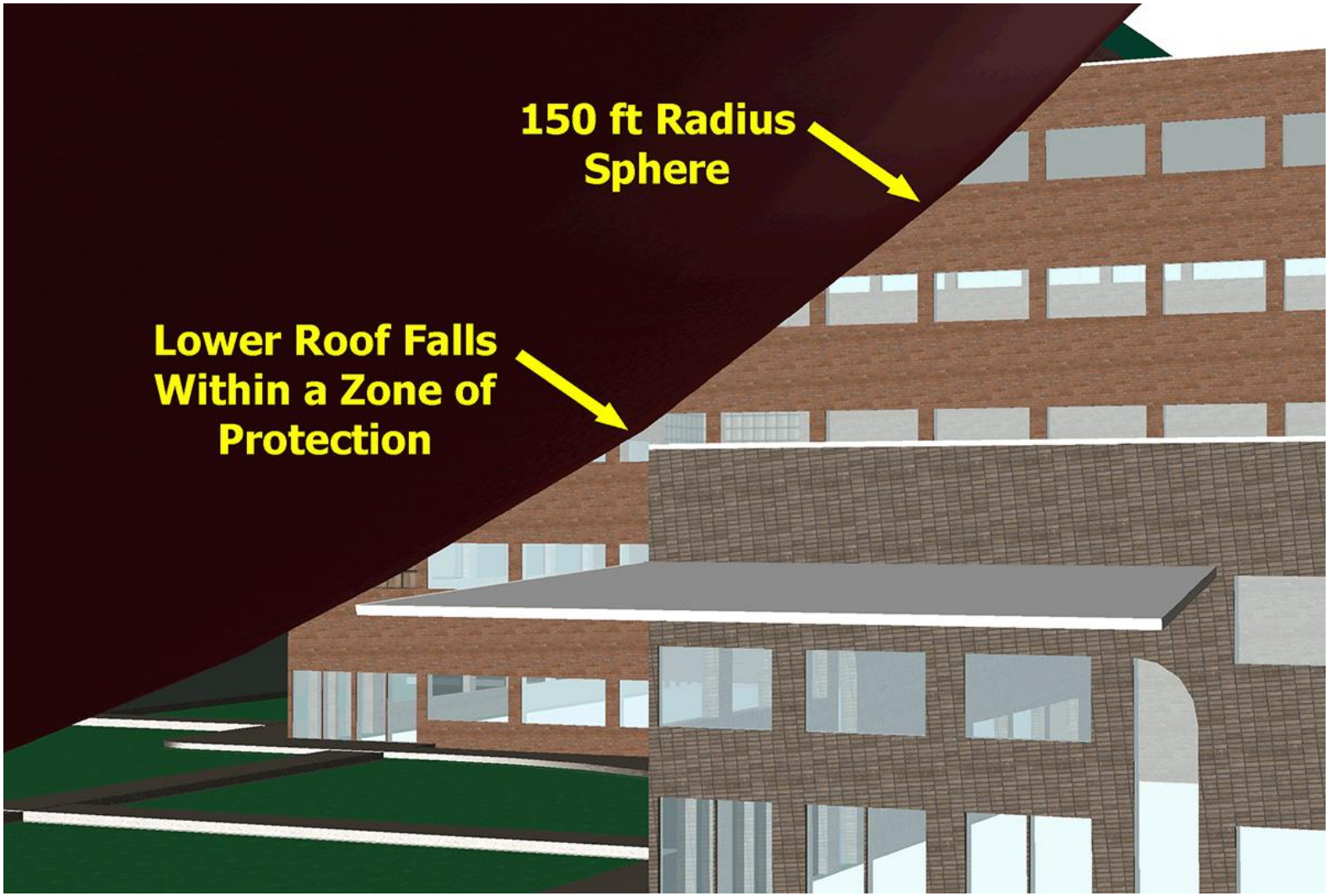
- Visualizing a 3 dimensional sphere also aids in determining if portions of a structure fall within a Zone of Protection



Zone of Protection

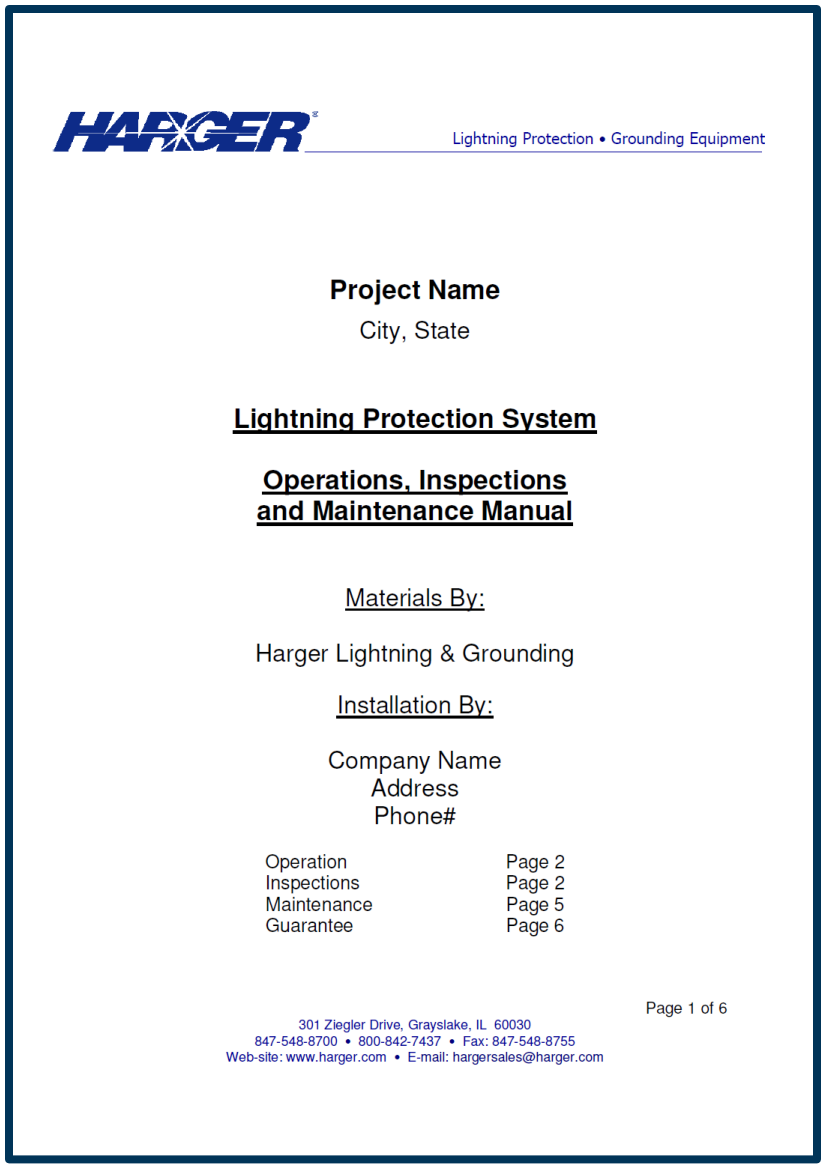


Zone of Protection



VI. Inspection/Maintenance Programs

- NFPA 780 – Recommended guidelines for maintenance of the lightning protection system shall be provided to the owner at the completion of the installation



HARGER Lightning Protection • Grounding Equipment

Project Name

City, State

Lightning Protection System

Operations, Inspections and Maintenance Manual

Materials By:

Harger Lightning & Grounding

Installation By:

Company Name
Address
Phone#

301 Ziegler Drive, Grayslake, IL 60030
847-548-8700 • 800-842-7437 • Fax: 847-548-8755
Web-site: www.harger.com • E-mail: hargersales@harger.com

VI. Inspection/Maintenance Programs

- Periodic inspections of the system should include the following:
  - Visual inspection on all exposed components of the system
  - Continuity tests for the concealed portions of the lightning protection system
  - Ground resistance testing
  - Any new additions to the building

VI. Inspection/Maintenance Programs

- Why inspections are important

VI. Inspection/Maintenance Programs

- Why inspections are important

VI. Inspection/Maintenance Programs

- Proper records of each inspection should be maintained and any necessary changes or repairs of the lightning protection system should be completed immediately
- Photo documentation from the original installation greatly enhances the annual inspection process

VI. Inspection/Maintenance Programs

- Proper maintenance of the system facilitates for a successful recertification of the lightning protection system
- Unfortunately it is common that the lightning protection systems are not maintained

Thank you for your time!

QUESTIONS?

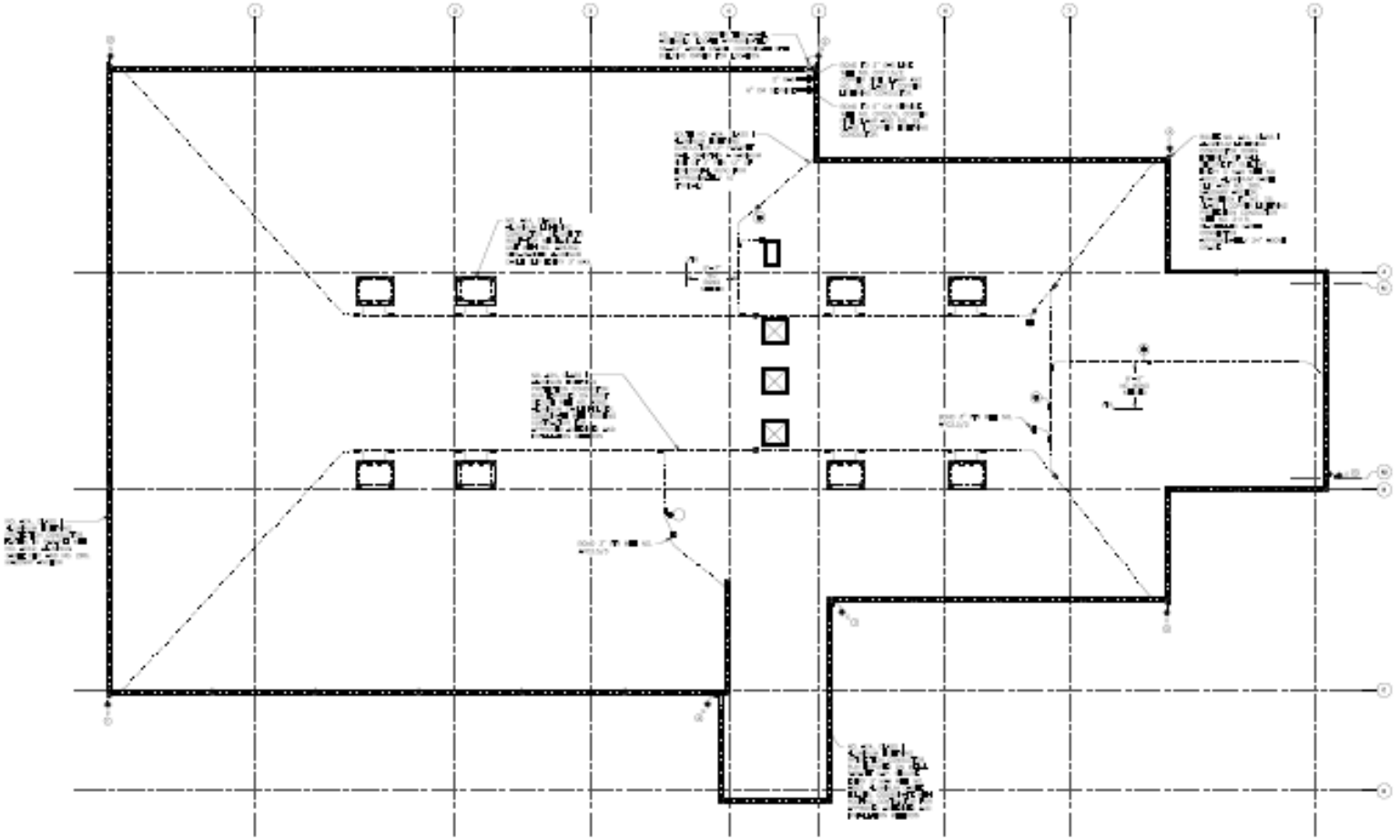
This concludes the educational content of this activity

847.548.8700 | www.harger.com

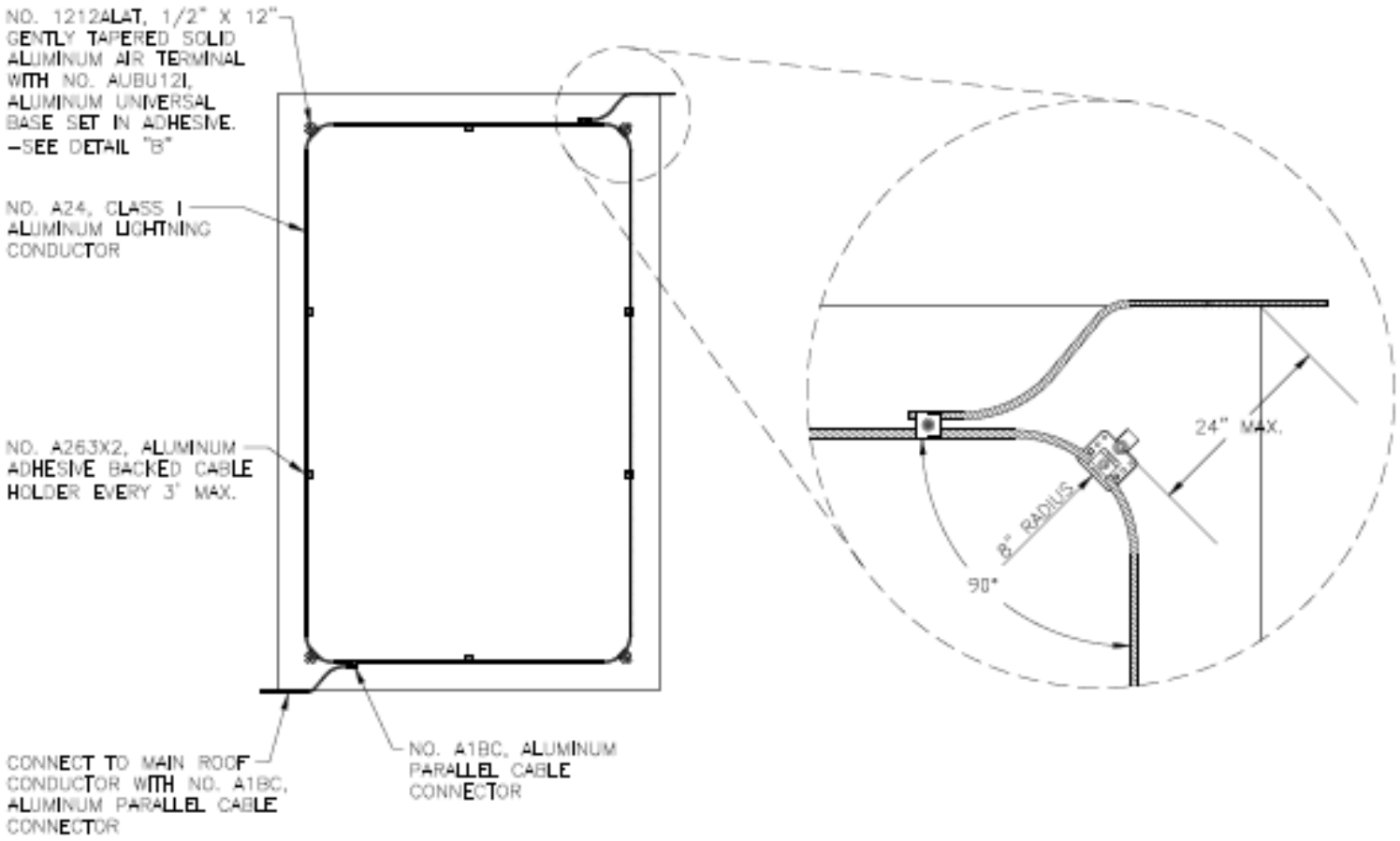
VII Harger Support

- Harger is eager to support your lightning protection needs with our fully staffed engineering department
- We offer specifications support and even complimentary design services for those engineering firms that wish to partner with us
- We have produced thousands of details over the years, please let us know if you need specific ones
- We can also provide budgetary numbers for your future projects

VII Harger Support



VII Harger Support



Thank You

- Since 1960, Harger has been providing the lightning protection and grounding industries with engineering expertise and quality Made in America components
- We look forward to supporting your needs