

STRUCTURAL LIGHTNING PROTECTION

“May not the knowledge of this power of points be of use to mankind, in preserving houses, churches, ships, etc., from the stroke of lightning, by directing us to fix, on the highest parts of those edifices, upright rods of iron made sharp as a needle...Would not these pointed rods probably draw the electrical fire silently out of a cloud before it came nigh enough to strike, and thereby secure us from that most sudden and terrible mischief!” Ben Franklin.

The third step in securing effective lightning protection is structural lightning protection. This term describes what is most readily recognized as a lightning rod system.

There are three common approaches to structural lightning protection, loosely grouped as follows:

- Lightning interception systems - the common Franklin lightning rod technology
- Lightning attraction systems – Early Streamer Emission (ESE) or Electronically Activated Streamer Emission (EASE) technology
- Lightning prevention systems – typically called Charge Transfer Systems (CTS) and/or Dissipation Array Systems (DAS) (although often used generically, DAS is a trademarked term of Lightning Eliminators and Consultants of Boulder, CO)

The first two types of lightning protection systems (LPS) claim to protect structures by providing zones of protection over that structure. The zone of protection is defined as the space adjacent to a lightning protection system that is substantially immune to direct lightning flashes. Think of it as a volume of space around a lightning rod wherein lightning will attach to that lightning rod in preference to anything else around it. Conventional lightning protection consists of a network of lightning rods interconnected by conductors leading to a grounding system. As long as the entire protected structure is located within a lightning rod zone of protection, the claim is that lightning will always attach to a lightning rod and be harmlessly conveyed on the conductor system around the protected structure to ground, thereby sparing damage to the protected structure.

It is helpful to remember that the primary purpose of a conventional lightning rod system is to keep the protected structure from burning down. That is why

lightning protection is covered under the National **Fire** Protection Association standard, NFPA 780. This technology was introduced by Ben Franklin, and goes back almost 250 years, essentially unchanged since then. That was fine back in the days of barns filled with hay and horses. Lightning would strike the lightning rod system and be conveyed to ground. The barn would not burn down and everyone would be happy, particularly the horses. Now, we have filled the “barns” with computers. If lightning strikes the building, it still does not burn down, but none of the computers work, so everyone is not happy. So, although this type of system may protect a structure from physical and fire damage, the structure and its contents remain vulnerable to secondary effect, electromagnetic pulse (EMP) and ground reference potential change damage.

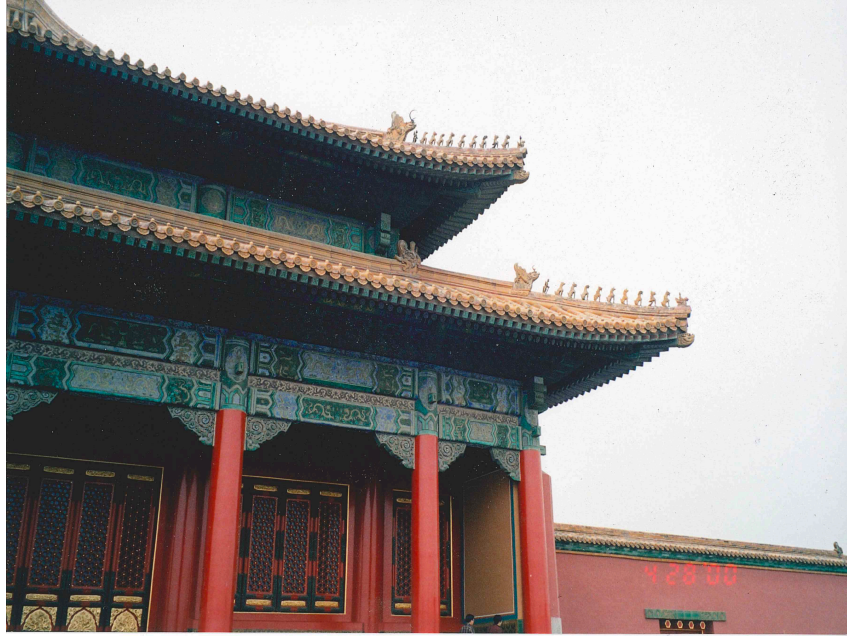
The third type of system claims to protect a structure by reducing the difference in potential between the cloud and ground sufficiently to prevent a strike or through creating a space charge above the structure, i.e., a shield through which lightning cannot travel. These systems are based on patents going back to the 1830’s. Several of these patents addressed lightning protection for petroleum storage tanks. However, the systems described in these and more recent patents never achieved general acceptance, and not covered by any US standard, and are the subject of some controversy.

Let’s look at these systems in more detail.

LIGHTNING INTERCEPTION SYSTEM

The first and oldest type of system is the Franklin lightning rod system as described in National Fire Protection Association NFPA 780. NFPA 780 is the United States “Standard for the Installation of Lightning Protection Systems”. Underwriters Laboratories (UL) converts NFPA 780 into Standards for Safety materials and installation guidelines. UL 96 covers Lightning Protection Components and UL 96A covers Installation Requirements. UL is the Nationally Recognized Testing Laboratory (NRTL – pronounced to rhyme with “turtle”) in the lightning protection industry.

This type of system basically just “gets in the way” of any strike to a protected structure and conveys the lightning energy to ground. It consists of a system of lightning rods arranged around the perimeter of the structure, particularly on outside corners, with additional lightning rods in the center of the structure and on elevated features, such as stairway or elevator penthouses. Lightning rods are installed on the likely lightning strike attachment locations on the structure.



The ancient Chinese recognized that lightning was most likely to attach to corners and edges of a structure. If you look at the roof an old Chinese building such as one found in the Forbidden City, you will notice a parade of small, fearsome looking figurines arranged along the edges. The purpose of these figurines was to frighten away lightning. They unintentionally comprised the lightning strike interception component of the first lightning protection systems.

Layout requirements for individual lightning rods call for the zone of protection of each one to overlap the zone of protection of an adjacent rod. If the entire structure is contained within the zone of protection of one or more lightning rods, the theory is that lightning should always attach to a rod in preference to the protected structure. Once it is intercepted by a lightning rod, it is conveyed to ground over the conductor system, and dissipated to earth through the grounding system.

LIGHTNING ATTRACTION SYSTEM

These systems work the same way as a conventional Franklin rod system, attracting lightning to a preferred point(s), then conveying it to ground. They employ air terminal(s) that are claimed to have a larger lightning attraction or collection area than a conventional lightning rod, thereby providing a larger zone of protection. As such, fewer air terminals are required to protect any given structure. The air terminals used in these systems employ either

geometry (ESE – early streamer emitting) or electronics (EASE – electronically activated streamer emitting) to trigger the formation of a streamer before natural streamers begin to form. As such the ESE streamers have a head start (ΔT) over natural streamers. This time advantage is claimed to make them appear longer (ΔL), thus reaching the stepped leaders first and triggering the strike to themselves.

Although there is no US recognized standard covering this type of system, there are several foreign national standards. These systems are commonly used by major US theme park operators to provide protection for crowds.

LIGHTNING PREVENTION SYSTEM

The third type of system is generally known as the Dissipation Array System (DAS) or Charge Transfer System (CTS). Although often used generically, they are trademarked terms of Lightning Eliminators and Consultants of Boulder, CO. This system claims to reduce the electrostatic potential between the protected structure and passing clouds to a level that a direct lightning strike is prevented, or by creating a space charge (ion shield) above the protected structure isolating the site from the charged clouds. The patent describing this type of system claims to collect ground charge with a “ground charge collector” surrounding the protected structure or site. It further describes a hemispherical or linear array of dissipation elements (hence Dissipation Array System) located above the protected structure to transfer the collected ground charge to the atmosphere above the protected structure (hence Charge Transfer System). Service wires convey the ground charge from the ground charge collector to the dissipation array.

This system does not meet the requirements of NFPA 780, UL 96A, or any other recognized standard. It uses undersized conductors, undersized strike termination devices and other undersized system components, none of which are listed by UL or any other NRTL for lightning protection purposes.

Lightning Master is qualified and pleased to offer all of these technologies based upon the needs, requests and requirements of our customers.