

What Are Lightning Protection Systems?

A lightning protection system provides a safe pathway for energy from a lightning strike to find its way to earth, encouraging the bolt to bypass building components that might otherwise be damaged. So its job is both to provide a path for the lightning strike to reach ground (instead of reaching the ground through the building or its components), *and* to avoid damaging the building as the electrical current of the lightning bolt flows through the protection system components. In other words, a lightning rod and its components do not *prevent* a lightning strike, rather they give it a safer pathway to earth than would occur if the energy passed through building components on the way down.

The basic components of a lightning protection system include the following

- **Air terminals** or "lightning rods" are metal rods which form the initial contact point for lightning strikes that are reaching towards ground in the immediate area. Modern lightning rods are placed vertically, typically extending about 10' above the building component they are intended to protect. Lightning rods are made of 1/2" diameter aluminum or 3/8" diameter copper; older components may be made of iron or steel.
- **Main Conductor Cables**, heavy twisted or braided 14-gauge aluminum or 16-gauge copper cable (or thicker) which is connected to the air terminal and/or run near the ridge or other building high points, routed to the ground.
- **Grounds** Ground rods, usually of a corrosion resistant alloy of copper and steel, 1/2" in diameter and 9' long. The ground rod is driven 10' into the earth [LPI specification] and connected to the cables.
- **Bonding & Mounting hardware** are used to splice or connect between air terminals, cables, ground rods, and possibly other devices, and to support the air terminals, cables, or other devices in place. These components too must be corrosion resistant and strong enough to keep their components secure.
- **Lightning arrestors** are electrical devices installed in or on a building's electrical components and designed to protect electrical equipment from the electrical surge that occurs when lightning strikes a nearby power line. Common components receiving extra protection include computer equipment, televisions, telephones, sump pumps, and wells or well pumps.

As we mentioned above, a lightning protection system does not prevent lightning from striking; it provides a means for controlling it and preventing damage by providing a low resistance path for the discharge of lightning energy. This means that the energy from a

lightning strike is directed along a heavy metal cable from an air terminal or other protection device down to a rod driven into the earth.

If an easier path is not provided for the energy (or current) to flow to earth, the energy from the lightning strike will find its own, often remarkably odd, pathway to earth anyway, perhaps moving on building water piping, electrical wiring, or even through damp timbers.

When the tremendous energy of a lightning strike moves through these building components instead of through a desired and safest cable designed for that purpose, damage to the building is likely, including explosion, fire, or electrical damage.

The modern lightning rods have a short blunt tip and that they are connected to earth by heavy metal cables, often using braided copper. Having a properly-designed lightning protection system is very important if you're going to have one at all, since an *improperly designed* or installed system might actually *increase* the chances of a building being damaged by a lightning hit.

Lightning strikes at buildings and other sudden electrical currents (such as a tree touching a high tension power line) produce very high voltages which can take surprising routes at a property such as following underground tree roots, metal porch railings, and copper or steel building water pipes.

How do Lightning Protection Systems Work?

Lightning protection systems control electrical discharges by directing them through a low-resistance path to the ground, avoiding passage through parts of a structure and reducing risk of fire or other damage.

Air terminals (rods - the sketch at page top is of a lightning protection system terminal rod tip) are fastened to the building to intercept electric discharges which might otherwise strike a building component itself, such as a chimney or metal roof.

Electrical discharges striking the air terminal are directed through heavy duty metal conductors to a grounding system (rods driven into the soil) and thence into the earth.

Design Details of Lightning Protection Systems Using Copper Components

- **Building chimneys** shall be protected with an air terminal to be placed no more than 2' from any outside corner.
- **Lightning protection system air terminals** shall be solid copper, round, pointed, 3/8" or larger in diameter, project at least 10" above the object or building section to be protected, and shall comply with UL and LPI requirements for lightning protection systems and shall be located within 2' of outside corners and at intervals no greater than 20 horizontal feet (along the ridge line).
- **Air terminal bases** shall be made of cast bronze and shall be securely mounted using pressure-bolt or crimp connectors and stainless steel screws, nails, or bolts.
- **Lightning Protection System Cabling** shall all be 28-strand 16 gauge copper (230#/1000', 72,258 mils or equivalent).
- **Corrosion protection** shall be provided by lead coating on metal components (air terminals, terminal bases, cable connectors, strapping,) where located within 2' of the chimney top.
- **Cable fasteners** shall be made of 1/2" wide 20 ga. copper strips and shall be spaced at 2' intervals (exceeding the UL and LPI requirements).
- **Ground rods** shall be at least 1/2" in diameter and 11' long, and driven into the ground 10', leaving 1' of the ground rod exposed [this is the UL standard] and shall be connected to the lightning protection system by two-bolt cast-bronze clamps at least 1.5" long and using stainless steel cap screws. UL requires that at least two ground rods shall be installed.
- **Metal components on the building** such as antennas, weather vanes, and metal gutters are connected to the roof or down conductor
- **Building ground-devices** such as water piping, electrical systems, telephone, cable, internet systems, and metal waste piping shall be grounded in common and bonded to the lightning protection system using full-sized grounding conductors.
- **Other hardware** such as miscellaneous bolts, nuts, nails, screws, shall be stainless steel.
- **Surge protection** devices are installed at receptacles on for circuits serving electronic equipment like computers, TV's, or other electronics. Surge protection may also be installed at the electrical panel to protect the circuit serving a well or well pump, or to protect equipment from strikes drawn to steel well casings protruding above ground as well as to protect building appliances.