# How an electric fence works

#### When animals (or predators) touch a fence...

- 1. The energizer pushes an electric pulse through its "+" terminal to the fence.
- 2. The pulse travels through the conductors and pressurizes the fence with excess electrons. That pressure is measured in volts.
- 3. When an animal touches the fence, excess electrons enter it and travel through the animal to the soil.
- 4. After exiting the animal, the pressurized electrons travel through the soil's moisture back to the energizer's ground rod.
- 5. The electrons enter the energizer via the ground rod. The amount that returns is equal to the shock effect.



# Factors that affect a pulse's strength and shock effect.

- Joules of output from the energizer equal the volume of electrons in a pulse. The more joules, the larger the potential shock effect to an animal.
- Resistance of conductors, animal and soil. High total resistance absorbs more electrons and reduces the shock effect.
- Electron loss via grass contact and poor insulators. Electrons that leak this way are not available to shock the animal.
- Soil resistance. This also absorbs electrons and reduces the total electrons that complete the circuit.

#### Ground rods?

Ground rods guide the pulse from the soil and back into the energizer. The larger the pulse or higher the resistance of the soil (because it's dry, sandy, or rocky), the more ground rods that are needed to collect the electrons from the soil.

# What is the effect of dry soil?

Soil moisture determines the conductivity (or not) of soil. Dry soil increases resistance a weaker, less effective pulse occurs that does not deter animals. To overcome this, use more ground rods, Pos/Neg fence and possibly a higher output energizer.

Warning: In 1991 a fatality occurred when a 2-year-old child's head contacted an electrified fence while he was crawling on wet grass. The fence was correctly installed. The energizer was a UL approved unit. That is why Premier strongly tells users to keep young children away from all electrified fences. Due to this incident and others like it, experts worldwide now suggest that human contact by an energized wire to the head and neck is the most dangerous point of contact. Having said that, known human fatalities from electric fences (all types) are less than one per year worldwide.



# Before you buy or build a fence...

Practical advice for successful fencing

## Where do I start?

#### A common question asked by many customers

With proper planning, installing your own fences doesn't need to be intimidating.

Use the following pages as a fencing guidebook. We've compiled the knowledge and advice that Premier has learned from 38 years in the business and a lifetime of installing and using electric and nonelectric fences on our own farms.

Take special note of what we suggest *not* to do. These are hard lessons learned from what didn't work well, escaped livestock, rebuilding damaged fences and time spent managing all of it. Let's get started!

### Will the fence be moved? If so, how often?

# 1. Moved daily or weekly (temporary/portable)

Temporary or portable fences are quick to install and remove.

To eliminate the need for large end and corner posts, the fence strands (whether single, multiple or a mesh/netting) must be only hand-tensioned. And they must be electrified properly.

# 2. Moved each season or less (semi-permanent)

Can be an interim barrier until a more permanent fence is installed. This allows folks to field-test fence and gate locations to see what works best.

Usually consists of electrified net or multiple electrified strands under low tension—supported by stronger/thicker posts than temporary fences.

Will need more maintenance attention than permanent fences.

#### 3. Never moved (permanent)

For boundary and subdivision fences for land that's owned by the user.

Requires strong wood or steel posts that support high-tensile wires, woven wire, rope or wide tape.

More reliable than other options but more expensive to install. May require a professional installer.

## A fence will not do something for which it was not designed

#### There are 3 basic fence designs. Be aware of the capabilities and limitations of each:

- **1. Fences that stop animals by pain (energized strands).** If you or dogs crowd animals against these fences the animals *will* break through. The result is damaged fences, escaped animals and animals that have learned not to fear (and thus avoid) a pain-barrier fence.
- **2. Fences that stop animals solely by physical strength.** We use these around corrals, handling yards and lanes. They work well for this but are often too expensive for large fields.
- **3. Fences that stop animals by physical strength and pain** (energized strands). Preferred for permanent fences. Energized wires are important:
  - a. To discourage animals during breeding season.
  - b. To hold back mothers and their progeny desperate for each other during the days of weaning.
  - c. To prevent animals from damaging posts and wires via scratching and rubbing (hair removal or general itches).

# Some common key fence questions



#### **Q. Should the fence be energized? A.** Absolutely. Why?

- An electrified strand has a zone of pain. Fewer strands are needed if one is energized. Both material and the labor to install is reduced.
- Energized fences last longer and require less maintenance because animals do not crowd, rub or scratch on them. So the fence wires (including wires that are not energized) require less tension to do their job. And braces and corner posts will last longer.
- Animals are more surely contained or excluded during breeding and weaning.

#### Q. Do the animals know the fence?

A. Local animals and wildlife get to know a fence by appearance, location and pain memory. If it's a strong or painful fence, they avoid it. On the other hand, new animals just off a truck often charge into permanent fences and straight through temporary or semipermanent fences. That's why strong, tall, visible permanent fences are essential for corrals and feedlots. Temporary fences that are not physically strong pose the greatest risk of escape to newly acquired animals. It pays to train them to electric fence inside a permanent one.

## Q. What specific animals need to be fenced in or out?

- **A.** Always design and build for the most difficult species. Rules of thumb:
  - Most sheep and goat fences will stop cattle and horses. The inverse is not always true.
  - Fencing adult males (bulls, rams, stallions, billies) in/out during breeding season requires taller fences with closer wire/strand spacing and more powerful electric pulses (in joules, not volts).
  - Fences for mixed sizes (ewes with lambs, etc.) need more strands than uniform groups.
  - Certain breeds need better fences (e.g. flighty Romanov sheep, tall Columbia sheep, Chianina cattle).

#### Q. Where will the fence be located?

- A. The best design hinges on the following:Is the terrain flat?
  - Will the fence go over hills, across ditches or around curves?
  - Is fence line brushy or around trees?
  - Are the soils rocky, soft, sandy or firm?

## Q. How keen will animals be to breach the fence line?

**A.** Build for the worst-case situation (if you can afford to do so).

Some situations that require more secure fences:

- **Hunger.** Starved animals will eventually challenge most fences.
- Weaning. Strong physical barriers are essential to success.
- **Breeding.** Libido induces all creatures to challenge rules and fences.
- **Boredom.** Animals in corrals, stalls and feedlots often crave any entertainment or activity.
- Gateways and handling yards. Animals often push each other into fences when being moved.
- **Goats.** Without a doubt, they are escape artists.
- Fear and fright. Predators or loud noises can cause prey species (e.g. horses, goats, turkeys) to run in terror straight into, under, over or through any fence, no matter what fence design (netting, hi-tensile or woven wire).



HT wire fences (left) like these are not easily seen and therefore not advised for horses. By comparison the rope fence (right) is visible and critical for animals that move at high speed (e.g. horses, deer) and/or have poor depth perception.

#### Q. How visible should a fence be?

A. It depends upon the species. Horses, deer and antelope move at high speed and have restricted color perception (compared to humans). They often fail to see small or dark fence wires like HT wire, MaxiShock and some polywires and charge through them.

That's why it's wise to include one or more strands of bicolored rope or tape (both highly visible) in fences.



We cannot stress visibility enough. Even in daylight a black/white net color is significantly more visible than orange or red against most backgrounds.

#### Q. How visible is Premier's white/black net (and now also yellow) compared to orange or red nets?

**A.** White/black provides contrast against all backgrounds 24/7 and is therefore more visible to humans and animals. Orange and red are visible to

humans in daylight but not at night. To most animals these colors appear gray in daylight and are nearly invisible at night—not safe.

Yellow is visible to both animals and humans—but less so than white/black. Less attractive too.

# Q. Why are lane and corral fences considered special situations?

A. Animals are often forced into contact with these fences. Therefore, they need better visibility, more strength and, if possible, no energized wires.



Heavy ice/snow can weigh down electroplastic conductors. When this occurs, turn off the energizer and break ice off the conductor. Sagging stretches and wears the plastic and metal filaments.

#### Q. Will heavy snow or ice occur?

A. Ice can bring down the strongest power lines so all fences are vulnerable to it. Some cope better than others.

The question is—are your animals likely to challenge the fence before the ice melts?

#### Q. Are dry periods common?

A. Electric fences typically rely on soil moisture as a conductor. When the soil is dry or covered in dry snow, normal electric fences and low-impedance energizers may not work effectively to keep animals in/out.

Solutions for this are:

- 1. Use a wide-impedance energizer. They're less affected by dry soil.
- 2. Integrate ground-return wires (connected to energizer's negative terminal) into the fence. Animals must touch 2 strands (a negative and a positive) but it works well.



#### **Q.** What's the cost if the fence fails?

- **A.** The higher the potential cost (in time and money) of a failure, the more reliable the fence design should be. Examples:
  - Along public highways. In some states the landowner is liable for damages to vehicles and humans.
  - Around stored feed. If animals gorge on grain, death may occur.
  - **High-value protection**, e.g. gardens, evergreens (*above*); or livestock from predators.
  - Fences with animals on both sides. Mix-ups are time-consuming and costly. Neighborhood relations can be strained. Unpleasant lawsuits may occur.

## Some advice for folks new to farming and fencing—

#### Fences...

- All fences, no matter the design, will need maintenance and repairs.
- Electrified fences should never touch metal. If they do, fence voltage will be sharply reduced.
- Animals and poultry will peck or chew on nonelectrified string fences.
- When the soil is dry, fences that rely on the soil to carry the pulse to ground rods do not work as well.

#### Energizers, batteries & accessories...

- Repeatedly going below a 40% charge on a lead-acid battery will reduce its ability to hold a charge.
- You need special insulated wire to carry power to a fence, not just any insulated wire from a store.
- You need a ground rod to connect to the negative terminal of the energizer. (Don't connect the energizer's negative terminal to the other end of the netting.)
- No electric fence should be plugged directly into an AC outlet. An electric fence must be connected to an energizer, not an outlet.

#### Posts...

- You will need a strong, stable post to support netting at each corner and/or major change of direction.
- Never use a hammer to drive *normal* netting posts into the hard soil. Instead drill pilot holes.
- Our *new drivable* posts are superior to both double and single spike posts because you can tap them into hard soil with a hammer (preferably a dead-blow hammer).

#### Animals...

- Will at some time get sick or hurt.
- You cannot save every animal that gets sick or injured.
- If you own animals you will need a veterinarian at some point. So establish that relationship before an emergency occurs.
- You must train animals to know and respect electrified fences.
- Animals can get caught in nearly any type of fence and may become injured when they do.
- If you do not keep a fence energized at all times your animals will lose fear of it. Then they will go over, under or through it. Retraining is difficult.

# **Common Fencing Mistakes**

## Insulator/Conductor Mistakes



#### Most common tube insulator error

This SupaTube has slid sideways out from under the staple—allowing the post to leak energy to the soil when it's wet from dew or rain. While HT wires need to be allowed to move inside a staple, the opposite is true of tube insulators. This is one reason we prefer ring insulators and rarely use tube insulators.



Insulator was too weak to withstand the up and down strain from the wire. Energizing barbed wire is a serious risk.

#### Too weak to take up/down strain

Years ago almost all insulators were weak and badly designed. Now only 50% are not up to the task (it varies by brand).

Buy the best (not necessarily the most expensive) that have plenty of plastic in them. Stick to white or black ones (more likely to have UV resistance—but even the right color is not a guarantee).



Pay attention to the little things

This insulator was installed upside down which allowed the tape to drop out of it.



#### **Broken strands**

Deer and livestock can break insulators and conductors. It is essential to repair them immediately.

This rope was easily repaired with a RopeLink.

### **Energizer and Battery Errors**

## Buying an energizer or battery that's too weak or too small

When most folks first experiment with electric fencing, they have limited ideas about its possibilities. So they limit their investment in the energizer.

But if it works (and it does if done properly), most folks then extend the fence and then extend it further, etc.

In a short time the longer fence is too long and grass-covered for the small energizer to keep fully energized.

The same is true of batteries. The 12 amp-hr battery (*right*) discharges quickly when paired with this energizer without a solar panel. Use a larger battery (80 or 100 amp-hr) if not using a solar panel.



#### Believing the "miles of fence" claims

Even politicians aren't as misleading as many energizer claims.

So why do many manufacturers still emphasize miles? Because other manufacturers do it. They fear that, if they don't include a "miles" claim, a customer will not buy their product.

For 38 years, Premier has refused to make such inaccurate claims.

#### Not enough earth (ground) rods

It's hard for the less experienced to believe that 6 ft of ground rod(s) may be needed for a 2 joule unit—and 18 ft for a 6 joule unit.

Extra ground rods increase the size of the energy "collection field" of the earth terminal. This, in turn, usually increases the potential size of the pulse.

Use galvanized ground rods (rust is an insulator). Connect them properly with stainless steel clamps.

## Allowing bare copper wires to touch steel wires or ground rods

If you do, corrosion by electrolysis will occur. **Result?** Poor contact and a weaker pulse. It's best not to use bare copper materials at all in electric fences. (Tinned copper is not a problem. The tin coating prevents any electrolysis.)

#### Most common DC battery error

Not keeping the battery charge level high enough. When a deep-cycle lead acid battery is drawn below a 40% charge, it is less able to ever be fully recharged.

Batteries with reduced charge levels may freeze in extremely cold weather. It pays to check the energizer batteries often—particularly during the cold of winter—to make sure your energizer and fence are working.

### Solar Panel Errors



Not keeping the panel clean Dirt, dust, debris and snow stop panels from recharging batteries. Solution? Clean the panels.

#### Solar panels not facing the sun

A solar panel won't function at its full potential if it's not fully facing the sun's rays (perpendicular to the sun at midday) for the maximum number of hours.

Depending on the time of year and your geographical location, the energizer's solar panel angle should change from nearly flat in the summer

to nearly vertical in the winter to maximize sun exposure.

# **Common Fencing Mistakes**

#### Grounding out on metal or wood

When netting touches a building (or any grounded object) it can leak energy away, particularly if the building or post is metal. To avoid this, install the net 2"–3" away from the building. This will still keep out predators because the conductors are also wrapped around the end posts of the netting.



#### Common voltmeter mistakes

- 1. Not buying a good one. I know we sell 5-light testers—but a true digital voltmeter is more accurate and informative.
- 2. Not using it. Many folks wait for animals
- to tell them (by escaping) when the voltage is too low.
- 3. Allowing your tester or voltmeter to shock you.
  - Don't grab the ground

probe while the tester is still on the fence (*see right*). When you've finished testing the fence, remove tester from the electrified wire first. Then,



and only then, pull the ground probe out of the soil. And do not pull out the ground probe by its wire.



#### Too few cut-out switches

Cut-out switches allow you to disconnect sections of fence without turning off the entire fence.

When looking for shorts in the fence, cut-out switches allow you to quickly determine which length of fence contains the problem.



#### Energized wires too close to barbed wire

An animal (or human) caught by the barbs could receive multiple shocks before getting away. This can kill.

To reduce risk, fences should be either all barbed and not energized or all smooth strands with energized offsets.

#### Too busy to check the fence

Problems increase and effectiveness declines without routine checking. Some fence designs are easier to maintain than others.

If animals ever lose their fear of electrified fences and its paingiving effect (which can happen without proper maintenance), it takes considerable extra time and effort to retrain them.

#### What to do with net clips

**Problem:** Allowing clips to come in contact with grounded wires and posts.

**Solution:** Wrap the clip back around an electrified strand on the netting to hold it in place.







#### Poor knots

Square knots for electroplastic conductors (twine, rope, polywire) often make poor electrical contact.

A fisherman's knot is more reliable. Adding a brass ferrule (included in net repair kits) in the center enables excellent electrical contact.



#### Exposing the public to "hot" fences

Always put warning signs on energized wires so visitors know they will "hurt." Place all conductive wires on the *inside* of permanent fences so "outsiders" can't readily make contact with them.

### Post Mistakes





# Driving staples that hold HT smooth wires tight against the post

High-tensile wires need to be free to move. This enables the total length of wire to expand and contract as temperatures change and when animals or tree limbs hit the fence.

# Spacing line posts in permanent fences too far apart

Those who suggest long spacing distances are describing straight HT smooth-wire fences in flat open country (not hilly country).

Much closer spacings are necessary for uneven terrain and irregular fence lines.

# **Troubleshooting Electric Fences**

## Is the problem with the energizer or the fence?

- 1. To check—first turn off the energizer.
- 2. Then disconnect the wires going to the fence and ground rod system.
- 3. Turn the energizer back on.
- 4. Then measure the voltage on the energizer between the 2 terminals (fence and earth) with a digital fence voltmeter or other fence testing device. Touch one end to the "-" earth terminal and the other end to the "+" fence terminal.
- 5. If the tester reads under 4000v, the energizer (or possibly the battery if it's a battery/solar energizer) is the problem.
- 6. If the tester reads more than 4000 volts, the energizer is working properly and the fence is the problem.

# If the fence is at fault...

#### How to find the fault(s)

First, re-attach the fence and ground wires to the energizer and turn it on. Then, you must walk or drive along the fence looking for situations that are reducing the voltage.

1. If you have a Fault Finder, use it. The arrow will tell you which direction the energy is flowing (leaking). Follow the fence from the energizer outward. Move in the direction of the arrow, testing as you go until you arrive at the problem.

Note: Fault Finders can tell which section of net is at fault if you touch it to the clips where 2 nets join. But they are not able to locate the exact location within a net because energy flows in multiple directions within a net.

2. If you don't have a Fault Finder, but do have a voltmeter or fence tester: Walk or drive along the fence.

a. Netting—look for:

- The lowest live strand touching a post's metal spike near the soil.
- Damaged strands touching the soil.
- Netting touching a wire or steel post.





#### b. HT wire, twine or rope fences-look for:

- · Damaged or broken insulators.
- Any point where an energized wire touches the soil, a steel or wood post or a nonenergized wire. Separate them.
- · Branches lying on the fence, forcing wires together (above). Remove them immediately.
- c. Listen for snapping sounds as you walk along a fence. These occur when a conductor is close to a grounded wire, stake, tree or large green weed.

#### d. Separate the

fence into partsby turning off switches, if it's an HT permanent wire fence, or by disconnecting On portions of electric netting. Then progressively reconnect it, checking voltage as



Off

you do so. When the voltage drops, you've found the problem.

3. If no faults are found the soil may be too dry. Conventional fence systems rely on soil moisture to be effective. However, not all areas have the required moisture.

If that's the case, a Pos/Neg fence (see at right) can be used. These fences are wired to allow the use of every other horizontal strand as an extension of the ground terminal, eliminating the dependence on soil moisture to carry the energizer's pulse.

In order to receive a shock, the animal must touch both a positive (hot) and negative (grounded) strand. This will deliver more pain to animals than normal nets but the fence needs added maintenance (grass contact across both a positive and negative wire).

Pos/Neg fences can be used as allpositive in moist conditions.





#### PN (Pos/Neg) for dry conditions

Connect energizer fence lead to positive "+" net clip and energizer ground lead to ground rod. Connect a PowerLink from negative "-" net clip to ground rod.



#### Fence testing mistakes

- Standard multimeters are not able to test fences (fence voltage is too high). Use a fence voltmeter.
- If receiving an inconsistent reading, check voltmeter's battery.

#### "Insulated" animals

Animals standing on dry soil or snow may not receive an adequate shock even when the fence is properly energized. Why? Dry soil and dry snow act as insulators, reducing the

ability of the energizer's electric pulse to pass through an animal.

If this is the case, Pos/Neg fence systems or higher-output energizers are better adapted for such situations.

# If the energizer is at fault...

#### 110 volt plug-in unit

- 1. Use a test light to check if the 110v outlet is working.
- 2. If the test light works and the energizer does not, call Premier. We are happy to help and will act quickly.



#### DC battery unit

First determine whether it's the battery or the energizer that's not working.

- 1. If it's a 12v energizer, carry it to a nearby vehicle. Attach the input cords carefully to the vehicle's battery.
- 2. If the energizer works, then the energizer's battery needs to be recharged or replaced.
- 3. If the energizer does not work, call Premier.

#### Solar unit

All strands electrified

for moist conditions

\*\* BARNING \*

Connect both net clips together and

attach energizer fence lead to net clips.

Then attach energizer ground lead to

around rod.

- 1. Disconnect energizer from the battery.
- 2. Carry it to a nearby vehicle. Attach the input cords carefully to the vehicle's battery.
- 3. If the energizer works, then the energizer's battery needs to be recharged or replaced. (For optimal sun access, make sure the panel is clean, facing south and never in the shade.)
- 4. If the energizer does not work, call Premier.





#### Energizer testing mistakes

- Some testers require batteries. If the tester's battery is low, it will give no reading or a misreading (sharp contrast in consecutive pulse voltage).
- Fault finders are unable to test fence energizers.
- If a battery energizer's light is pulsing but less than 3000v is measured across the terminals, check the battery charge level (with a digital battery tester). Energizers with undercharged batteries may produce an insufficient pulse.