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# Beef Cattle Handbook



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## Fence Systems for Grazing Management 1: Electric Fence Energizers

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One of the initial management considerations in designing grazing systems is selection and installation of the proper fencing equipment. Three types of fencing are likely to be used in a grazing cell: perimeter, permanent subdivision, and temporary or portable subdivision fencing. All of the above fences can be constructed as electric fences. Perimeter fence and permanent paddock fencing is most satisfactorily done with electrified 12.5 gauge hi-tensile wire. Numerous options are available for portable fencing. This section deals with fence energizer selection and proper installation. Fencing materials and construction are covered in individual sections in this manual.

### Energizers

The modern electric fence energizer has the capacity to maintain effective voltage for animal control under much more adverse vegetative load conditions than earlier types. Manufacturers have attempted to rate the power capacity of fence energizers by several methods including miles of fence powered, voltage output, joules, and effective voltage under varying resistance levels.

Each of these ratings have their limitations. Miles of fence powered is meaningless unless the wire gauge, vegetation load, quality of fence construction and other factors are specifically indicated. Reported voltage output is generally peak voltage with no fence attached to the energizer or what is referred to as "no-load voltage". An energizer with 15,000 v no-load potential may actually be considerably less powerful than a unit with 5,000 v no-load.

Joules are the most common means of comparing fence energizers. One joule is equal to an output of one

watt per second. Comparison by joule output is only valid if the pulse lengths are similar and if measured at comparable resistance levels. Energizers with longer output pulses will give a false impression of higher power than units with shorter pulse duration. Energizers must have a pulse length of less than .0003 seconds to be classified as low impedance. Joule comparisons are useful in selecting the right size unit within one manufacturer's line of energizers, but not for comparing among brands.

The most valid form of energizer comparison is measurement of actual fenceline voltage under several known levels of resistance. This test puts aside all manufacturer's claims, cuts through electricians jargon, and simply shows how a unit will perform relative to others in known situations. Unfortunately, no unbiased organization or agency in the US has attempted to do this test across the spectrum of all available energizers. Several manufacturers have published tables comparing their units to other selected energizer models, but no across the board comparisons of all makes and models has been made.

With these points in mind, how does one go about selecting the proper energizer for a particular situation? The first decision to make is whether to use a battery unit or mains (110 volt or 220 volt plug-in) unit. In almost all situations where power is available, it is advisable to use a mains unit. Mains units are invariably cheaper per unit of output power than battery units and mains power is usually fairly reliable. Electricity charges for operating mains units, based on 8¢ per kwh, range from less than 10¢ per month for small units to around \$2 per

month for very high power units.

If mains power is not available and a battery unit is required, there are many sizes and types to choose from. Very small units with less than one joule output may be powered by self-contained lantern batteries, either 6 or 9 volt cells or a multiple of "D" cells. Larger units up to about 9 joule output can be powered by 12 volt automotive type or deep cycle gel batteries. When using 12 volt systems, it is highly advisable to install a solar panel to keep the battery charged. The higher the output of the energizer, the more rapidly a storage battery is drained. The largest battery units may fully drain a deep cycle 12 volt battery in less than a week. To avoid the weekly turnaround of batteries, a solar recharge system is very effective.

### Solar Panels

Just as the energizer should be matched to the size of the fencing job, the solar panel must match the energy draw of the energizer. For each one joule energizer output, allow 7 watts of solar panel capacity in high sunlight areas and 10 watts in low sunshine areas. In Missouri the 7 watt capacity has proven adequate in most conditions, but in wet cloudy springs 7 watts has not been adequate for keeping batteries fully charged. Solar panels should be oriented from due south to no more than 20 degrees to the southwest. For year round use, the panel should be oriented 40 degrees off horizontal. Because the angle of the sun's rays striking the earth differs through the seasons, the efficiency of the 40 degrees orientation varies seasonally. For panels used only during the spring to fall 25-30 degrees off horizontal would be more appropriate. Winter grazing requires a panel more steeply inclined, up to 60 degrees off horizontal. (Fig. 1)

### Grounding Systems

An electric fence energizer is only as effective as the grounding system installed with it. Extent of grounding systems are dictated by three factors: output capacity of the energizer, conductivity of the soil, and the type of livestock or predator being controlled.

As a general rule, install a minimum of three feet of ground rod per joule of energizer output capacity. To realize the full livestock control potential of your energizer it must be adequately grounded. Galvanized or copper ground rods may be used. If using copper rods, make sure to also use a copper wire from the energizer ground terminal to the ground rod to prevent loss of effectiveness due to electrolysis occurring where two different metals are joined. Most energizers have stainless steel terminals which can be safely joined to copper. If the energizer features galvanized terminals, then use only galvanized wire and ground rods. Typically, ground rods are 1/2 - 5/8 inch diameter and 6 - 8 feet long. Galvanized pipe can be used very effectively in place of manufactured ground rods. Wire should be clamped tightly to the ground rod either with a clamp made specifically for that use or with stainless steel pipe clamps.



Figure 1.

The ground rods should be driven full length into the ground to reach moist soil year round and placed a minimum of 10 feet apart. Placement on the north side of a shed under the drip line is an ideal location. In shallow, rocky soils it may be impossible to put the ground rods more than a few feet in the ground. If this is the case it becomes more critical to find a location that is likely to remain moist year round and lay the ground rods in trenches in this area. Again, the north side of a shed under the drip line works well. Locating ground rods in low, wet areas will enhance the effectiveness of the grounding system.

In shallow rocky or sandy soils, conductivity is quite poor. Whereas a deep silt loam soil may retain good conductivity at all times, drouthy non-conductive soils pose some special grounding problems. To enhance the effectiveness of electric fence in these environments, it may be appropriate to construct what is termed an earth-return fence system. In a conventional electric fence on a soil with good conductivity, generally all wires will be energized, except in the predator control situation where the earth-return system would be used. In an earth-return system alternate wires are either electrically charged 1/2 or are non-charged and serve as part of the total grounding system. Just as all charged wires ultimately lead back to the fence terminal on the energizer, all ground wires lead back to the ground or earth terminal of the energizer. When an animal touches two alternate wires, the full impact of the total grounding

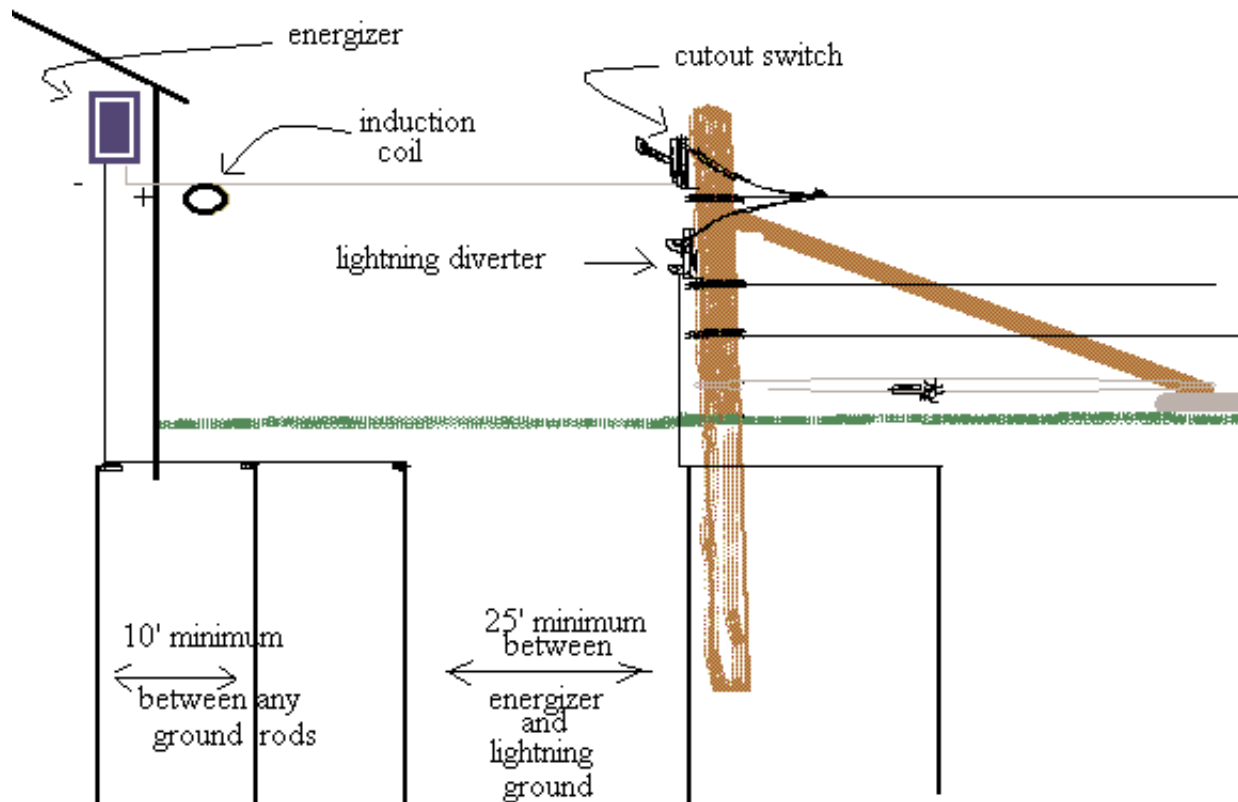


Figure 2. Typical Installation of a Low-impedance Energizer.

system is brought to bear on the culprit animal. In this system, it is important to have the ground wires either directly linked to the energizer earth terminal or have each separate stretch of fence grounded with ground rods comparable to those serving the energizer.

The voltage required to maintain control of livestock varies with the type of livestock in the pasture. Generally accepted figures for adequate livestock control are: cattle - 1600 volts; sheep and hair goats - 2000 volts; hogs, horses, and meat goats - 1200 volts. An earth-return fence system may provide better livestock control for sheep and hair goats than will a simple energizer grounded system. All other livestock will generally be controlled without the use of an earth-return system except in dry, sandy, or gravelly soil conditions.

### Lightning Protection

The one fear of all electric fence users is lightning strike and a blown up energizer. A mains unit should be installed with lightning protection on both the incoming power side and the fence side. The majority of fence energizers returned to the manufacturer for repair have been damaged on the power input side, not the fence side as is popularly believed.

For incoming surge protection, a plug-in surge protector should be installed at the power outlet and the energizer plugged into the surge protector. This is the same type of protector used on home computers and other valuable appliances, and can be picked up at almost any appliance or variety store. Most rural electric systems experience daily variations in voltage flow that

are as hazardous to electric fence energizers as lightning strikes and a surge protector is good insurance for everyday usage.

For lightning protection on the fence side, several practices are advisable. Location of the energizer is the first step. Placement of the energizer in a building in a low-lying area or a lightning rod protected building is superior to placing it in a building on a hilltop with no lightning rods. Frequently, there is no choice where the energizer is to be installed, but when there is a choice, use common sense and stay away from lightning prone areas.

The ground stakes should be placed well away from the ground system of power poles or the service box. Never use the existing ground system of power poles or breaker boxes for the energizer ground. A short in the power line can feed into the fence system through the common ground and create a dangerously charged situation in the fence, as well as damage the energizer. A lightning strike on a power line with a common ground with the energizer, creates a situation where the energizer could be damaged through both the incoming line and the ground system. The ground system for the energizer should be placed at least 25 feet from the nearest power line ground rod.

An induction coil or lightning choke should be installed near the energizer in the fence leadout wire. Either of these devices work as an in-line resistor to the lightning surge and can reverse the energy flow back to the fence line and away from the energizer. Figure 2 depicts proper installation of a plug-in energizer with grounding system and lightning protection.

## Summary

Selecting the right size energizer for the fencing job you need to do is the first step for successful use of electric fences in grazing management. Maintaining effective voltage to control livestock is the overall goal of the system design. Plug-in energizers are usually cheaper on a per unit of output basis, than are battery types. Using a solar panel to recharge batteries is very effective but can become quite expensive on larger capacity units. Proper grounding is critical to the effectiveness of electric fencing. A minimum of three feet of ground rod per joule of energizer output is required for low-impedance chargers to deliver their full capacity.

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