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# High Tensile Permanent Electric Fence, Electrifying the Fence

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Since the beginning of livestock domestication, fences have been used to contain and control livestock. Early fencing used physical materials to create barriers and restrict livestock movements. Since the discovery of electricity, electric fencing has been developed to create a psychological barrier. Livestock, through a learned behavior, respect a single electrified wire as much as they do a physical boundary. However, if the fence is not powered correctly, livestock will quickly learn to disrespect the fence. This fact sheet discusses the proper way to energize or power the high tensile fence so livestock will respect its boundaries.

After designing and installing a high tensile fence, the last step is to set up the energizer and grounding system to provide a high level of animal control. It requires the right size of energizer and a well designed and constructed grounding system to deliver the need shocking power required to control livestock and wildlife. This fact sheet will provide the needed information to select the right energizer for your fence and design and install a grounding system for your environment.

## Energizer Size

Most electric fence energizers are rated by the joules of output. One joule of output is generally sufficient for every mile of fence (Gerrish, 1999). Obviously multi-wire fences with heavy vegetation loads (or in other words lots of lush green vegetation conducting electricity to the ground) will require more joules of output than single-wire fences with little vegetation touching them.

## Power Source

For your power source, choose between using “grid power” (plug in to an electrical outlet), a battery (deep cycle marine or RV battery), or a combination of a battery and solar panel, Figures 1 and 2. Grid power is more reliable and less expensive than batteries; however, batteries are portable and often the only option in remote pastures. If using a battery and solar panel combination, make sure they are both suitable to the power requirements of the fence. To keep your battery fully charged, you will need 7-10 watts of solar panel capacity for every joule of energizer output (7 watts for high sunlight areas and 10 watts for cloudy areas). So, in a sunny environment, a 3-joule energizer will require 21 watts of solar panel capacity. To maximize sunlight interception, orient the solar panel facing south and tilt it 20-30 degrees from horizontal for summer use and 60 degrees from horizontal during winter use (Gerrish, 1999). If you have any questions concerning the type and size of energizer, battery, and solar panel you should use, call a reputable electric fence and energizer dealer.

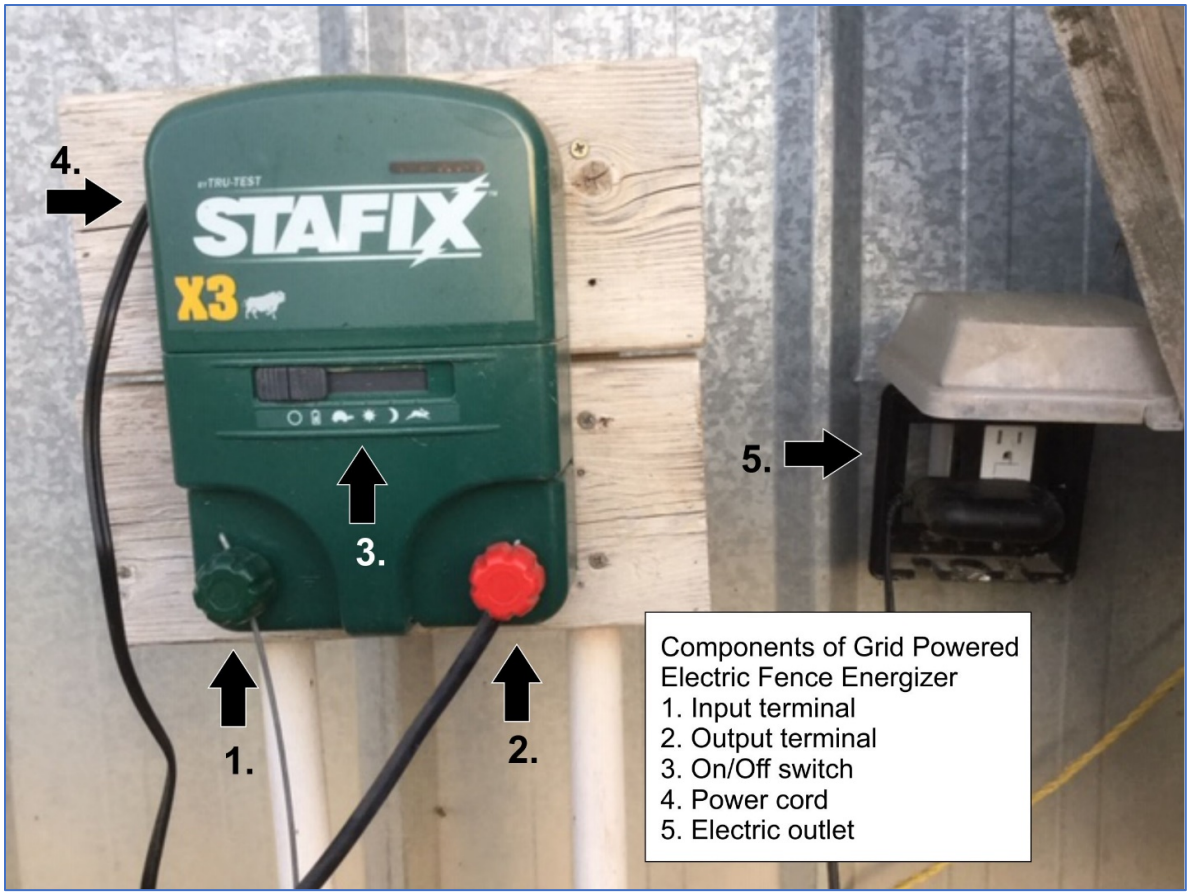


*Figure 1. Components of grid powered electric fence energizer.*

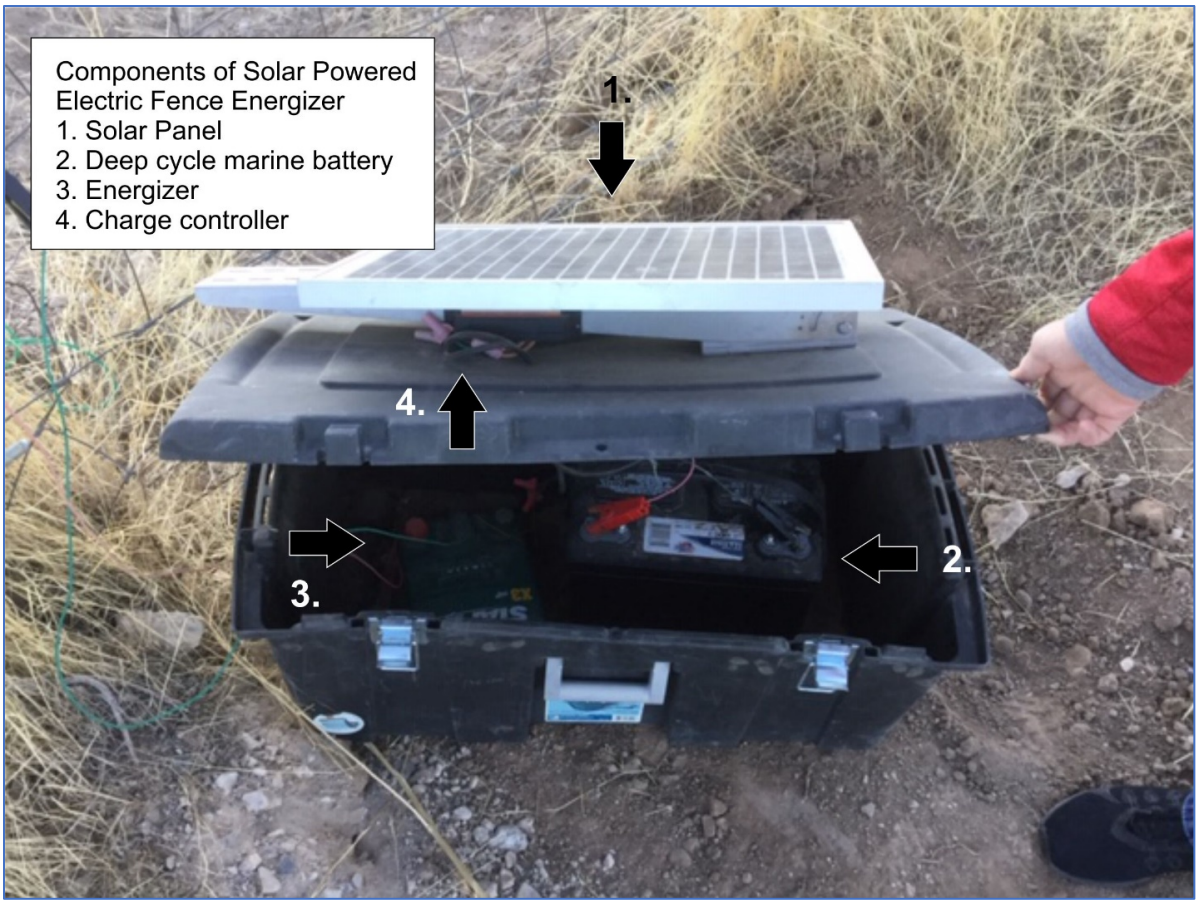


*Figure 2. Components of solar powered electric fence energizer.*

## Grounding System

An effective grounding system is critical to the performance of an electric fence. The electric fence grounding system is made up of two individual grounding beds; one is attached to the lightening diverter, and the other is attached to the input terminal of the energizer. The lightening diverter see Figure 3 and its grounding bed diverts electricity from a lightning strike away from the energizer where it could cause major damage. The energizer's grounding bed allows electricity to complete its circuit when something makes a connection between the "hot" fence and the ground.

Dry sandy soils will not conduct electricity back to the grounding bed, reducing the effectiveness of the fence. In these types of situations, it will be necessary to have a fence return grounding system. This is done by connecting every other high tensile wire to the input terminal on the energizer and the rest of the fence wires to the output energizer terminal. This will produce a good shock to the animal when it touches both a grounded high tensile wire and an adjacent energized wire.

## Ground Beds

Spacing between the fence's ground beds and any other grounding system (including the lightning diverter's ground bed) should be at least 50 feet, and individual ground rods should be spaced 10 feet apart from each other. Ground rod spacing is important because, collectively, the rods act as an antenna receiving the electrical current in the soil allowing it to flow back to the energizer and complete its circuit. If the ground rods are spaced too close together, the ground bed's receptiveness will be reduced. The ground rods should be driven deep enough into the ground to ensure they will be in moist soil year-round. Placing them in a shady spot or under a drip-line will increase their effectiveness in dry soils. Generally speaking, a good ground bed requires at least 3 feet of rod in the ground for every joule of output from the fence energizer. Meaning a six joule energizer will require 18 feet of rod in the soil or three rods driven 6 feet into the soil and spaced 10 feet apart (Figure 3).

Ground rods are connected to each other in series and to the energizer input terminal, or lightning diverter, with metal wire. Because mixing metal types can cause electrolysis, it is important to either buy a grounding kit - which includes ground rods, metal wire, and clamps - or check with an electric fence dealer to ensure that the metal wire and clamps you are using to connect the ground rods to the energizer terminal will work well with each other. Also, your lightening diverter's ground bed should have at least one more ground rod than your fence's ground bed.

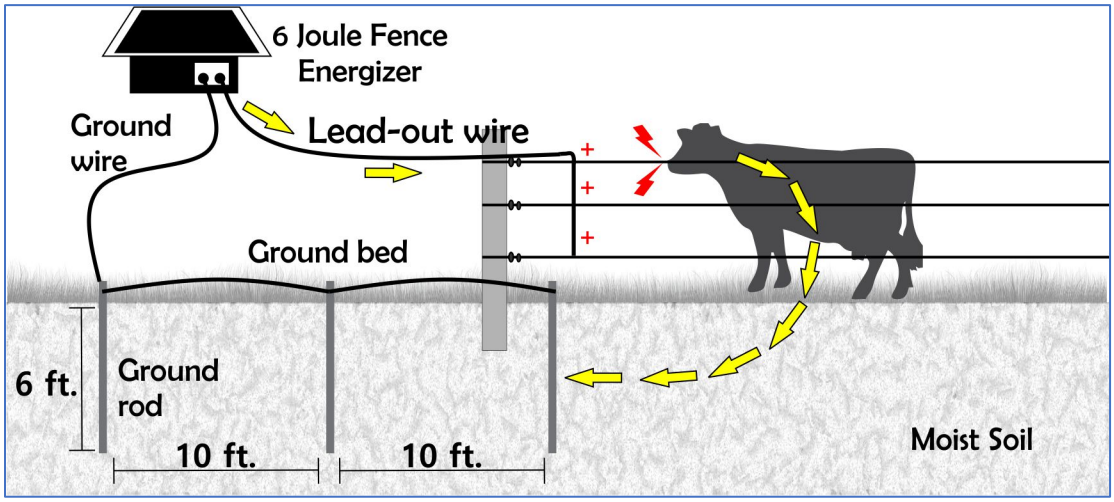


*Figure 3. Electric fence ground return system.*

## Lightning Diverter Installation

The lighting diverter prevents lightning strikes from making their way to and damaging the energizer. A lightning diverter is recommended for all high tensile permanent electric fences. The coil in the diverter backs up the flow, forcing the current to jump the spark gap and flow down into the ground bed. The lightning diverter should be installed on the lead-out wire between the energizer and any fence connections. The section of lead-out wire from the output terminal of the energizer to the lightning diverter must be insulated. The rest of the lead-out wire from the lightning diverter to where it attaches to the fence does not need to be insulated (but it doesn't hurt) because it does not come in contact with the soil or the grounding system. Attach the insulated lead-out wire to the diverter on the side of the metal coil that is *farthest* from the spark gap. See Figure 4. Attach the non-insulated lead-out wire (which attaches to the fence) to the diverter on the other side of the metal coil *closest* to the spark gap. Attach the grounding wire to the bottom of the lightning diverter. Adjust the spark gap to have as small of gap as possible without allowing the electric pulses from the energizer to jump the gap. This will take some adjusting until you get it in just the right spot (Remember to turn off the energizer whenever making adjustments.). If the electric pulse is jumping the gap you will hear it snap and/or see it spark.

## Testing the Fence and Ground Systems

Both the fence and its grounding system should be tested at least once a year to ensure they are working effectively. Be cautious to avoid injury whenever working on your electric fence.

## Testing the Fence and Finding Faults

Use a voltmeter to check the voltage on the fence. Many different things could reduce the voltage on the fence. If the voltmeter reads low voltage (less than 2,000 volts or 2 kV), you can diagnose the problem by following these steps:

1) Check the Energizer. Disconnect the lead-out wire and the ground wire from the terminals on the energizer. Check the voltage on the energizer by connecting the one lead of the voltmeter to the energizer output terminal and the other lead to the energizer input terminal. If it is reading lower than the manufacturer's specifications, then there is an issue with the energizer.


*Figure 4. Lightning diverter.*

2) Check the lead-out wire for low voltage (less than 2,000 volts or 2 kV).
3) Check the ground system (as described below).
4) Check the fence-line for low voltage. Walk along the fence, reading the voltage every 330 feet. The voltage will fall until you pass the fault, after which it will remain the same. Some common causes of faults are heavy vegetation growing on the fence, broken wires, poor insulation or broken insulators, and bad connections. It is also possible that the reduced voltage could be due to induction which occurs when electricity travels from an electrified wire to something else that is conductive even when they aren't touching. If this occurs, try to increase the distance between the two items or insulate one of them (Staffix Fence Manual, n.d.).

## How to Test a Ground Earth Return System

To test the ground bed, short circuit the fence by leaning several metal rods or stakes against at least one of the live wires on the fence while the energizer is off, for safety reasons. These rods or stakes should be placed 330 feet away from the fence's ground bed. After this, turn the energizer on and test the voltage on the fence. Continue adding rods until the volt meter reads 1,000 volts or less. Next, pound a small stake into the ground at least 3 feet away from any of the ground rods. Then, attach one lead of your voltmeter to a ground rod and the other to the small stake. If the voltmeter reads 0.3 kV or less, then your ground bed is working fine. If, however, it reads more than 0.3 kV, then the ground bed isn't working properly, and you may need to add more ground rods (Source: Staffix Electric Fencing Manual).

## How to Test a Fence Earth Return System

Once again, short circuit the fence, as described above, until it reads 1,000 volts or less. Then, at the end of the fence line, pound a steel rod or stake at least 1 foot into the ground. Next, measure the voltage between one of the ground wires and one of the live wires on the fence, and then measure the voltage between one of the live wires and the steel rod. The voltage between the steel rod and the live wire should not be more than 0.3 kV greater than the voltage between the ground wire and the live wire. If the voltage difference is greater than 0.3 kV, then the grounding system is not working properly, and you will need to troubleshoot the problem and fix it (Staffix Fence Manual, n.d.).

## Summary

Once the right energizer has been installed and the proper grounding system is set up and tested properly the fence will carry a strong electric charge that will ensure good animal control for many years. As a precaution it may be necessary to place electric fence danger signs around the fence to ensure public safety. Also follow all local laws and ordinances regarding electric fences.

## References


Gerrish, J. (1999). Fence systems for grazing management. In J. Gerrish & C. Roberts (Eds.). *Missouri Grazing Manual* (pp. 89-99). Columbia, MO: MU Extension, University of Missouri-Columbia.

Staffix (n.d.). Staffix fence manual. Retrieved from https://kencove.com/fence/96_Stafix+Electric+Fencing+Manual_resource.php.