

The Importance of Safety Standards for Lightning Protection

**Without the proper system in place,
lightning will produce heat, fires and even explosions.**

By Kim Loehr

Lightning protection has come a long way since Ben Franklin first invented the lightning rod in 1752. While the principles behind the science of lightning protection remain the same, today's structures and their amenities have presented several challenges. Electricity, gas, indoor plumbing, telecommunication systems and irrigation systems have created induction problems for modern structures, allowing lightning's access into a structure through energized lines or system grounds.

The lightning protection safety standards address protection for these functions and systems, providing information and detailed installation procedures. These safety standards for installation have been reviewed and revised to not only address a building's needs for the structural lightning protection system, but to also provide requirements to protect the internal functions of the building.

In other words, today's lightning protection systems provide practical and tested solutions for the interconnection of grounded building systems, surge suppression, requirements for communication and data lines and coordinated bonding. This adds up to a total package protection approach.

Recognized Authorities

When questions arise about lightning protection, it is important to know where to turn for accurate and up-to-date technical information. Whether the questions arise on the drawing table or on the job site, there are three nationally recognized authorities that can be con-



The most commonly employed grounding application utilizes ground rods composed of copper, copper-clad steel, hot-dipped galvanized steel or stainless steel. These rods must extend vertically at least 10 feet into the earth. (Photos courtesy of Lightning Protection Institute)

sulted for technical information. These authorities are:

- National Fire Protection Association (NFPA)—Standard for the Installation of Lightning Protection Systems, NFPA 780;
- Underwriters Laboratories (UL)—Installation Requirements for Lightning Protection Systems, UL96A, and UL96, Standard for Lightning Protection Components;
- Lightning Protection Institute (LPI)—Standard of Practice, LPI-175.

Of these three, NFPA 780 has the longest history and is the most comprehen-

sive standard. The NFPA first adopted "Specifications for Protection of Buildings Against Lightning in 1904." Since its beginning, the NFPA Committee on Lightning Protection has continued to revise and update the standard. The most recent edition was published in 2004.

In 1992, the numerical designation of the document was changed from 78 to 780, and the name was changed from "Lightning Protection Code" to "Standard for the Installation of Lightning Protection Systems." At this time, NFPA 780 was accepted as an American National Standard.

UL has been testing equipment and inspecting lightning protection systems in the US since 1908. UL's extensive group of field representatives are trained in lightning protection to inspect sites including horse barns, missile silos, homes and high-rise buildings. UL has eliminated the previous use of a metal tag mounted to structures and changed to a paper certificate. A certificate of conformance is issued to the owner through the UL-listed installing contractor for those projects that comply with the UL96A safety standard. The UL96 component standard regulates manufacturers of products used in lightning protection systems through on-site factory inspections.

According to UL, "Lightning accounts for more than one billion dollars annually in structural damage to buildings in the United States. What's not reported is the loss of business, downtime, and liability when business or commercial tenants are forced to shut down to repair lightning damage." →

Safety Standards for Lighting Protection

While NFPA, UL and LPI are all not-for-profit organizations publishing safety information and installation standards for lightning protection, LPI is the only organization founded specifically to study lightning protection. LPI started promoting lightning protection education, awareness and safety in 1955. Its membership is comprised of engineers, manufacturers, contractors, scientists, architects, and safety directors. LPI offers certification and education programming. The LPI's "Master Installer" and "Certified System" programs qualify competence and quality control in the lightning protection industry.

How the Network System Protects

Lightning is electricity. When electricity is confined to a properly designed conductive path, damage can be minimized. Destruction results when electricity encounters resistance, similar to the resistance used in arc welding. When electrical current runs through an arc welder, the resistance it encounters when arcing through air, generates the heat necessary to melt steel.

The highly conductive copper and aluminum materials used in a lightning protection system provide a low resistance path for lightning to travel without resistance. When the lightning protection network is in place, a lightning strike is intercepted and directed to ground without impact to a structure or its contents.

Without the presence of the low-resistance path provided by a lightning protection system (network), the lightning will fight its way through non-conductive building materials like wood, brick, rubber membranes, glass, plastic, etc., on its way to the earth's ground. The resistance the lightning encounters will produce heat, fires and even explosions. It also is common for lightning to travel via conductive matter it finds along the way, including plumbing, gutters, flashing, structural members and/or wiring for power, communication or data.

None of these systems is designed to provide a safe path to ground for lightning. Providing this safe path to ground is the first focus of a lightning protection system design.

Roof and Ground Network

While the concept behind the lightning protection is relatively simple, the requirements for proper installation are specific and often complex. The single best way to ensure proper system design and installation is to specify compliance with American National Standards Institute (ANSI) safety standards for lightning protection (NFPA 780, UL96, UL96A).

Strict compliance with the requirements of these standards for the roof system, grounding and surge protection are essential to proper system per-



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

formance. A lightning protection system includes the following elements:

- A network of prominent strike termination devices;
- A network of ground terminations;
- A network of conductors or qualified structural steel members interconnecting the strike and ground terminations;
- Interconnections with other metallic grounded building systems;
- Surge protection devices on all incoming power, data and communication lines.

The first three elements of the system intercept, conduct and dissipate the lightning discharge, while the fourth addresses the secondary effects of a strike by limiting the dangers of the harmful current caused by side flashing. The last element protects connected equipment and wiring from damaging currents and surges that can travel on utility lines.

Specialized techniques are often needed for specific applications, such as connections across insulated joints, bonding, grounding strips, ground grids and/or ground plates. Failure to make proper provisions for special grounding techniques, or for any of the above five elements can result in inadequate protection.

While it is true that lightning protection is not a new concept, our modern structures have prompted updates and revisions to the safety standards to address problems with lightning entering along energized lines or system grounds. It is not enough to simply provide a lightning path for a structure. Today's lightning protection systems must be designed to cover the contents, equipment, operations and functions housed in a given facility.

It is this multi-step approach that led to significant revisions in the 2004 Edition of the NFPA 780 standard, under the section covering surge protection (found under *The Protection of Ordinary Structures*). Wording in the previous NFPA editions was vague and unclear. The current standard now covers installation information in detail, while also providing the following:

- Product requirements to achieve acceptable levels of protection at entrances;
- Indications for additional needs for internal equipment protection;
- Specifications regarding addition of grounds specific to surge protection device installation for remote entrances.

Assessments of when and where lightning protection is needed should ultimately consider the basic principles of lightning, risk assessment for the structure and the fundamentals of the protection system. **PME**

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