Pasture Infrastructure: Fence and Water

Mark Townsend
Agriculture Agent Associate
Frederick County

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Know Your Context

- Business or Hobby?
  - Grazing for Profit or for Fun?
- Management
  - Time commitment
  - Additional enterprises
  - Manage for what you WANT
- Infrastructure Design
  - Modular Systems win-out
  - Mix of static and dynamic infrastructure

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Evaluating Resources

Types of Resources:

Fixed

- Acreage
- Soil Type
- Topography
  - Slope
  - Aspect

Semi-Flexible

- Pre-existing infrastructure
  - Fences
  - Water
- Forage Base
  - Current Carrying Capacity

Flexible

- Temporary Infrastructure
  - Portable Fence
  - Portable Water

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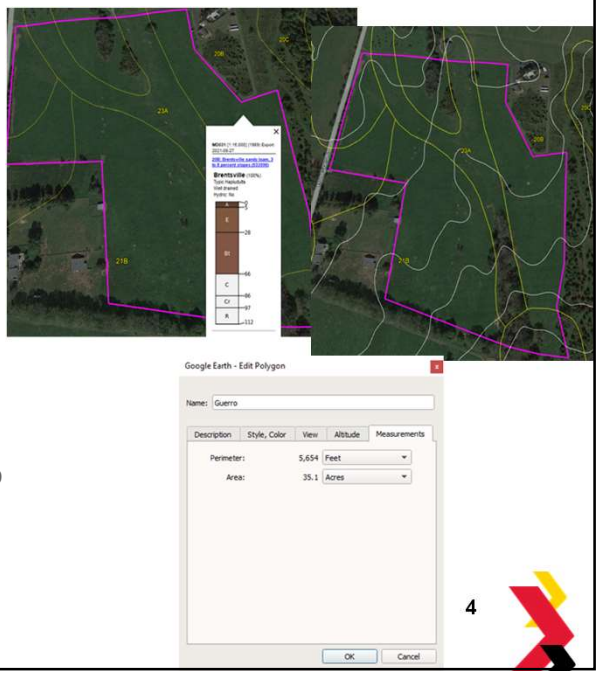
Planning Tools

- GIS tools
  - Web Soil Survey
  - Google Earth
    - SSURGO, USGS Topography
- MD is a “Fence Out” State
  - Our job to keep animals on the property.

Fencing is a process, but it's important to get off on the right foot.



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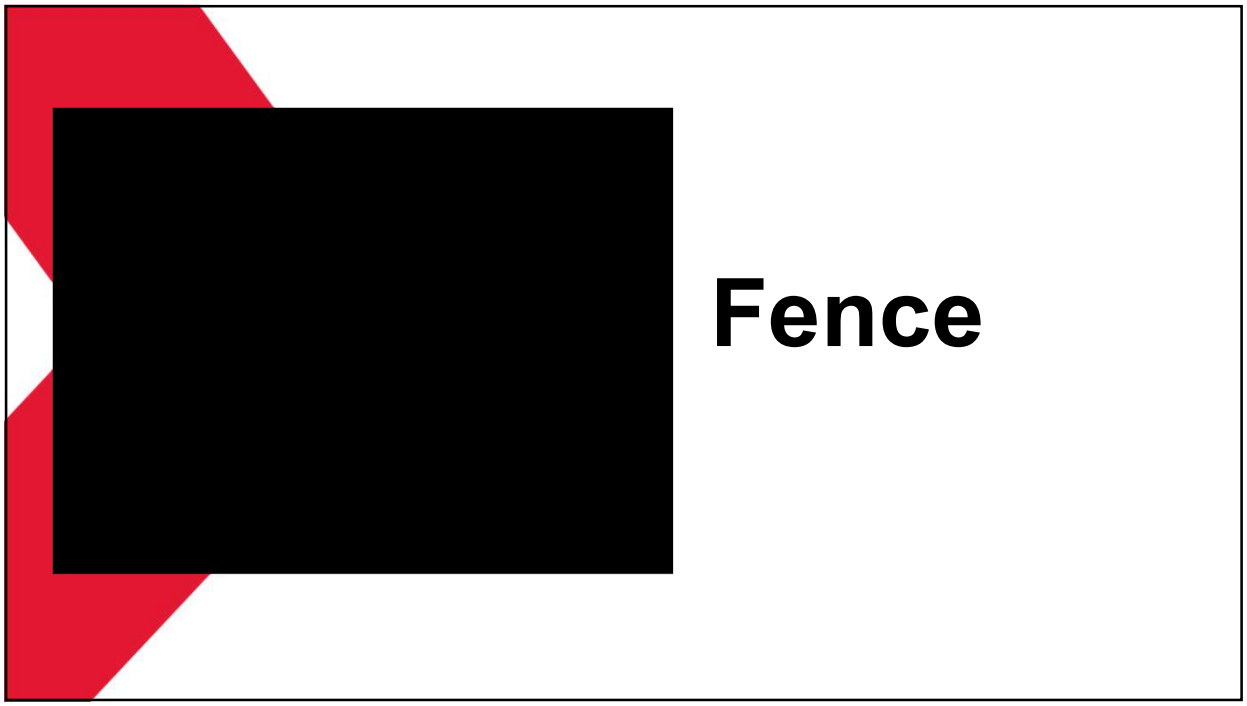


Pasture Design and Layout

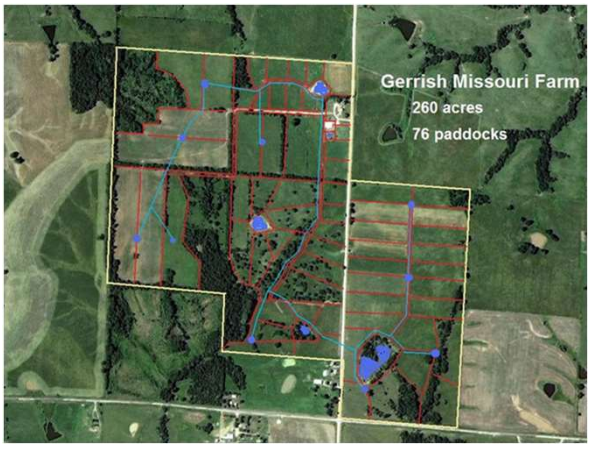
Dependent on context

Generally:

- Nearly square paddocks are most efficient (minimizing travel distance).
- Long narrow rectangles have improved utilization (strip grazing)
  - Significant trampling (longer durations)
- Wagon-wheel is good, but uneven distribution of manure
- Beware of congregation points (shade, water, slope, animal behavior.)

Stay mindful of watering points

- Often the most limiting factor to pasture design.



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Perimeter Fence: Wire

Wire Type

- Field Fence/“No-Climb”
- Barbed Wire
- Woven Wire
- High-Tensile Wire

Wire Selection

- Enterprise Mix
  - Sheep & Goats: Field Fence
  - Cattle: 4+ strand Barbed or High Tensile
- Management Goals

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Woven Wire

Physical barrier, very secure, $$$

Wire height and spacing varies

- 24 - 48” tall
- 1 ½” - 9” wide gaps
  - Chose based on Livestock enterprise

Tag # gives specifications

Ex. “1047-12-11” = 10 horizontal wires with a height of 47” spaced 12” apart using 11-gauge wire

- Often best to add a top wire (barbed or HT)

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Barbed Wire

"The fence that tamed the west"

- Two or more smooth galvanized wire wrapped together with barbs spaced 4 - 6" apart.
- Standard Barbed Wire vs. Suspension
  - Standard: 3-5 strands stretched between posts spaced 20 - 30' apart.
  - Suspension (Uncommon) : 4 - 6 strands stretched between line posts spaced 80 - 120' apart
  - 3" of sag is meant to sway and deter

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High Tensile Wire

First used in New Zealand and Australia

- Relatively inexpensive, ease of construction, less maintenance, longer lasting, physical AND mental barrier.
- 12 ½ or 14 gauge class 3 wire
  - Tensile strength of 170,000 - 200,000 psi
    - 180,000 is generally recommended ($, strong)
  - Very low torsional strength*
  - Can withstand 1,100 lbs of pressure without losing elasticity
    - Easy to wrap, knot, and clamp.
- Tension strainers
  - 200 lbs is more than enough

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Permanent Fence: Posts

Post Type

- Wood Posts (3.5” diam)
- Metal T-Posts
- Galvanized Pipe

Post Spacing

- Cost
- Depends on Wire Type and # of Wires
  - Tighter spacing for high traffic regions
- Depth
  - Soil Type dependent: Clayey soils vs. Lighter Soils
  - Roughly 10x the diameter of the post
    - Ex: 3.5” diameter wood post ~ 3.5 ft buried

Cost Comparison: 1320 ft 4-strand fence with 12' gate		
Type	Total Cost	Cost/ft
Barbed Wire with 50' Line & 25 T-post	$1,689.95	$1.28
Barbed Wire with 25' T-Post	$1,745.27	$1.32
High Tensile Wire with 30' Line posts	$1,637.50	$1.24
High Tensile Wire with 50' Line and 25' T-post	$1,607.13	$1.22

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Wood Post Considerations

Most posts are softwoods (white-pine), hardwood posts hard to find.

Treated posts:

- Worth the $ for preservation
  - Can treat, untreated posts yourself (paint top)
- Disqualifies organic certification

Post Diameter

- Line posts and H-brace, brace post can be smaller (3.5 - 5”)
- End posts larger (6”)

Cut post in half = 2x more posts!

- Sorta, loss of structure, NRCS doesn’t like this

Used Telephone posts are terrific end posts

3” staples are adequate

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Insulators and Energizers

- High quality Insulators
  - Offset/extended insulators work in a pinch (renewing old fences)
    - Break easily
  - “Half-turn” insulators
    - Low Profile
  - In-line insulators
    - Work very well
    - Cannot replace without splicing wire

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Energizers

Energizers

- Species dependent
- Rule of Thumb: 1 Joule/ 8 Miles of Fence
  - **All hot wires**
- Go bigger than you think you need
  - Room for expansion
- Protect your Energizer
  - Lightning Arrestors
  - Fault Testers
  - Do not set energizers in parallel (electricians)
  - Some brands have great customer support

Species	Minimum Voltage	Comments
Cattle	2000 – 4000	Dairy cows are often very quiet and the low end voltage may be sufficient. Bulls can be aggressive and need higher voltage to contain them.
Sheep	4000 – 5000	Wool is an excellent insulator, so sheep fences need high voltage to ensure the shock is felt.
Goats	4000 – 5000	Some breeds of goats are well insulated – see comments on sheep
Horses	2000 – 3000	Stallions can be aggressive and need higher voltage to contain them.
Deer and Elk	3000 – 5000	
Wolves and Coyotes	4000 – 5000	Some sources suggest a minimum voltage of 5000 for deterring predators.
Bears	5000	

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Interior Fencing: Semi-Flexible vs. Flexible

Semi-Flexible/Semi-Permanent

- Driven Posts with High-Tensile Wire
  - Advantages:
    - Sturdy
    - Low Maintenance after installation
  - Disadvantages
    - High Cost/Acre
    - Limited Management Flexibility

Flexible/Temporary

- Fiberglass Posts with Polywire
  - Advantages
    - Extreme management flexibility
    - Lower cost/acre
  - Disadvantages
    - Time consuming install and takedown
    - Animals training

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Semi-Permanent Interior Fencing

- Two-strand high tensile wire
  - Less costly than permanent fencing
    - Use around farm roads or internal tree-lines
  - Wider spacing (30-50')
  - T-posts
    - Sturdy
    - Potential to ground wire
  - Fiberglass Posts
    - Less robust
    - Electrically neutral

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Interior Flexible Fencing

Three Components: Wire, Posts, Reels

Wire

- Wire sizes dependent upon enterprise
  - Cattle & Sheep: 2.5-3 mm
  - Hogs: 5 mm
  - Equine: Tape
    - Greater visibility
- Polywire < Polybraid
  - Far more conductive
  - Greater longevity

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Interior Flexible Fencing: Posts

Step-In vs. "Knock-In" Posts

Step-In

- Generally made of plastic
  - Very light
- Quick installation
  - Soil dependent
- Pre-set wire heights
  - Not very modular
- Slightly cumbersome
- Can dry-rot
  - Wire holders fall off

"Knock"-In

- Generally made of fiberglass
  - Still light
  - Different sizes (⅜", ⅝", ¾")
- Hammer or drive in
  - Use the cap!
- Metal wire-clips
  - Conduct electricity
  - Modular wire placement
- Longevity

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Interior Flexible Fencing: Reels

- Non-Geared Reels
  - Retrieves wire as fast as you turn the handle (1:1)
  - $30-$70
- Geared Reels
  - Retrieves wire at a greater rate than the handle speed
    - 3:1, 4:1, etc.
  - $90+
    - Is it worth it for you?
      - Maybe best to have a mix of both types
- In a pinch, anything can be a reel!
  - Extension Cord reels work well

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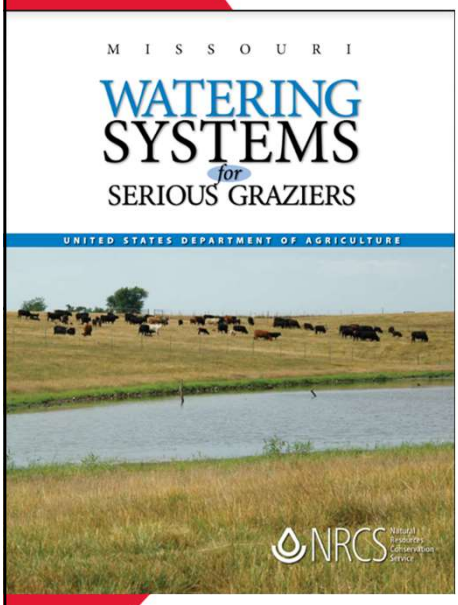

Water

General Water Considerations

Match your trough to your stock

- Trough Design
  - Height above ground
  - Ball or Open
  - Capacity
- Delivery Method
- Pipe Flow Rate/Recharge Rate
- Winter Grazing?
- Consider current and future needs

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Permanent Water

Water Source

- Drilling new wells is expensive
  - Consider tying into existing wells
  - Ensure flow is adequate
- Ponds and Streams
  - Can pump (Up to avg 10,000 gal/day/yr)
  - **NO DIRECT ACCESS**
- Municipal Supplies
  - Proximity dependent
  - Potentially expensive
  - Chlorine and Fluorine content

Table 2. Gallons of water per minute.

Pipe Diameter, in inches	100	200	500	750	1,000	1,500	2,000	3,500	1 mile
	In feet								
½	4	3	2	-	-	1	-	-	-
¾	8	8	5	4	3		2	-	1
1	13	13	8	7	6	5	4	3	2
1¼	23	23	19	15	12	9	8	6	4
1½	30	30	26	22	19	15	12	9	7
2	50	50	50	43	37	29	25	18	15

Courtesy of Kentucky Grazers Supply.

Livestock	WATER NEEDED PER ANIMAL (50° DAY)	WATER NEEDED PER ANIMAL (90° DAY)
Dry beef cows	8 - 12 gallons	20 - 30 gallons
Lactating beef cows	12 - 20 gallons	25 - 35 gallons
Lactating dairy cows	20 - 30 gallons	30 - 40 gallons
600-pound weaned calves	6 - 9 gallons	10 - 15 gallons
Horses	8 - 12 gallons	20 - 25 gallons
Sheep and goats	2 - 3 gallons	3 - 4 gallons

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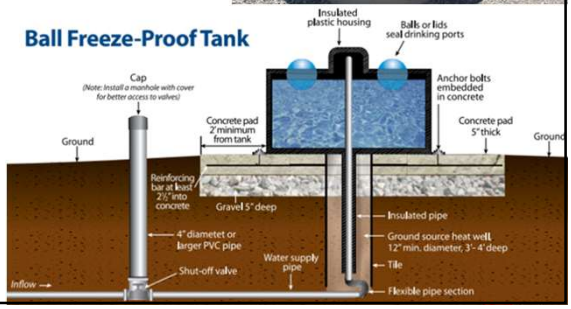
Frost Free Ball and Concrete Stock-Tanks

- Option for winter access
- From 5 gal to 250 gal
  - Many configurable options
    - With good supply, these can water most of the herd on the hottest day.
- Long-term investment
  - Significant upfront cost
  - Very limited flexibility



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Semi-Permanent Water

Buried Polyethylene Pipe with Outlets

- Frost free for winter supply
- Outlets at typical watering points
  - Quick Connect Couplings
    - Attach to a hose attached to tough
    - Option to move through throughout paddock
- Significant investment
  - Buried pipe cost driver

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Flexible Water

Above Ground Polyethylene Pipe with Outlets

- Modular Design
  - Reel-up with irrigation reel
  - Multi-point watering
- Lower cost–no burying
- Not frost tolerant
  - Grazing season only

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Final Thoughts

- Tailor the systems to your operation
- Mixture Permanent, Semi-Permanent and Temporary Systems
  - Reliability of permanent
  - Modularity of Semi-Permanent
  - Flexibility of Temporary
- Infrastructure Changes
  - Try new things and keep constant when possible

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More information

https://extension.umd.edu/programs/agriculture-food-systems

Mark Townsend, Agriculture Agent Associate
UME-Frederick County
330 Montevue Lane, Frederick, MD 21702
Email: mtownsen@umd.edu
Phone: (301) 600-3578

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

Electric Fencing: Installing an Energizer & Grounding System

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

How does an electric fence work?

An electric fence is a psychological barrier, unlike other fences that create a physical barrier. Therefore, it is important that the system be set up to maintain an adequate voltage to deter or contain livestock. Livestock should be "trained" to electric fence. In other words, you should ensure that their first exposures to it are in a low-stress environment where they can explore and receive a memorable shock. Generally, cattle will respect fence kept at a minimum of 3,000 volts; sheep with thick wool may require a minimum of 5,000 volts. After your fence is working, consider purchasing and installing a live fence indicator, which indicates with a flashing light that the fence is above a specified minimum voltage.

An electric fence energizer produces a very high voltage (around 7,000-9,000 volts) with very low amperage (around 110-120 milliamps). Contrast this with deadly residential household electric, which produces only 110 volts, but 15 or more amps (15,000 milliamps). An energizer delivers its current in very short pulses (usually about once per second for a duration of 1/300th of a second or less). If the current was not pulsed, muscle contractions in the hand of a person who grabbed an electrified wire may prevent them from letting go. The low amps and a pulsating current make electric fencing a very safe tool.

The energizer sends a pulse of electrons (e^-) from its positive terminal to the fence wire. Electrons flow along the surface of the wire (not inside the 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). This type of system is the most common one used in the eastern U.S.

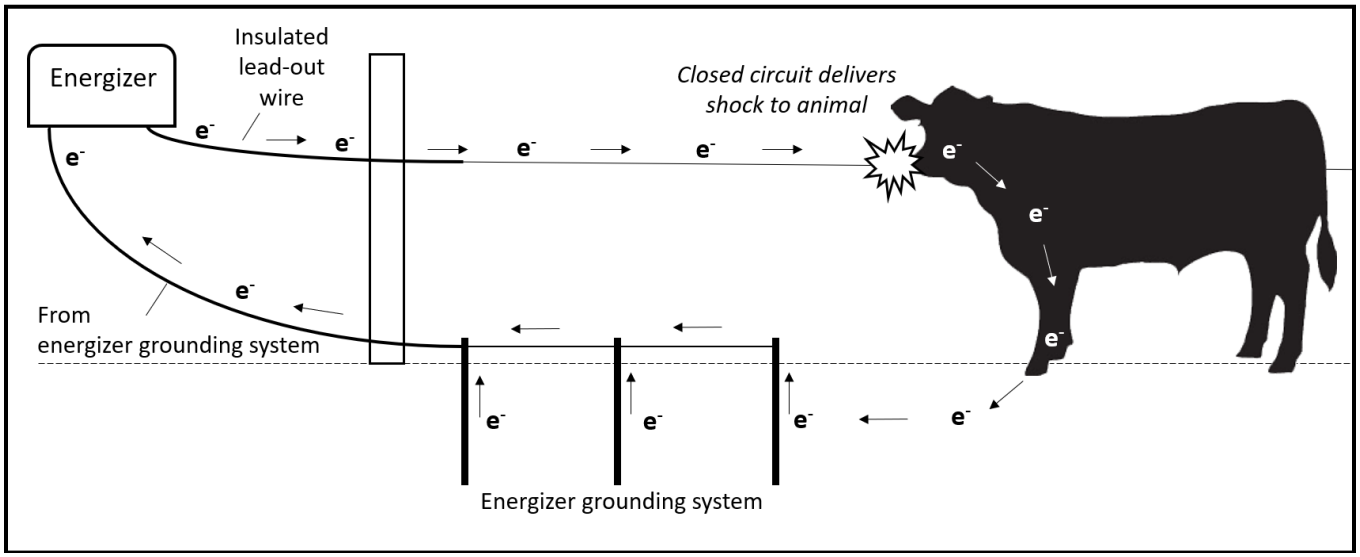

Figure 1. How an electric fence delivers a shock.

In some areas (especially in the western U.S.) where soil conditions are continuously dry, many producers use either a continuous ground system or an earth-return system. In a continuous ground system (figure 2), a non-electrified (ground) wire is installed on the fence and connected to the ground terminal of the energizer. When an animal touches the hot and ground wires at the same, electrons return to the energizer through the ground wire to complete the circuit.

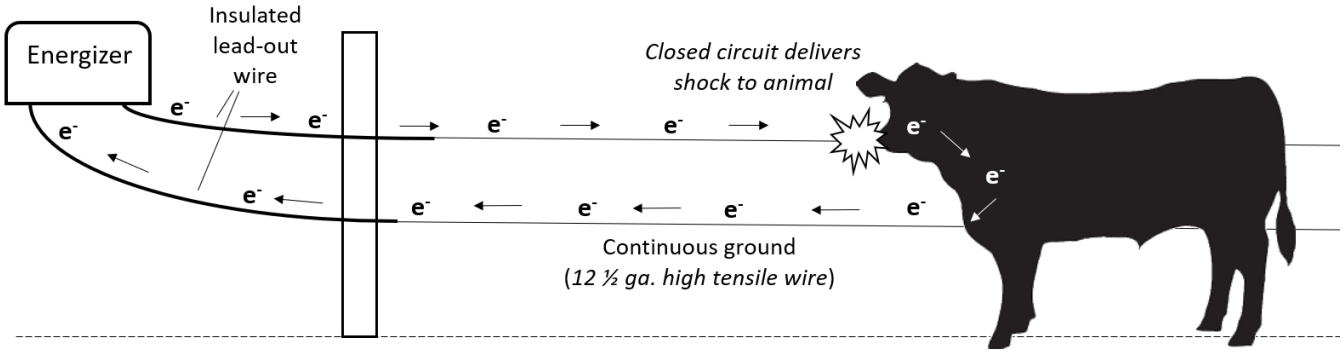

Figure 2. Continuous ground system.

In an earth return system (figure 3), a ground wire on the fence is connected directly to a conventional energizer grounding system. Sometimes the fence's ground wire is periodically connected to its own ground rods, which then send electrons through the soil to the energizer's grounding system. Either style of earth return system reduces the electrical resistance encountered in dry soils. If soil moisture is adequate, an earth return system additionally enables a circuit to be completed conventionally through the soil, even if an animal touches only the fence's hot wire.

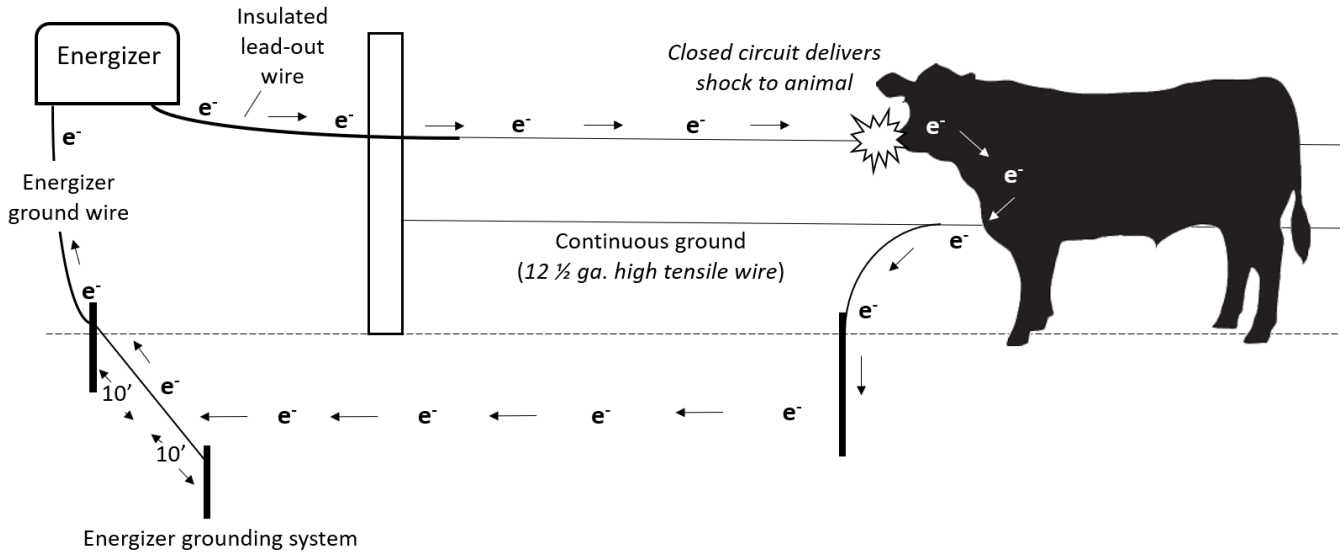

Figure 3. Earth return system.

When no animal bridges the fence wire to the soil, however, the circuit is incomplete. In this case, the pulse of electrons on the wire simply dissipates into air and nearby objects through a process called induction (figure 4). You sometimes experience the effects of induction when you touch a gate that has become electrified, or when you pick up a voltage reading with a voltmeter when you are still inches away from the wire. You may also

observe livestock that appear to be smelling the current on a fence, when in reality their wet muzzles are able to feel the induced current.

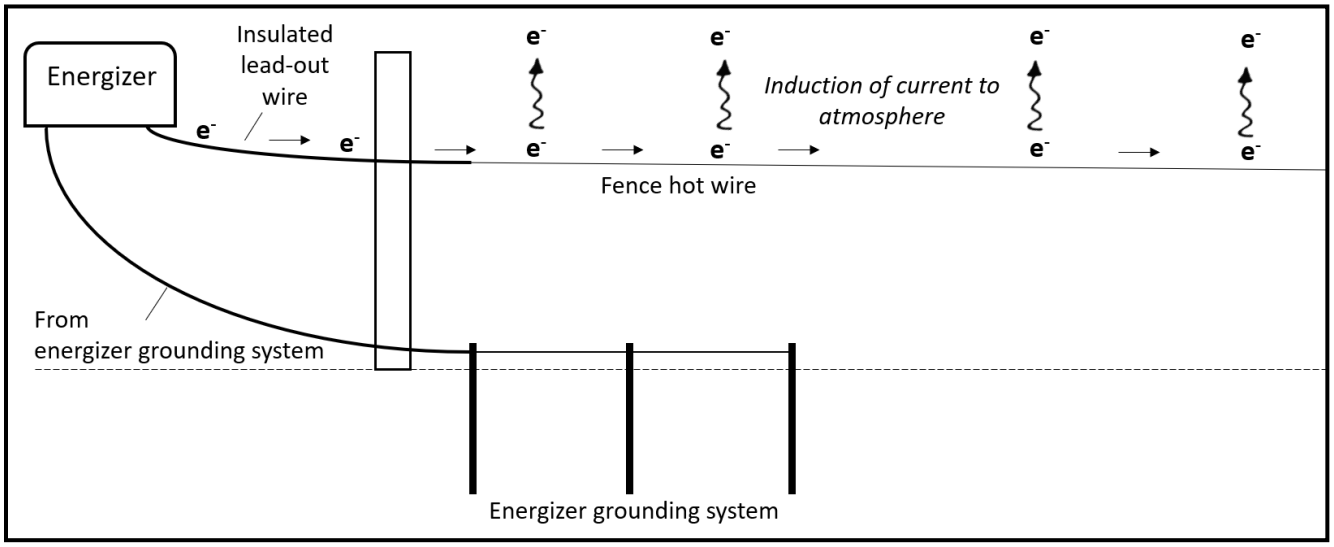

Figure 4. Electrical induction when circuit is incomplete.

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. While quality fence wire should have little resistivity, it is worth noting that because electricity flows only on a wire's surface, wire with flaking or rusty coating is a poor conductor. Electric polywire or polytape, which contain multiple small wires, have less surface area and more resistivity than a single 12 ½ gauge fence wire. Depending on the size of your energizer, the higher resistivity of polywire or polytape can limit the amount of this type of fence that can be effectively electrified.

The resistivity of an animal touching the fence is generally low. As electrons flow from the animal to the soil, greater resistance is encountered. The resistivity of soil varies depending on its mineral and moisture content. Finally, the grounding system 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 an energizer and grounding system.

How to select an energizer

Unfortunately, there is not a standard rating that enables consumers to accurately compare energizers across companies. Some companies rate energizers based on miles of fence it will energize, but this is subjective and depends on factors such as soil type, vegetation load, and how well you have minimized electrical resistance in the construction of your fence system. Stored joules and output joules are often listed on energizers. Stored Joules indicate the energy that is stored in the energizer's capacitor prior to its discharge into the transformer, which then delivers the voltage and amperage to the energizer's terminal. This process is inefficient, so output Joules will always be less than stored Joules. Transformers vary in their efficiency, so while stored Joules may be useful for comparing energizers within a brand, it is not very meaningful for comparing across companies. The best way to compare energizers is probably by looking at output Joules. Because of widely varied conditions: soil type, climate, vegetative load, fence construction; it is difficult to say exactly how many output Joules will serve a certain number of acres or miles of fence. Some sources in the western U.S., where soil conditions are usually

dry, suggest one output Joule per mile of fence. Some sources in the eastern U.S. suggest 1 output Joule per 5 miles of fence. A good overall rule of thumb is probably about 1 output Joule per 2 ½ mile of fence.

You may consider buying a larger energizer than what you currently need so additional fence to be added without any loss of performance. Several types of energizers are available. Mains or plug-in energizers use residential electric power, and are the most cost effective based on the price per output Joule. They are commonly available up to 25 output Joules. They use relatively little electricity and usually require little maintenance if installed correctly. Solar energizers are portable energizers that rely on a gel or lithium battery to supply power. This battery is recharged by a solar panel. Most solar energizers are less than 1 output joule, though larger ones up to about 2 output joules are available. Solar energizers are typically a best fit for areas where electric service is not available. They are also commonly used with temporary fencing because of their portability. Energizers that use only a deep-cycle (marine) battery are also available. With this type of energizer, the battery must be recharged relatively frequently, which often means purchasing a second battery to use while the first one is recharging. Battery-only energizers are quickly becoming obsolete because of the increased selection and effectiveness of solar energizers.

Many energizers are advertised as “low impedance”. Low impedance energizers use a shorter pulse and lower amperage than early energizers that are considered “high impedance”. High impedance energizers are sometimes referred to as brush burners, although this is a misconception, as they are actually less effective at pushing through a vegetative load than are modern low impedance energizers. In fact, almost all energizers on the market now are low impedance.

Never install more than one energizer on a fence, as it will eventually damage the energizers.

How to install an energizer

1. Purchase 12.5 gauge insulated lead-out wire to connect the energizer to the fence. This will eliminate any shorts or leaked voltage. Make sure the wire creates a tight connection to the positive terminal on the energizer. Do not use residential electric wire; twelve-gauge Romex cable, for example, is only rated to carry 600 volts, far less than the 7,000 or so volts your energizer puts out! Use a galvanized or stainless electric fence wire clamp to connect the lead-out cable to the fence. Avoid running lead-out wire (or fencelines) parallel with telephone or power wires, particularly if they are directly overhead. Doing so may induce voltage from the power line onto your fence, or may cause your energizer to interfere with telephone signals (heard as clicks on the phone line).

2. Electrical surges coming from residential electric supply are one of the main causes of damage to energizers. It is important to purchase an external, after-market surge protector (like the type used for home computers) to protect your energizer from electrical surges. Lightning strikes on the fence are also common and can severely damage an energizer. You should therefore install a lightning diverter on the lead-out wire between the energizer and the fence. One terminal on the lightning diverter will attach to the lead-out wire coming from the energizer and going to the fence. Depending on the type of lightning diverter you use, a second terminal on the diverter will attach to a wire going to your energizer’s grounding system (figure 5), or to a separate grounding system installed specifically for grounding lightning (figure 6). Follow the recommendations specified for the lightning diverter you purchase.

Installing an induction coil can provide additional lightning protection (figure 7). An induction coil can easily be made of about 50’ of insulated lead-out wire gathered and fastened in 10” diameter loops. When installed as part of the fence lead-out wire and located near the energizer, it can arrest or reverse any voltage that makes it past the lightning diverter. Some energizers come with internal lightning and surge protection, however these are not foolproof, so it is still good insurance to install primary protection with a surge protector, lightning diverter, and possibly even an induction coil.

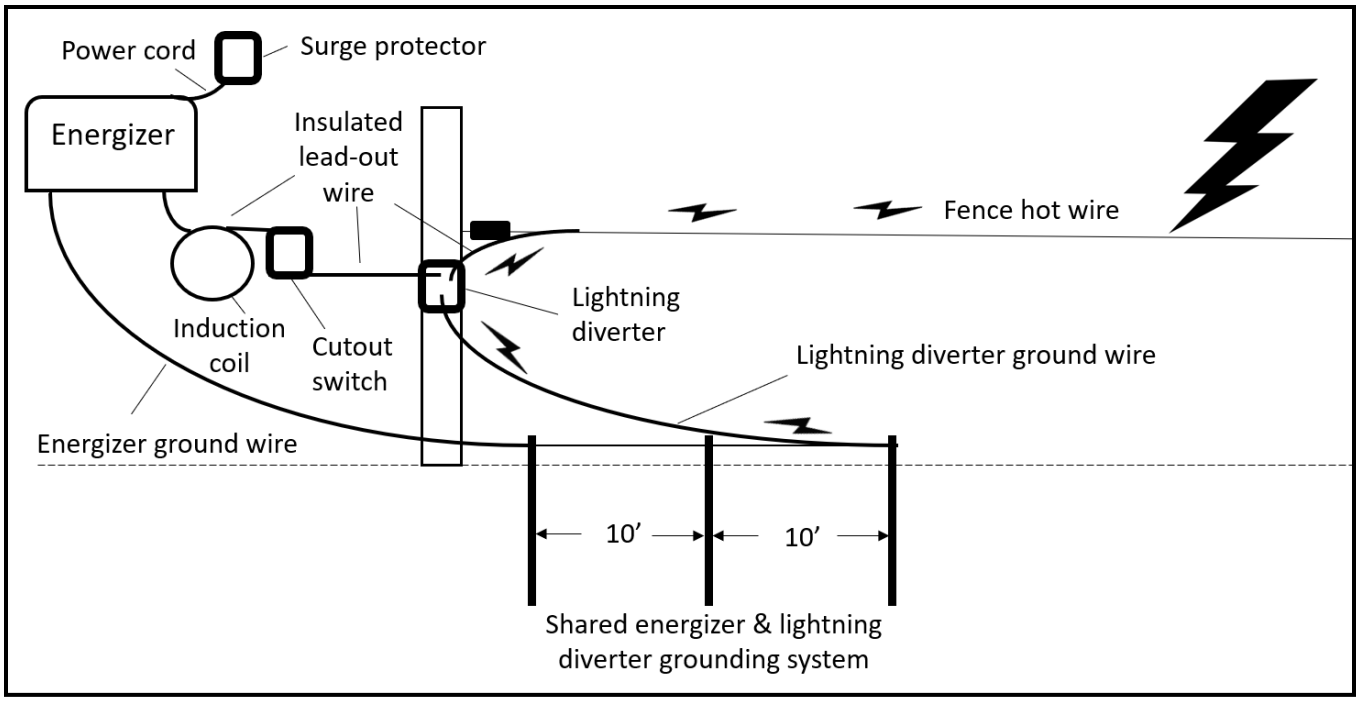

Figure 5. Lightning diverter using the energizer’s grounding system.

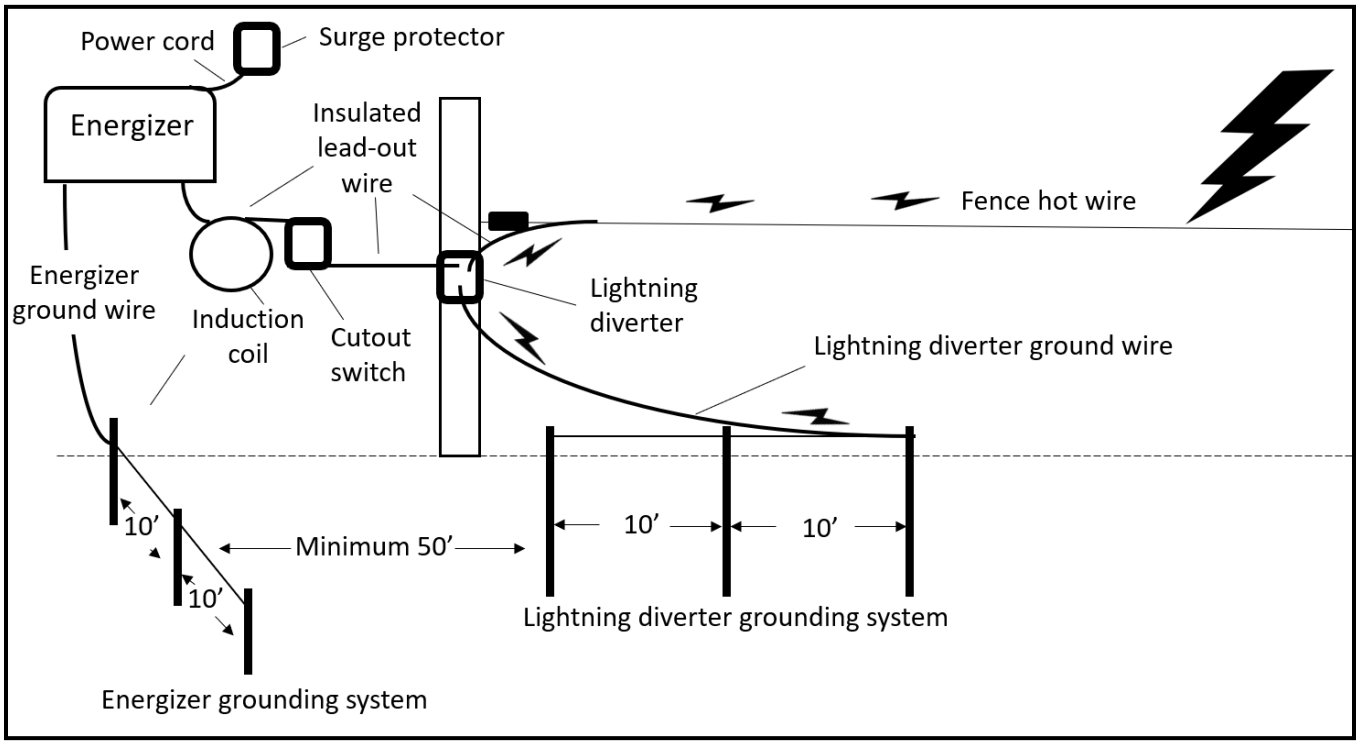

Figure 6. Lightning diverter using a separate grounding system.

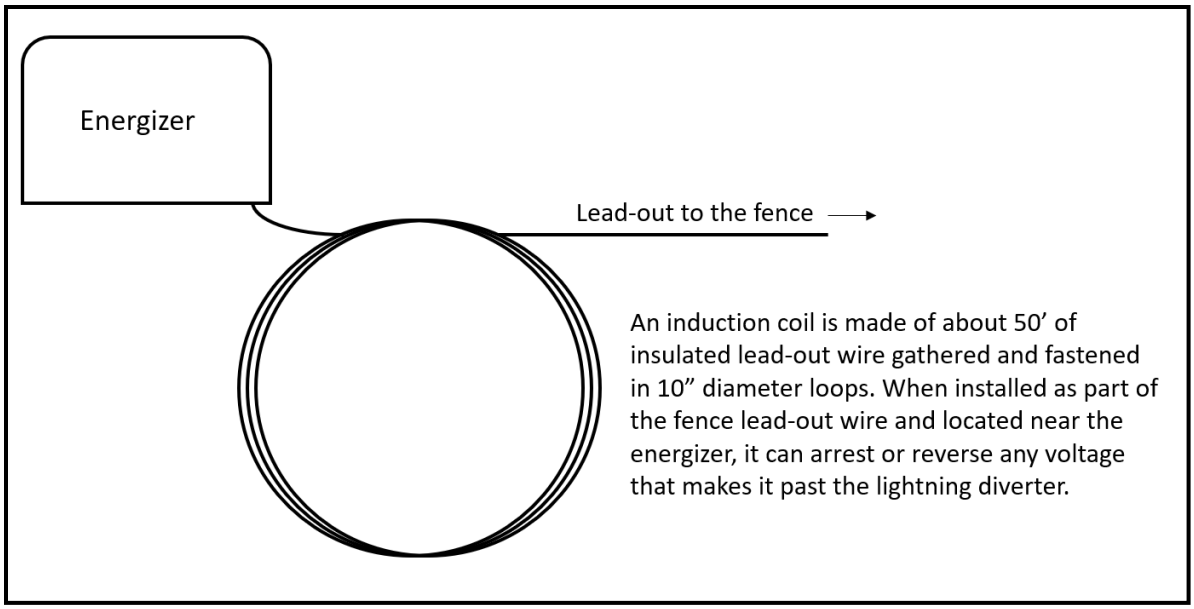

Figure 7. Induction coil.

3. Use 12 ½ gauge high-tensile fence wire (or if running through a building, use insulated lead-out wire) to connect the energizer to ground rods. Again, make sure to create a tight connection to the ground terminal on the energizer.

How to install a grounding system

An adequate grounding system is essential for an effective electric fence. Unfortunately, poor grounding is a leading cause of problems with electric fencing.

1. The location of grounding system should be at least 33 ft. away from utility grounds, your service box ground, 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). In summary, about 1.2 feet of ground rod installed in moist soil is required for each output joule. For most solar energizers, a single 3-foot portable ground rod with a T-handle for easy removal works well.

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

4. Use one, unbroken wire to connect all ground rods and use ground rod clamps to make a tight connection to the rod. If the terminals on your energizer are stainless steel, you can use galvanized or copper ground rods without risk of corrosion. If the terminals are galvanized, then use galvanized ground rods and stainless-steel clamps. Do not use rebar or other repurposed items.

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 your grounding system will tell you if it is adequate. Try to test or re-test your grounding system during dry weather to ensure it is functioning well. 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 8). 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, reducing electron flow to the energizer and minimizing the shocking potential.

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 volts for cattle, and about 5,000 volts for wool sheep should be maintained to properly control livestock.

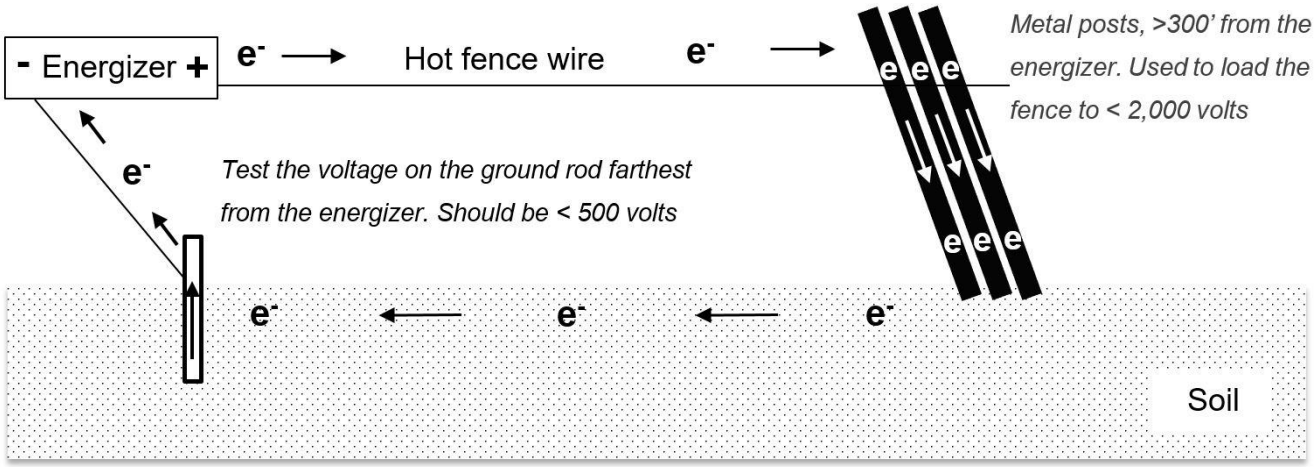

Figure 2. How to test a grounding system.

Troubleshooting

Factors such as soil moisture or a vegetation load on the fence can cause fence voltage to fluctuate throughout the year, so it is a good idea to purchase a voltmeter and periodically test your fence prior to the onset of any issues. This will give you some idea of how hot your fence is throughout the year when it is working properly. Several types of voltmeters can be found on the market. Some voltage testers have only a series of lights that indicate relative fence voltage, and this type of tester is not very helpful for accurately measuring volts or drops in voltage on a fence. Purchase a voltmeter that provides a numerical reading in volts or kilovolts (one kilovolt (kV) equals 1,000 volts). Some voltmeters also read milliamps (although they will often simply say "amps") in addition to volts, and these fence testers are usually called faultfinders. Often the amp reading on faultfinders will be accompanied by an arrow that points in the direction of a fault. In addition to a slot on which to lay the fence wire to be tested, all voltmeters/faultfinders have a terminal or lead that must be grounded. Some meters have a wire lead that is inserted into the soil, while others have a metal plate or terminal on the meter that you must hold while testing the fence. In the latter case you serve as the ground (don't worry, you won't get shocked!).

Follow the following steps in order to troubleshoot a reduction in fence voltage.

1. Do a quick survey for any obvious faults on the fence, such as downed trees or wires that have come loose from an insulator.

2. If no obvious fault can be found, test the energizer to make sure it is functioning properly. Turn off and unplug the energizer from its power source. Unhook the wires from both terminals of the energizer. Turn on the energizer. Using a voltmeter, place the testing probe on the positive terminal and place the earth/ground lead on the negative terminal. If the energizer is working properly it should pulse with about 7,000-9,000 volts. If not, you should suspect an issue with the energizer. Check any fuses on the energizer. Look for any black carbon deposits indicating lightning damage to internal components.

3. If the energizer is working properly, check the grounding system connections and wire, lightning diverter, and the energizer lead-out wire where it connects to the fence. Check to see if the lightning diverter itself has been damaged.

4. If no problems are found with the energizer, grounding system, or lightning diverters, you will have to begin a more precise survey for faults on the fence. To aid in faultfinding, it is helpful to first understand what voltage and amperage are. Voltage is a measure of the energy difference between two objects—in this case, the energy difference between fence wire and soil. Moving energy, or current, is measured in amps.

When no objects are bridging the wire and the soil, there is little current flow and the energy difference between wire and soil is high. In other words, the voltage will be high and amps will be relatively low. Some amps will usually be present on the fence even under ideal circumstances due to minor current flow through poor quality insulators or a grass load on a wire. This will typically be in the range of 1 or 2 amps per mile of fence being energized.

A major drop in voltage accompanied by a significant increase in amperage likely represents a major flow of current somewhere on the fence, such as a wire touching a metal T-post, a cracked insulator, or a section of downed fence. Check for poor connections and joints, broken wires or cutout switches that are arcing.
It is possible for friction with rocks to wear through the insulation on buried wire over time (which is why you should always sleeve insulated wire in conduit when crossing under gates or other high-traffic areas).

Voltmeters or faultfinders are only able to read about a hundred feet or so in either direction. Starting at the energizer, begin testing the fence with your voltmeter or faultfinder every hundred feet or so, especially on both sides of critical points such as gates or lane crossings. On multiple-wire fences, be sure to test all hot wires.

Arrows on a faultfinder will point in the direction of the flowing current (the fault), but this also is limited to a hundred feet or so in either direction. Voltage and amperage will vary as you along the fence. If you get a low voltage/high amperage reading in one section of fence followed by high voltage/low amperage reading in the next, it is an indicator that you have passed the location of the fault. Take advantage of any cutout switches on the fence to isolate and test smaller areas.

5. If you are still unable to locate a fault after testing the entire fence, then the issue may be inadequate grounding. If you fence was previously working well this is unlikely, but it could be the case if you added additional fencing to the existing system or if soil conditions are extremely dry. You can test the grounding system and/or add additional ground rods to see if this is the problem.

General tips for constructing an electric fence

- Use 12 ½ gauge high-tensile wire with a Class 3 galvanized coating. Class 3 wire has roughly three times as much galvanization as Class 1 wire, which means greater conductivity and life expectancy of the wire.
- Use quality wire clamps or crimps for all wire connections rather than hand wrapping, especially for energizer lead out wire and jumper wires.
- All hot wires on a multiple-wire fence should be connected at the beginning and end of each run of fence in order to reduce electrical resistance. All ground wires in a continuous ground or earth return system should also be connected at the beginning and end of each run of fence.
- Consider installing cutout switches to enable sections of fence to be isolated for troubleshooting, or to minimizing the amount of fencing the energizer must electrify. You may also wish to use a cutout switch to remove power from a fence's bottom wire during heavy grass loads.

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