

# Coordinating Lightning Protection for Reroofing Projects

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November 24, 2008

## Tips for Ensuring Proper Maintenance for Both Systems

Lightning protection systems are sophisticated networks that incorporate strike termination devices, lightning current conductors, bonding conductors, ground electrodes and lightning surge protection devices. While the lightning risk for a structure is often the product of the lightning frequency and the consequence of the strike to the structure, designers typically consider a variety of factors when laying out a system plan. This risk assessment takes into account factors including the building environment, type of construction, structure occupancy, structure contents and lightning stroke consequences.

Naturally, a structure's "landscape" changes over time. Weather events like high winds, ice and snow, and extreme temperatures can degrade a structure's roof system and affect the continuity of the lightning protection system. Building upgrades can affect the lightning protection system as well. Roof construction, remodeling, and changes to electrical mechanical or communication system can alter or interrupt the lightning protection system. Facility maintenance programs should include an annual inspection of the lightning protection system to ensure quality control.

Unfortunately, the integration and maintenance of lightning protection systems in conjunction with roof systems has not received adequate attention from the roofing and construction industries. A lack of coordination between roof system and lightning protection system specifications and their associated trades can result in a variety of maintenance issues and roofing problems. There is a consensus in the roofing industry that standard details pertaining to the integration of a lightning protection system into a roof system need to be developed by the Metal Building Manufacturers Association (MBMA) and the National Roofing Contractors Association (NRCA). In the interim, the lightning protection safety standards of NFPA 780, UL 96A and LPI 175 should be used as a point of reference.



The most commonly employed grounding application utilizes ground rods composed of copper, copper-clad steel or stainless steel. These rods must extend vertically at least 3 meters (10 feet) into the earth. Factors such as soil content, environmental challenges and structural characteristics can dictate special grounding requirements or applications.

## System Maintenance



This schematic diagram shows a typical lightning protection system for a commercial building. (Graphic courtesy of East Coast Lightning Equipment.)

Maintenance and inspection of existing lightning protection systems to continue the designed safety for the structure is an ongoing process. NFPA 780, “Standard for the Installation of Lightning Protection Systems,” 2008 Edition, advocates a visual inspection to make sure exposed components are still in good working order every year and a comprehensive testing inspection every five years for any system. Specialized systems for critical structures may need even shorter inspection cycles. Underwriters Laboratories Inc., the industry’s inspection resource for new installations, has recognized this need on their current Master Label Certificates. After an inspection, the UL-listed installer forwards the certificate to the structure/building owner and posts the certificate on UL’s Web site ([www.ul.com/lightning](http://www.ul.com/lightning)), providing proof that the lightning protection system complies with UL, NFPA or U.S. government standards.

“Specifying compliance with UL or NFPA standards is key to safe and effective lightning system performance,” said Karl Keip, lightning protection service manager for Underwriters Laboratories. “Lightning protection systems that have received the UL Master Label Certification, indicate that a system has been inspected for conformance with these national standards for system installation.”

Lightning protection installation certification from UL has a five-year limit on validity. When an installation reaches the five-year mark, UL will issue a “Certification Expiration Notice” to the UL-listed installer, citing the expiration date and need for certification renewal.

“The Lightning Protection Institute Standard of Practice for the Design-Installation-Inspection of Lightning Protection Systems” (LPI-175) outlines the importance of reinspecting the lightning protection system at regular intervals to verify its continued effectiveness, similar to the case with inspections of roofing materials, flashings, or exterior wall coverings. LPI-175 provides a list of checkpoints for the building owner or system installer to reference during the inspection and maintenance procedure. An inspection program will not only identify elements of the lightning protection system that may need to be corrected, but it will address changes to the structure that require an extension of the system for proper protection. Structural additions and remodels may call for extension of the existing system, but less apparent are internal system changes that may extend to the exterior of the building. The addition of roof mounted vents and mechanical units from process changes or placing an antenna for communication networks or cameras for security upgrades can change the risk of damage significantly. Review by a professional installer or inspector of lightning protection systems can catch these details and the system will be extended to incorporate these changes for continued safe performance.

## Roof Replacement

A major development in the life of any lightning protection system will occur when the building's roofing system requires major overhaul or replacement. The entire array of direct strike protection for the structure, along with critical bonding elements for internal grounded systems that vent through the roof, can be affected during this process.



“The reroofing process is seldom as simple as removing and reinstalling the existing lightning protection components,” explained Mark Morgan, a member of the NFPA Technical Committee on Lightning Protection and an officer of the Lightning Safety Alliance (LSA). “There are so many potential problems with unqualified contractors attempting a removal and reinstall; it has proven to be a major source of substandard systems on older structures.”

UL-listed strike termination devices, also known as air terminals, can be designed with blunt tips and spring-mount bases to accommodate high-traffic roof areas.

When lightning protection systems are inadequately integrated into a roof system and/or not maintained properly, roof-related problems can arise and the lightning protection system may be rendered ineffective. Examples of common problems that can arise due to inadequate installation or improper maintenance include:

- Bitumen displacement. Displacement of bitumen can occur in hot climates when conductors rest directly on smooth or mineral surfaced built-up or modified bituminous membranes. If improperly installed, lightning protection conductors can sink into the membrane and displace the bitumen above the reinforcement. If bitumen displacement occurs, the service life of the membrane can be compromised.
- Surface abrasion. The loss of the roof's protective granules and wearing away of polymer matrices can result from excessive distance between conductor connectors and/or detached connectors. Proper installation and maintenance of the lightning protection system can prevent these problems, which can shorten a roof's service life.
- Wind-induced detachment of lightning protection components. Wind damage can occur in areas with a basic wind speed greater than 90 mph. An experienced lightning protection contractor can employ test methods to evaluate attachment strength and long-term effectiveness of the lightning protection components.
- Alterations and rooftop additions. Addition or changes in mechanical equipment, antennas, security cameras and equipment vents will need to be bonded to the lightning protection system as required by the provisions of the safety standards.
- Heavy rooftop traffic. Foot traffic from window washers, technicians and other contractors can pose a problem for air terminals and cable if disconnections to the system occur.

Various elements of the reroofing process require the supervision of a qualified lightning protection contractor. A decision must be made on the removal and care of existing system components for possible reinstallation. The process of removal and reinstallation on phased projects needs coordination to maximize time under protection. Structurally mounted hardware needs to be properly anchored according to the Standards. Bonding reinstallation must fulfill the

system needs for roof-level potential equalization. Runs of cable conductor must provide the most direct low-impedance path to building downleads and structural steel. The total package must return the building to the protected zone of the lightning protection system for the expected safety level of occupants and contents.

The Lightning Protection Institute (LPI) provides certification testing for individuals to show their competency in this specialized trade according to the lightning protection Standards. A Master Installer member of LPI has qualified through examination for system design, inspection and installation. LPI's examination program for Professional members receives the title Designer/Inspector and relates to those functions.

"The Master Installer Program is designed to raise the bar for excellence in lightning protection installation and design," said Bud VanSickle, executive director for the Lightning Protection Institute (LPI). The LPI is a not-for-profit nationwide group founded in 1955 to promote lightning safety, awareness and protection education.

"The LPI's educational programs respond to the quality control requests of government agencies, facility managers, architectural and engineering firms and insurance underwriters. We've learned that lightning safety and risk management are concerns that affect just about everyone," explained VanSickle.

UL's Lightning Protection Inspection Service provides the lightning protection industry with independent third party inspection services and verifies that inspected systems comply with national standards. UL has trained over 200 lightning protection inspectors across the U.S. to recognize and certify the requirements for complete systems. LPI and UL are available to provide lightning protection information during initial construction, as well as on a retrofit basis. These entities are key resources for inspection and maintenance of the lightning protection system throughout the life of the structure.

For more information about lightning protection and lightning protection safety standards for installation, visit the LPI Web site at [www.lightning.org](http://www.lightning.org).

## Sidebar: Lightning Protection Glossary of Terms



Bonding of metallic bodies and roof components to ensure continuity is a requirement of lightning protection safety standards.

lightning protection system.

These terms are defined by the Lightning Protection Institute Standard of Practice – LPI-175/2008 Edition.

**Authority having jurisdiction:** The organization, office, or individual responsible for approving equipment, materials, an installation or procedure.

**Bonding:** The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.

**Bonding conductor:** A conductor used for potential equalization between grounded metal bodies or electrically conductive objects and a

**Cable:** A factory assembly combining multiple conductor strands.

**Catenary lightning protection system:** A lightning protection system consisting of one or more overhead ground wires (also known as “overhead shielding”).

**Conductors:** Devices defined by the standard as suitable to carry lightning current. This may include strike termination devices, cables, lightning protection fittings, ground terminals, or metallic structural members.

**Fastener:** A component or set of components used to securely attach materials to the structure. A fastener may also be a mechanical device, such as a rivet, bolt, screw, or pin that is used to securely hold two or more components together.

**Ground electrode:** The portion of a lightning protection system, such as a ground rod, ground plate electrode, or ground conductor, that is installed for the purpose of providing electrical contact with the earth.

**Labeled:** Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

**Lightning protection system:** A complete system of strike termination devices, main conductors (including conductive structural members), grounding electrodes, bonding or interconnecting conductors, surge suppression devices and other connectors or fittings required to complete the system.

**Listed:** Equipment, materials or services included in a list published by an organization that is

acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

**Strike termination device (air terminal):** A component of a lightning protection system that intercepts lightning flashes and connects them to a path to ground. Strike termination devices include air terminals, metal masts, permanent metal parts of structures as described in LPI-175 and overhead ground wires installed in catenary lightning protection systems.

**Surge protective device (SPD):** A device composed of any combination of linear or nonlinear circuit elements intended for limiting surge voltages on equipment by diverting or limiting surge current.

**Transient voltage surge suppressor (TVSS):** A surge protective device for limiting transient voltages by diverting or limiting surge current; it also prevents continued flow of follow current while remaining capable of repeating these functions.

**Voltage protection rating (VPR):** A rating (or ratings) selected by the manufacturer based on the measured limiting voltage determined when the SPD is subjected to a combination waveform with an open circuit voltage of 6 kV and a short-circuit current of 3 kA. The value is rounded up to the next highest 100 V level.

**Zone of Protection:** The space adjacent to a lightning protection system that is substantially immune to direct lightning flashes.

## Sidebar: Typical Commercial Lightning Protection System Components

**Adhesive base/adhesive cable fastener:** Holds the air terminal assembly in place, while connecting and fastening the cable conductor to the structure.

**UL Master Label:** Signifies that the lightning protection system was inspected to comply with UL installation standards. (Note: UL automated its inspection services in 2003 and began issuing certificates via the Internet to replace the metal Master Labels. Effective 4/12/07, UL revised wording to “UL Lightning Protection Inspection Certificate.”)



Fasteners are used to securely attach materials to the structure.

**Surge protective device (SPD):** A device composed on any combination of linear or nonlinear circuit elements intended for limiting surge voltages on equipment by diverting or limiting surge current.

**Cable connector:** Fittings used for the bonding or connection of down conductors and/or grounding equipment. (Bimetallic connectors must be used for splicing or bonding of dissimilar metals.)

**Pipe clamp:** Used to connect underground metallic piping systems.

**Bolt fitting:** A parallel cable connector which ensures continuity.

**Side mount base:** Adhesive cable fastener used to side mount air terminals for placement on a structure's wall.

**Through-roof assembly:** Used to achieve a thru-roof connection to the grounded steel framework.

**Bolt fitting and ground termination:** Used for steel column grounding connections.

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