Virginia Cooperative Extension
Virginia Tech • Virginia State University
www.ext.vt.edu

Electric Fencing: Installing and Testing a Proper Grounding System

Matt Booher, Virginia Cooperative Extension Agent, Crop and Soils, Augusta County

Introduction

An adequate grounding system is essential for an effective electric fence. Unfortunately, poor grounding is a leading cause of problems with electric fencing. This publication will discuss how to install and test a proper grounding system.

How does an electric fence work?

The energizer sends a pulsed charge of electrons (e^-) from its positive terminal to the fence wire. If an animal is touching the fence wire, it serves as a bridge to allow electrons to flow into the soil. The fence's grounding system acts like an antenna to receive electrons in the soil and creates a path back to the negative terminal of the energizer, thus completing a circuit and delivering a shock to the animal (figure 1).

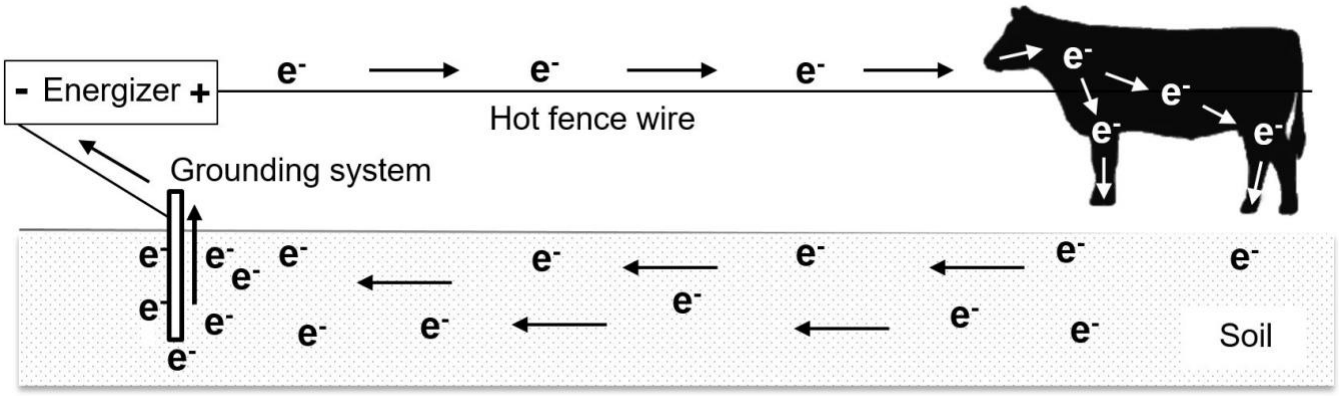

Figure 1. How an electric fence delivers a shock.

When no animal bridges the fence wire to the soil, however, the circuit is incomplete. The fence wire in the case where no animal is touching the fence should have a relatively high voltage reading (potential energy) but low current flow (measured in amperage or "amps"). A small amperage reading will usually be present even under ideal circumstances (typically 1 or 2 amps per mile of fence being energized). However, a drop in voltage accompanied by an increased amperage reading likely represents a fault somewhere on the fence. Small amperage increases are commonly caused by something like vegetation on the fence or worn insulators. A major drop in voltage and rise in amperage is commonly caused by something like a wire touching a metal T-post or a section of downed fence.

Understanding the role of resistance

Each object in the "circuit" of the electrical fence system presents resistance to the flow of electrons. The fence wire presents the initial resistance in the path of electron flow. Quality fence wire should have little resistivity (it is worth noting that, since electricity flows only on a wire's surface, wire with flaking or rusty coating is a poor

conductor). The resistivity of an animal touching the fence is generally low as well. As electrons flow from the animal to the soil, greater resistance is encountered. The resistivity of soil varies depending on its natural mineral and moisture content. The final resistance encountered is the grounding system, which represents a potentially large source of resistance that can greatly limit current flow back to the energizer. Increasing the size of the grounding system by adding additional ground rods if needed can greatly increase the effectiveness of your fence. Let's look at how to properly install and test a grounding system.

How to install a grounding system

1. The location of ground system should be at least 33 ft. away from utility grounds and metal water pipes. Do not touch metal buildings; use insulated lead-out wire to get past buildings. Locate the grounding system in a location that has the best chance of remaining moist in a summer drought (e.g. under a roof eave).

2. Industry guidelines recommend installing a minimum of 3 ground rods for energizers up to 15 Joules, 5 rods for energizers up to 25 Joules, and 7 rods for energizers up to 35 Joules. For a ground rod to be effective, it should have at least 6 feet in moist soil. Therefore, in a scenario where 3 ground rods are recommended there must be 18 total feet of ground rod length in moist soil (3 rods x 6 feet = 18 feet).

3. Place ground rods at least 10 feet apart to minimize electrical resistance and maximize electron flow from the soil and into the grounding system (figure 2)

4. Use one, unbroken wire to connect all ground rods and use ground rod clamps to make a tight connection to the rod. In order to avoid corrosion, do not mix metals. High tensile galvanized fence wire works well with galvanized ground rods.

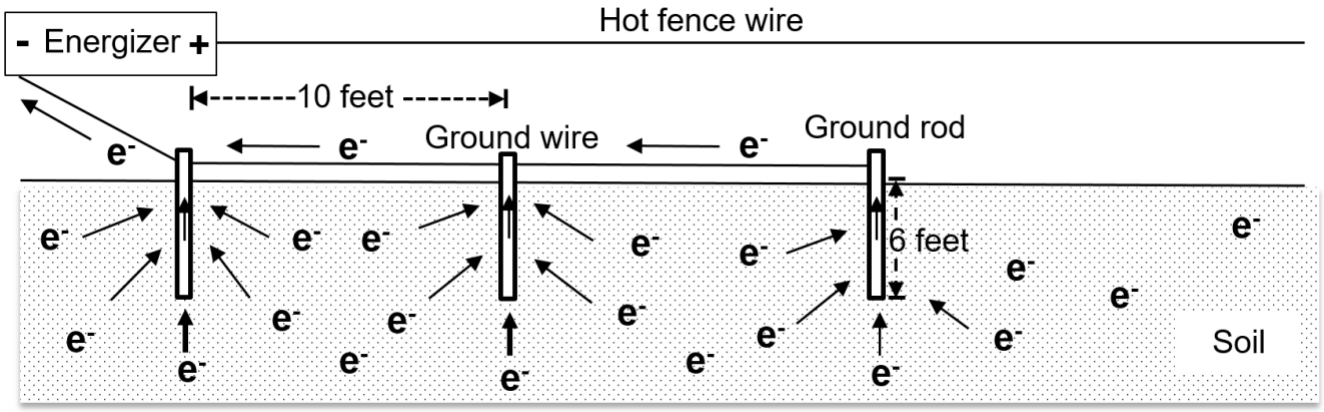

Figure 2. Illustration of electron flow in a properly grounded electric fence system.

Soil treatment

When grounding in very dry or sandy soils, or when using a very high output energizer, it may be necessary to regularly water the soil at the ground rod. A super-grounding mixture can also be used to immediately improve conductivity of the soil closest to the grounding system. When placing ground rods, dig a hole around the top of the rod and pour in a slurry mixture of water and two parts bentonite to one part coarse rock salt. This mixture is extremely corrosive, so stainless steel rather than galvanized ground rods should be used. In addition, ground rod placement should be extended at least 35 feet apart. Add water to the holes during dry weather. The super-grounding mixture is not a permanent fix, but should remain effective for several years.

Testing the grounding system

During initial installation, testing will tell you if your grounding system is adequate for your fence's energizer. Be sure to test or re-test your grounding system during dry weather to ensure it will be adequate year-round. If you are having problems with low voltage on an existing fence, testing can tell you if your existing grounding system has lost its effectiveness due to corrosion or drought (first rule out the possibility of issues with the energizer or electrical shorts in the fence). To test your grounding system:

1. *First, turn off the energizer*. Use multiple metal posts placed against the fence wire at least 300 feet from the energizer to load down the fence until you obtain 2,000 volts or less on the fence (figure 3). This is an important step. Loading down the fence allows electrons to flow into the soil so you can test the capability of your grounding system. The amps reading on the fence will increase as the voltage decreases. *Turn the energizer back on.*

2. Use your voltmeter to test the voltage on the last ground rod (farthest from the energizer). A good ground will read under about 500 volts. If it is higher than 500 volts, it indicates an inadequate ground. The lack of ground rods creates resistance and becomes a bottleneck to flowing electrons, resulting in an increase in potential energy (volts) on the ground rods. When this occurs, there is a reduction in the kinetic (moving) energy of the circuit and reduced shock to the animal.

3. Continue adding ground rods until the voltage reading on the ground rod farthest from the energizer is 500 volts or less. Once it is determined if your grounding system is adequate, remove the metal posts used for shorting-out the fence. The voltage on the fence should have increased significantly. A minimum fence voltage of 3,000 - 5,000 volts for cattle, and 8,000 volts for wool sheep should be maintained to properly control livestock.

It is important to test and modify your grounding system during limited soil moisture conditions to ensure good performance all year!

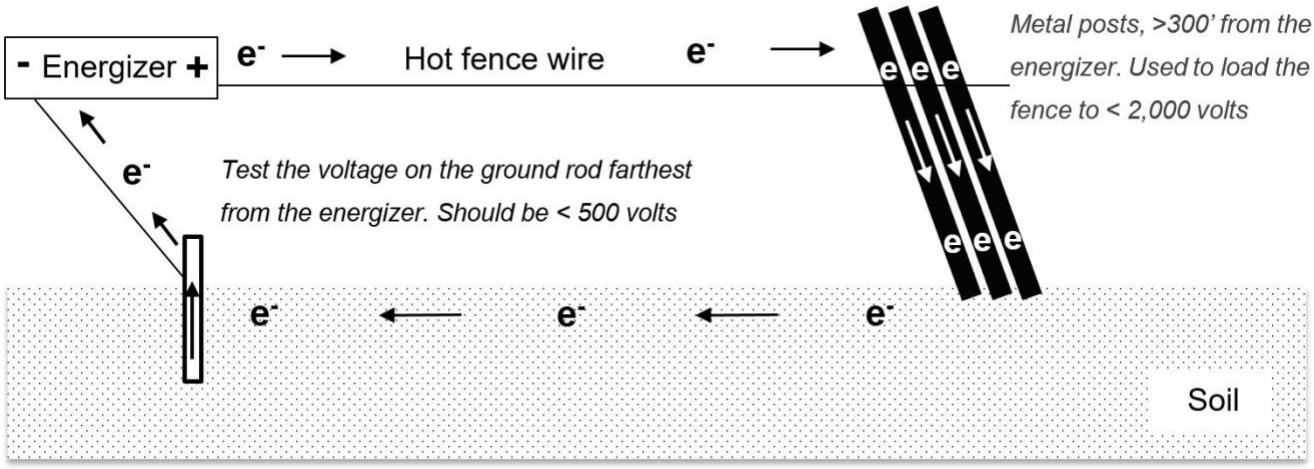

Figure 3. How to test a grounding system.

Visit Virginia Cooperative Extension: ext.vt.edu

2021 SPES-204NP (SPES-300NP)