

Lightning Protection for the Farm

by
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Lightning, one of the most destructive forces of nature, is particularly dangerous and costly on the farm. In a typical summer, lightning damages more than 18,000 houses and thousands of barns and miscellaneous buildings. Lightning is a frequent cause of farm fires. Barns, sheds and other stock buildings are particularly vulnerable. Damage to farm buildings runs into tens of millions of dollars every year. Lightning bolts, properly called flashes, cause more than 80 percent of all livestock losses that are due to accidents.

Lightning protection can prevent or greatly reduce the danger of loss of life and property damage. A lightning protection system that is properly designed, installed and maintained can afford almost 100 percent protection to buildings.

Lightning is electric current with tremendous amperage. Ordinary homes have 10 to 240 volts with 100 or 250 amperes available in the main service. One-tenth of an amp is enough to kill, if the current passes through the body. It also could start a fire if there is a short in the wiring.

The amperage from a lightning flash, may be at least 2,000 times as great as the current in the home. House current consists of continuous electric impulses that follow a controlled path of low-resistance wires. Lightning is a gigantic, uncontrolled, split-second surge of electrical current that delivers a tremendous amount of energy.

When a storm builds up, negative charges accumulate in the base of the clouds. Positive charges accumulate at the top part of the clouds, in the ground and in objects over which the clouds pass. The eventual result may be a lightning flash. When the voltage becomes great enough to push the current across the gap be-

tween the ground or objects and the clouds, the result is a lightning flash.

Lightning strikes trees, buildings or other objects because they are better electrical conductors than the air and provide easier paths to ground.

A lightning flash is classed as either hot or cold, according to whether its flow of current lasts long enough to start a fire in a flammable material. About two of every three flashes are cold. There are still enough hot flashes of lightning to cause tens of thousands of fires annually. Lightning may ignite an unprotected roof, or the current may punch inside a building, seeking paths of metal or moisture. Some of the charge dissipates inside the building, and flammable materials cannot withstand the 50,000-degree-Fahrenheit heat generated by a hot flash of lightning.

When a hot flash sets fire to a barn, it usually burns to the ground. The average farm house is not such a tinder box, and because the flash jars the occupants the fire usually is detected immediately. If occupants are in the dwelling, they usually can save the structure from total destruction.

Lightning can enter a building in four ways.

- By a direct strike to the building.
- By striking an object, such as a television antenna or cupola or a metal track extending from the building.
- By striking a nearby tree and leaping to the building to find a better path to ground.
- By striking and following a power line or an ungrounded wire fence attached to the building.

The lightning flash generally will follow a metallic path to ground. At points along that path the main

bolt may jump, for example, from wiring to plumbing, where parts of the current may side-flash to objects such as appliances, water lines or even a person or an animal.

Lightning protection systems must provide a direct, easy path for a flash of lightning to follow to the ground to prevent damage and injury or death (Figure 1). Lightning protection systems can be concealed or unconcealed. The concealed system is installed in new construction. The unconcealed system is installed after the building has been built, and may be partly concealed.

The Parts of a Lightning Protection System

1. Rods called air terminals are made of copper or aluminum. Lead-coated air terminals are used on chimneys to protect against corrosion. Air terminals usually are 10 to 24 inches long, but can be longer. However, anything over 24 inches must be supported by suitable braces attached to lower than the mid-point of the terminal. Shorter lengths usually are preferred because they are less conspicuous. Air terminals shorter than 24 inches can be spaced a maximum of 20 feet apart, while air terminals 24 to 36 inches long can be spaced up to 25 feet apart. There should be an air terminal within 24 inches of the end of any ridge or other sharp object. Terminals must be at least as strong as a copper tube that has a wall thickness of .032 inch and a diameter of five-eighths inch.

2. Lightning conductors consist of special braided, twisted or flat cable or star-section rod made of heavy copper or aluminum. Their purpose is to conduct the lightning bolt safely to the ground. The main lightning

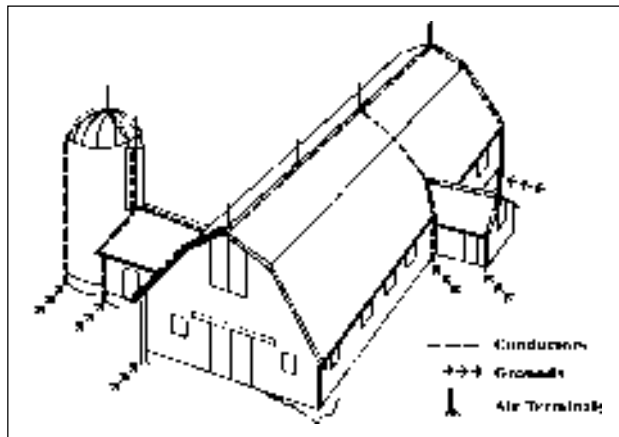


Figure 1

conductor is to connect all air terminals—with at least two down conductors—to ground rods or grounding plates. The conductor cable, when installed on the roof or sides of buildings and interconnected to all air terminals and grounds, must not be bent more than 90 degrees. The bend should not have less than an eight-inch radius (Figure 2).

The conducting capacity of a conductor depends upon its weight. The minimum acceptable weight per 1,000 feet is 187.5 pounds for copper and 95 pounds for aluminum.

3. Branch conductors are used to connect structural metal parts to the main conductor system, a process known as bonding. Any large interior or exterior metal body should be bonded if within six feet of a conductor. These metal parts may be objects attached to or part of the building that may be subject to direct lightning discharges because of their exposure or proximity to a lightning conductor. They may include eave troughs, hay tracks, metal roofing, metal ridge rolls, metal ventilators, metal chimney extensions, television antennas, wire fences, guy and supporting wires and metal clothes lines.

4. Lightning arresters protect a buildings' electrical wiring system (Figure 3). Arresters should be installed as part of a lightning protection system, or added to increase the effectiveness of an existing protection system. Arresters should be installed between the power circuit and ground, where the circuit enters a building served by overhead wires. Their purpose is to prevent dangerous surges of electricity into a wiring system if lightning strikes the power lines.

Before working on any service lines into a building,

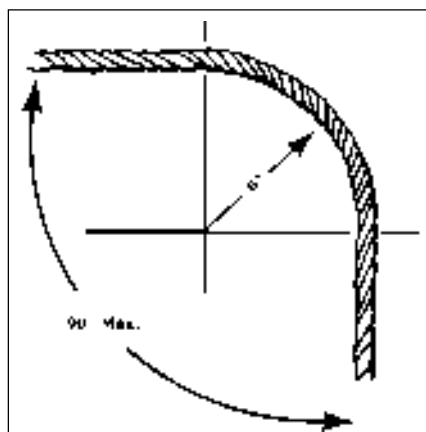


Figure 2

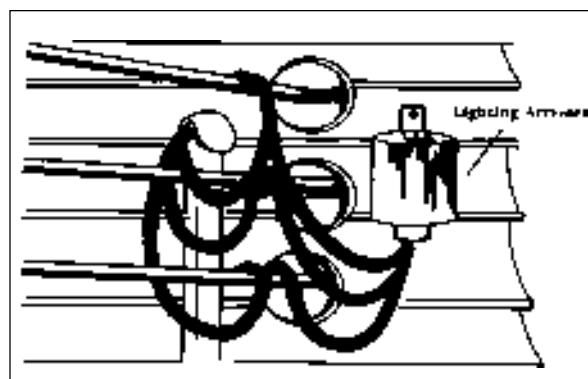


Figure 3

make sure the lines have been de-energized and contact the electric utility if work is to be done ahead of the meter. Arresters should be installed on television antennas, which may help reduce or prevent damage to a television set.

5. Grounding of the system is extremely important.

Grounding of Lightning Protection Systems

Protective systems can be grounded four ways:

1. Clamp each conductor cable to a copper-clad or galvanized-steel rod. The rods usually are eight feet long. However, 10-foot rods would be better if available and should be driven completely into the ground. Make the connection as shown in Figure 4. Below ground this would eliminate a trip hazard for humans and animals. Metal grounding rods are a minimum of one-half-inch diameter. A diameter of five-eighths-inch is better. At least two ground connections are needed for every system. They should be spaced as far apart as possible, preferably at opposite corners of the building. They should extend below and away from the building to prevent damage to the walls from a lightning discharge. Ground rods should be driven at least two feet away from the building footing (Figure 4). Aluminum conductor cable should be connected to copper or steel ground connections with specially-designed bi-metal clamps so the connections will not corrode to render the system inoperative. The conductor-to-ground joints for aluminum must be made at least one foot above ground level. Bare aluminum will disintegrate rapidly to aluminum hydroxide when in contact with soil.

2. Strand a copper conductor cable and bury it in a trench that should be about five feet deep and 15 feet long. For example, shallower trenches should be pro-

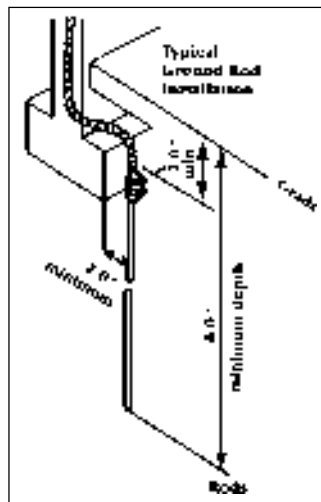


Figure 4

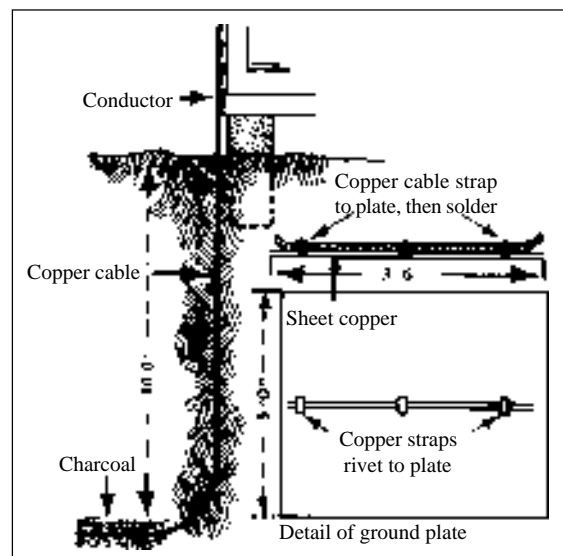


Figure 6

portionately longer, so if four feet deep, it should be about 20 feet long. Cover the floor of the trench with about five inches of pea-sized charcoal to increase the grounding ability of the cable. Then lay in the stranded cable so that it is not twisted. Spread the strands over the charcoal. Cover them with another five inches of charcoal before filling the trench with soil (Figure 5).

3. Clamp copper conducting cable to a copper plate. The plate should be one-eighth inch copper sheeting at least 11 square feet in size. The plate should be buried about 10 feet below the surface, laid on five inches of charcoal and covered by five inches of charcoal before it is covered with soil. The conductor cable should be attached to the copper plate by copper straps riveted and soldered to the plate (Figure 6).

4. Clamp the conductor cable to a **metal** water pipe. Many water systems do not have a continuous **metal** pipe connection buried in the ground. Connections to

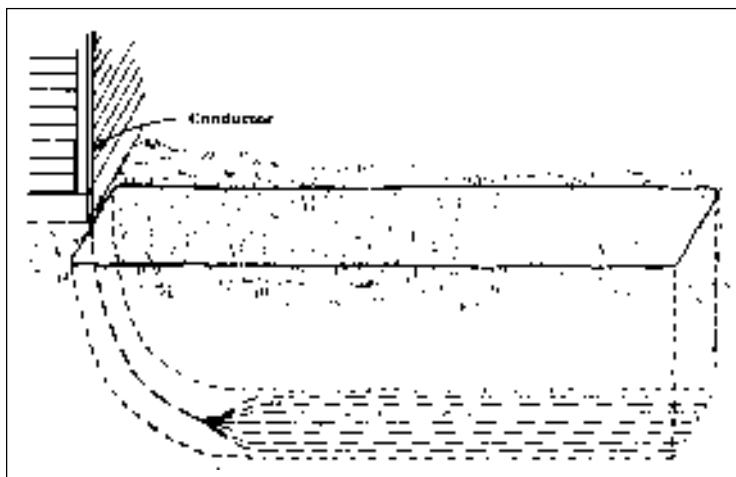


Figure 5

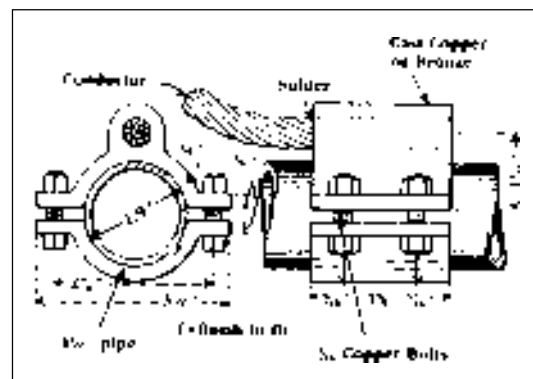


Figure 7

metal water piping, where it enters a building, generally makes a very good ground if made with a clamp designed for this purpose. The clamps usually are copper or bronze. The clamp should be at least one fourth inch thick. (Figure 7). Where rods cannot be driven in shallow top soil, a buried copper plate for each conductor system serves as a good grounding system.

Protecting Trees

Trees may be ruined or severely damaged by lightning. Lightning protection systems should be considered for valuable trees, and trees that are taller than a building and within 10 feet of it or if livestock shelter under them during storms. The protection requires air terminals, a down conductor and ground.

Many cattle are killed as a result of lightning striking a tree that they are under for protection. When lightning kills cattle beneath a tree, death usually is not caused by the main stream of the lightning flash, but by current flowing through the animals that are in direct contact with the charged soil. If lightning is of great concern to landowners, alternatives include cutting down the trees, fencing livestock from the trees or protecting isolated trees or small groves where livestock congregate during storms with a conductor system. The value of the trees may determine the best procedure.

When protecting a tree with a lightning protection system, an air terminal should be placed at the tip of the main trunk, using a full-size grounding cable attached to a ground rod that is away from the tree to prevent damage to the root system. Main branches should have air terminals attached with smaller, branch-line cable attached to the main conductor. Trees that are of three feet in diameter or larger should have

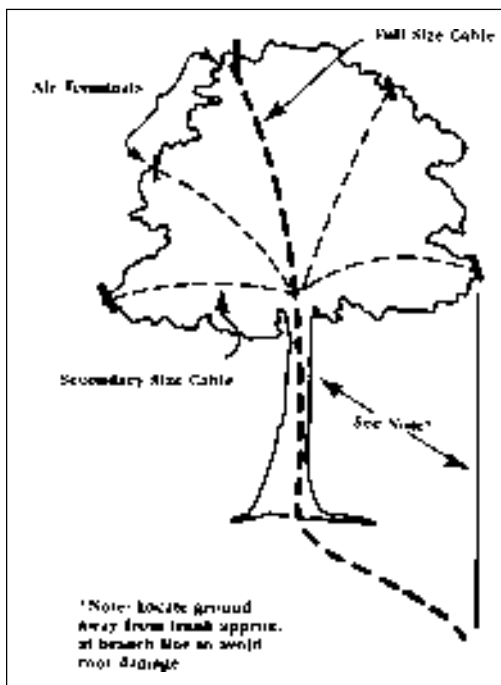


Figure 8

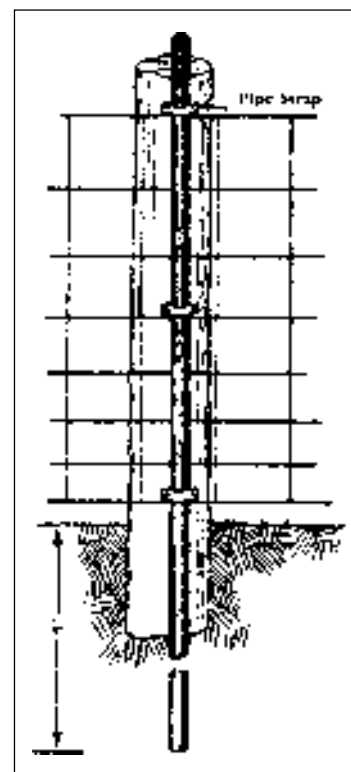


Figure 9

two ground rods attached to the main conductor system. All conductor clamps, ground rod clamps and branch connectors should be of an appropriate type for the system (Figure 8).

Fences

Lightning may travel up to two miles along a wire fence that is not grounded, to endanger humans and livestock. Fences that should be grounded include those attached to trees and buildings, those with wooden posts and those with steel posts set in concrete. To ground a wire fence, drive one-half-inch steel rods or three-fourths-inch pipe five feet deep next to wooden posts at 150-foot intervals. Allow a few inches of the ground rod or pipe to extend above the top of each post. Fasten the rods or pipes to the posts with pipe straps, so they make a good tight connection on all the fence wires.