Cornell Cooperative Extension

RURAL
Safety and Health

LIGHTNING PROTECTION FOR FARMS

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THIS FACT SHEET COVERS

Lightning, one of nature's most powerful forces, can cause a great deal of damage, particularly in a farm environment. A lightning strike can start fires in buildings, damage electrical equipment, and electrocute humans and livestock. Losses from lightning can be very costly. Replacing buildings, equipment, or livestock disrupts farm operations and incurs considerable expense, and of course a human life cannot be replaced. Fortunately, most losses caused by lightning strikes can be prevented by installing proper lightning protection systems.

Characteristics of Lightning

Positive and negative electrical charges exist throughout nature. Under normal conditions, these charges are paired up and neutral, exhibiting no net electrical charge. The charges, however, have the ability to move about and separate. Strong air currents, moist air, and extreme temperature differences can all disrupt the natural balance of these charges.

Lightning occurs when the imbalance between charges becomes too great. Certain weather conditions can cause an abundance of negative

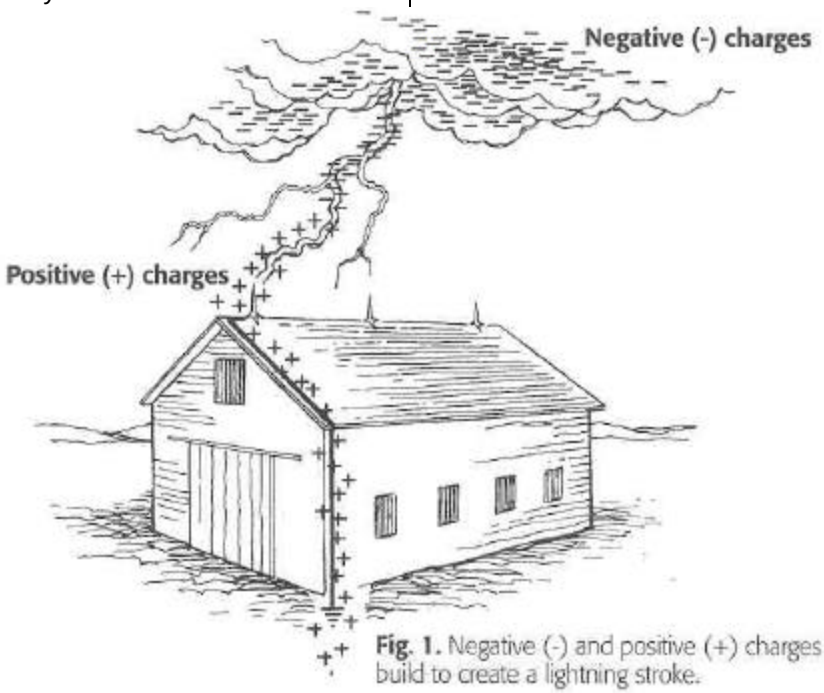


Fig. 1. Negative (-) and positive (+) charges build to create a lightning stroke.

charges to gather on the bottom of clouds, while positive charges accumulate on buildings, trees, or any objects that project above the ground. When the negative and positive charges build to high enough levels, a streamer of negative charges moves erratically toward the earth. At the same time, a short leader of positive charges may move a short distance up into the air. When the two charges meet, the downward moving streamer completes the grounding path as the positive charges instantaneously move back up the path to the clouds (see fig. 1). The resulting flash is lightning. A lightning "stroke" happens very quickly and contains a great deal of electrical energy.

Lone trees and isolated buildings, which are closer to the clouds than their surroundings, tend to concentrate positive charges. Consequently, they are frequently the objects of lightning strikes. High objects actually intercept lightning strikes from other nearby objects. That is why it Is particularly important to take precautionary measures to protect farm buildings from the damage lightning strikes can produce.

Principles of Building Protection

Lightning can enter a building in one of four ways:

1. It can strike a metal object on the roof.

2. It can strike a building directly (called a direct strike).

3. It can strike a tree or silo near the building and jump to the building. This occurs when the building provides an easier path to ground.

4. It can strike a power line or a wire fence and follow the line or fence to the building.

A properly designed lightning protection system safeguards vulnerable structures, equipment, and trees by providing an easy path to a ground, which harmlessly dispels the electrical charges. Protection should also be provided for objects located where a lightning strike's current might sideflash, such as electrical wires or metal devices on building roofs.

Depending on their location, some silos should be tied into a building's lightning protection system. It is also possible to extend protection to trees situated near farm structures or that offer cover for livestock. Detailed specifications for these systems can be found in the codes and standards cited later in this fact sheet

Installation Codes and Standards

Installing lightning protection systems is *not* a do-it-yourself job. To ensure that a lightning protection system is safe and effective, it should be designed and installed by trained professionals.

Certain codes and standards must be followed when lightning protection systems are installed. Standards and sources are listed below:

LPI-175: The lightning protection code, published by the Lightning Protection Institute.

NFPA 78: National Fire Protection Association Lightning Protection Code.

ASAE EP381: American Society of Agricultural Engineers, Engineering Practice.

96AUL: Requirements for Master Label for Lightning Protection, developed by Underwriters' Laboratories.

The Lightning Protection Institute will certify a lightning protection system that meets all its requirements. To retain certification, the system must undergo regular maintenance and be inspected annually. Maintenance of any lightning protection system is vital to make sure the system will work when it is needed. Weather conditions, such as high winds, can damage components of a lightning protection system. Building additions and re-roofing can also affect a system's performance.

Components of the System

Main Components

The major components of a building's lightning protection system are air terminals, conductors, and ground electrodes (see fig. 2).

Air terminals are more commonly known as lightning rods. They are placed at intervals on the roof and on any high points projecting from the roof. Lightning rods are made of solid copper or aluminum and are drawn to a point. Their design and placement ensure that lightning will strike them and not another part of a building. Specifications for lightning rods vary depending on a roof's type and size. Recommended height, anchoring methods, and spacing intervals can be found in the codes and standards previously listed.

Conductors are specially designed cables made from copper or aluminum that provide a low-resistance path to the ground for lightning's electrical charges. Conductors can be classified into three categories:

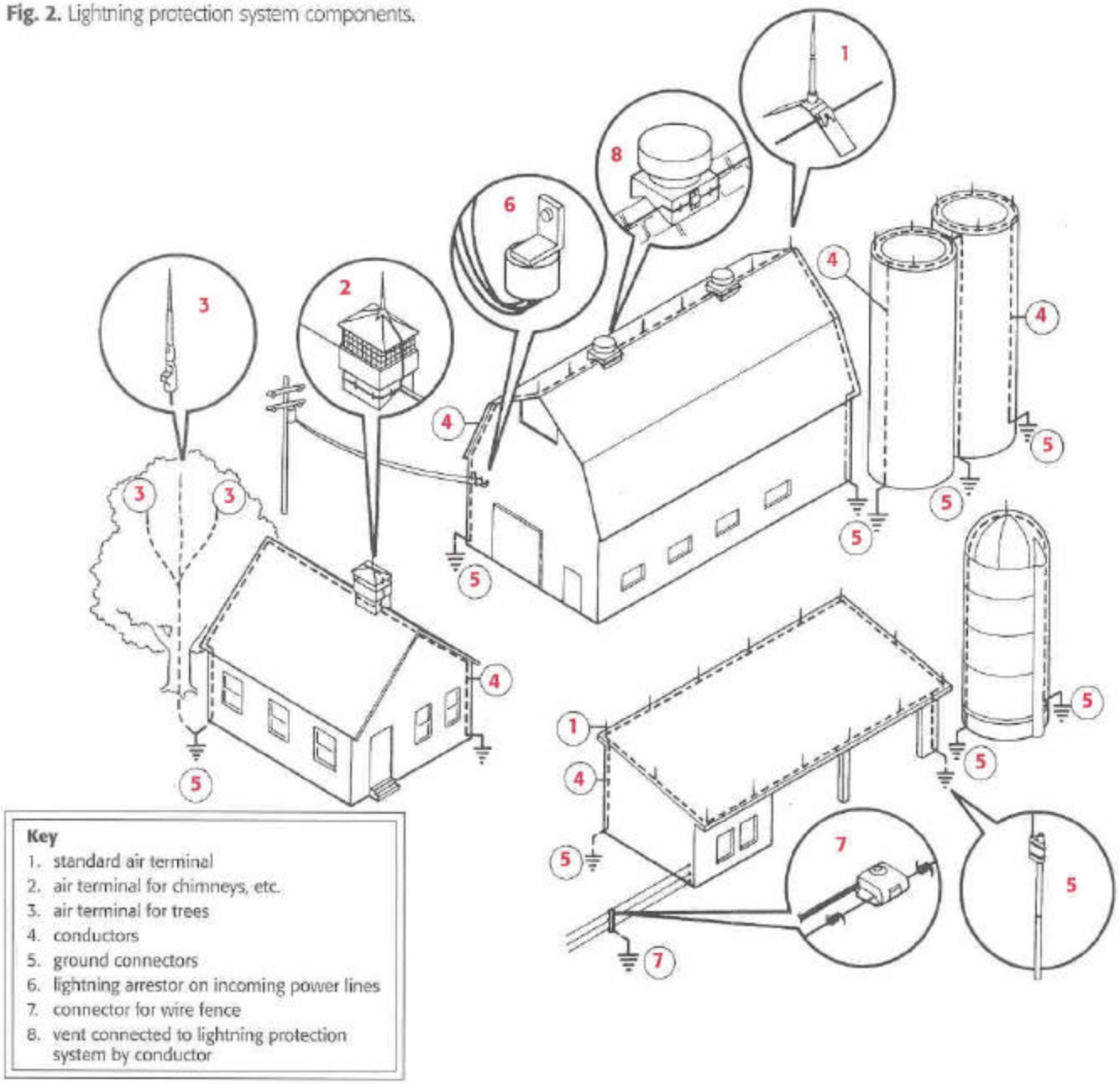
1. Main conductors interconnect all the lightning rods and down conductors.

2. Down conductors connect the main conductors to the ground. Each building needs at least two down conductors located at opposite corners of the building. Codes should be consulted to determine the number and location of down conductors for different building types.

3. Branch conductors connect metal objects such as vent fans, gutters, and water pipes to the grounding system to protect against possible sideflashes.

Ground electrodes are the ground connections for the lightning protection system, which serve to dissipate electrical charges safely. The down conductors are securely fastened to the ground electrodes. The type of ground connection used depends on the conductivity of the soil. Code specifications must be followed to make sure the most effective ground connection is made for a particular soil type.

Fig. 2. Lightning protection system components.



The best method for eliminating lightning-induced sideflashes between metal bodies is common grounding. This means that the grounds for all the electrical systems, the telephone service, and underground metal piping are connected to the lightning protection system. Plastic piping, which has become common in recent years, does not conduct lightning's electrical charges and requires special grounding.

Lightning Arresters

When lightning strikes a power line, it can travel along the line and enter a building's wiring system, causing a power surge that can damage wiring and electrical equipment. To prevent this from happening, lightning arresters should be installed outside, where the electric service enters a building, or at the inside service entrance. The arrester supplies a ground so that a power surge will not enter the building. If a farm has several buildings with separate electric service entrances, a grounded lightning arrester should be installed in each building.

Wire Fence Grounding

Ungrounded wire fences can be very hazardous to livestock and humans who are in the vicinity of the fence when lightning strikes it. Lightning strikes can travel almost two miles along an ungrounded fence. Wire fences supported by wooden or steel posts set in concrete are not grounded. The best way to ground these fences is to drive 1/2- or 3/4- inch steel rods or pipes next to the fence posts at least 5 feet into the ground, at intervals of no more than 150 feet along the fence (see fig. 3). The grounding rod should be securely fastened so that all the fence wires are in contact with the rod. Substituting galvanized steel fence posts for wooden posts at intervals of not more than 150 feet is also effective.

Electric fences should not be grounded in the manner described above because they already include a path to ground in their circuitry.

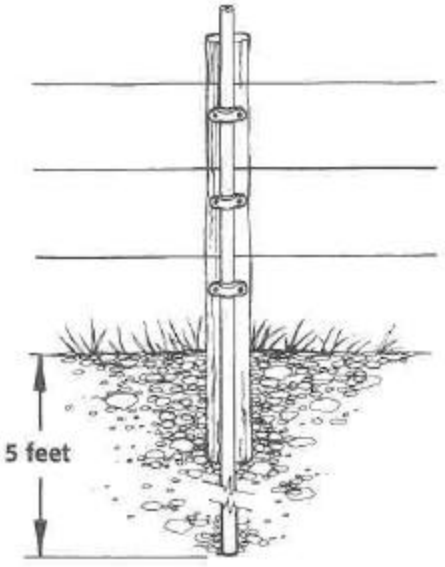


Fig. 3. Grounding rod for wire fences.

Personal Safety

Several precautions should be taken for protection from a lightning strike during a storm:

- Stay away from indoor water faucets, telephones, appliances, and lamps. These objects are all connected to outdoor conductors.
- Stay clear of chimneys, fireplaces, and stovepipes. Lightning will often strike chimneys, which then become a lightning stroke path.
- Don't get out of a closed vehicle until the storm passes.
- When no shelter is available, seek a low spot away from lone trees or fences and lie down.

Summary

Lightning can be a very destructive force, but steps can be taken to protect livestock, property, and human lives. Hire professionally trained personnel to design and install effective lightning protection systems on vulnerable buildings. Install lightning arresters at all electric service entrances to buildings to protect interior wiring and electrical equipment from a power surge caused by lightning. Ground wire fences to prevent hazards to livestock and humans. A small investment now can protect family members, farm workers, property, and equipment from lightning devastation.

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