

Lightning and Power Surges

Safeguard Your Property

Lightning is the visible discharge of static electricity within a cloud, between clouds, or between the earth and a cloud. Scientists still do not fully understand what causes lightning, but most experts believe that different kinds of ice interact in a cloud. Updrafts in the cloud separate the charges so that positive charges typically end up at the top of the cloud while negative charges flow to the bottom. The charge in the lower layer of the cloud induces an opposite charge in the earth below, creating a giant capacitor that can discharge in a very short period of time.

During a lightning stroke, a pilot-leader stroke of low amperage forms, followed by other strokes of increasing intensity in rapid succession. Each stroke further ionizes the pathway through the air, increasing conductivity. When the pathway is sufficiently conductive, a main stroke arcs between the earth and the cloud through the ionized air pathway, and is typically followed by other strokes. The main stroke may travel at 20,000 miles/second with currents as high as 200,000 amperes in a few millionths of a second.

Voltages typically reach tens of millions of volts but can get to several hundred million volts. Induced charges are important and influence much of the electrical code designed to protect property from lightning strokes. Lightning can explode electrical transformers, splinter wood in buildings, and cause over-pressurization due to high, rapid heating of water vapor in the surrounding air, which explains why windows are frequently blown out. Lightning can create electromagnetic fields that induce voltage and current surges in electric and communications lines causing damage to equipment, especially solid-state electronics.

The average lightning strike is 20 kilo-amperes, but strikes up to 200 KA have been measured. Temperatures in a lightning channel are about 36,000°F. The heat causes thunder as air explodes in the channel; heat also causes some fires and explosions.

High objects are generally targets or sources of lightning strikes. Special protection is needed for these structures as well as for some other facilities, e.g., pre-stressed concrete buildings; structures built on bare, solid rock; and non-pressurized tanks holding combustible or flammable liquids or gases.

A lightning protection system provides a means by which an electrical discharge may enter or leave the earth without passing through and damaging non-conducting parts of a structure, such as those made of wood, brick, tile, or concrete. A lightning protection system does not prevent lightning from striking; it provides a means for channeling it and prevents damage by providing a low resistance path for the discharge of electrical energy. NFPA 780 provides guidance for the installation of lightning systems.

Surge suppression systems protect buildings and equipment from damaging surges in voltage and current traveling along power and/or communications lines – including energy surges created by lightning and utility switching – and from sources internal to the structure, such as motors, pumps, and air conditioning systems. Surge protection devices divert high-current surges to ground through low-resistance conductors. Surge protection systems should be tested periodically according to the manufacturer's specifications, or every two months to ensure their performance. After a strong current surge, it may be necessary to replace fuses and/or the arrestor in the surge protector.

There are practical things you can do to safeguard property against lightning and power surges. There are four fundamentals: grounding, bonding, shielding, and surge suppression. Consider the following:

- Identify possible lightning hazards on your property. This includes roofs and peaks, tanks, radio receivers, and inappropriately secured electrical fixtures, among others.
- Install a lightning protection system – e.g., lightning rods (air terminals), down conductors, and grounding rods – on vulnerable structures and buildings. This will allow electrical current from lightning to travel safely to the ground.
- Install transient voltage surge suppressors at the main service entrance (the point where power from the utility enters the structure). This is a relatively inexpensive way to prevent electrical surges from entering buildings through the power lines.
- Install internal surge suppressors at the circuit breaker or distribution panel and/or at the point-of-use for specific, vulnerable electrical/electronic equipment, such as computers and other electronic equipment in order to limit the voltage to 1.5 times the normal voltage (maximum for solid state devices).
- Provide protection for critical equipment connected to the outside by communications or data lines, including metal sheathed fiber optic cable.
- Use continuous, grounded shielding around cables and other circuits where necessary.
- Interconnect (bond) all adjacent metal systems including structural steel, pipes, conduits, and HVAC systems, to prevent spark-over, unless otherwise indicated.
- Ground the electrical distribution system in accordance with the National Electrical Code (NFPA 70) or equivalent local building codes.
- Set flagpoles no closer to your building than 20 feet to prevent lightning strikes from traveling toward the building. If an existing flagpole is closer to any building than 20 feet, relocate it. A tall flagpole is a target for lightning, especially if it's the highest object in the area.

Lightning Protection Systems for Small Buildings:

- Air terminals: 20 feet apart along roof ridges and within two feet of ridge ends
- Air terminals located within two feet of outside corners of each chimney
- Down conductors (connecting air terminals to grounding systems)
- Minimum of two groundings (metal rods) at least 10-feet deep into the earth
- Roof projections, such as weather vanes, connected to grounding system
- Dormers protected by connection to the grounding system
- Antenna mast and receivers connected to the roof conductor and grounded
- Gutters and other metal objects grounded
- Surge arrester installed at service panel to protect appliances
- Transient voltage surge suppressors installed in receptacles to which computers and other electronic equipment are connected (Modems are a special problem.)

Direct damage to and loss of property from lightning exceeds more than \$1 billion annually in the U.S., exclusive of business interruption and other indirect losses, loss of equipment and data, loss of inventory, personal injury and commercial liability.

Only lightning and surge protection systems that are certified by a nationally recognized testing laboratory should be used. Systems should always be installed, tested, and maintained in accordance with local building codes, national standards and manufacturer's instructions. Use only qualified and licensed personnel. Consult with your local or state building permitting authority for requirements and a list of qualified and licensed electrical system installers.

The risk prevention information and advice presented in this brochure are intended only to advise our insureds and their managers of a variety of methods and best practice strategies based on generally accepted practices for controlling potentially loss producing situations commonly occurring in business premises and/or operations. The recommendations and information contained herein are not intended to warrant that all potential hazards or conditions have been evaluated or can be controlled. This guide is not intended as an offer to write insurance coverage for such conditions or exposures, or to imply that Alteris will write such coverage. The liability of Alteris is limited to the specific terms, limits and conditions of the insurance policies issued.