

Reducing Wildlife Conflict with Electric Fencing:

A Beginner's Guide



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USING ELECTRIC FENCES TO DETER WILDLIFE

This guide provides practical information to properly design and install an electric fence.

Electric fences effectively deter bears, wolves, coyotes and foxes from remote cabins, camps and your property. They can also keep wildlife away from other attractants, including livestock pens, chicken coops, beehives, dog kennels, vegetable gardens, fruit trees, berry bushes, bird feeders, compost and garbage.

From this booklet, you will learn:

- How flexible electric fencing can be to suit individual needs - from lightweight portable options for hunters to permanent wildlife exclusion fences around livestock or poultry.
- How to design an effective electric fence.
- How to select the appropriate components for your electric fence.
- The importance of properly selecting and leveling your fence line.



Electric fence sign, credit: Margo Supplies Ltd.

NOTE:

This guide provides advice on how to use electric fencing to keep out bears, wolves, coyotes and foxes. It does not address moose, elk or deer.

Electric fencing has been used for decades to safely and effectively contain livestock and deter predators. A properly-constructed electric fence is safe for people, livestock, pets and wildlife.

Modern electric fence power sources, or energizers, send fast, high-energy pulses of electricity through the fence and then have no voltage flow for $\frac{3}{4}$ of a second. This pulsing is designed to deliver a shock that repels the recipient away from the fence. Always take safety precautions when using electrified equipment:

- Purchase only Underwriters Laboratories (UL) or Underwriters Laboratories of Canada (ULC)–approved low impedance energizers.
- Avoid “weed burner” high impedance energizers.
- Place appropriate warning signs on electric fences.
- Caution children and visitors about touching the fence, using the gate and operating the energizer.
- Don’t set up fences over streams or standing water.
- Don’t touch both terminals of the energizer at the same time.

While touching an electric fence hurts, it will not cause permanent injury and is **safe to use around pets and children** because the current isn’t continuous.

HOW AN ELECTRIC FENCE WORKS

When an animal touches an electrified wire and the ground (or ground wire) at the same time, an electric pulse passes through them and back to the energizer via a grounding rod or ground wire. This completes the circuit, causing the animal to receive a shock. Proper fence design is essential for creating an effective barrier to wildlife. This includes selecting the appropriate type of energizer, making sure the fence is well grounded and choosing the appropriate materials and positioning of mesh/wire.

If there is poor conductivity between the positive and negative parts of the fence, the animal will get little or no shock. This may be caused by:

- Too few grounding rods.
- Not driving grounding rods deep enough.
- Poor metal-to-metal connections between the energizer and the grounding rod.
- Generally dry or gravelly soil.
- Other objects touching the fence, like vegetation, sticks, fallen trees and non-insulated posts.

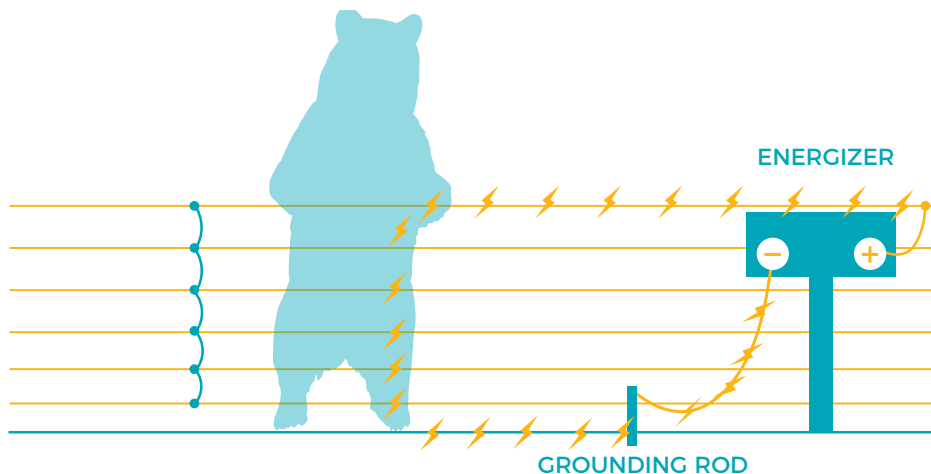


Figure 1: How an electric fence works

GETTING STARTED

Plan ahead before building an electric fence.

- 1. What are you trying to keep out, and what are you trying to protect?**
Knowing this will help you choose the appropriate fence design.
- 2. Will the electric fencing be temporary or permanent (year-round)?**
The answer will influence your material choices, such as galvanized stranded wire versus poly-wire, or fiberglass posts versus permanent posts.
- 3. How big is the area you want to fence and is there a power source?**
Knowing this will let you determine what type and size of energizer and the amount of fencing materials you'll need.
- 4. Is the soil in your area dry during certain months of the year?**
If your fence will be on dry, rocky soil, or cross concrete, pavement or wood, you will need to design a ground-return fencing system.
- 5. Will you need anything else for your fence like, corner bracing, gate options, alternative grounding options?**

FENCE LINE SELECTION AND PREPARATION

Choosing where to put your fence and preparing the area are important first steps in the design and construction of an effective electric fence.

You should try to:

- Select the most level ground to run the fence. Wildlife will use dips and hollows to gain access.
- Avoid crossing creeks, sloughs, ravines or other unstable and difficult areas, if at all possible.
- Keep the fence line as straight as possible.
- Clear trees, shrubs, other vegetation and debris along the fence line to allow wildlife to see the fence before encountering it, and to allow for fence maintenance.

The distance from the bottom wire to ground level may vary if fence lines are not leveled. Add extra posts to tightly contour the fence to uneven ground and maintain a consistent wire height.



Contoured fence, credit: Margo Supplies Ltd.

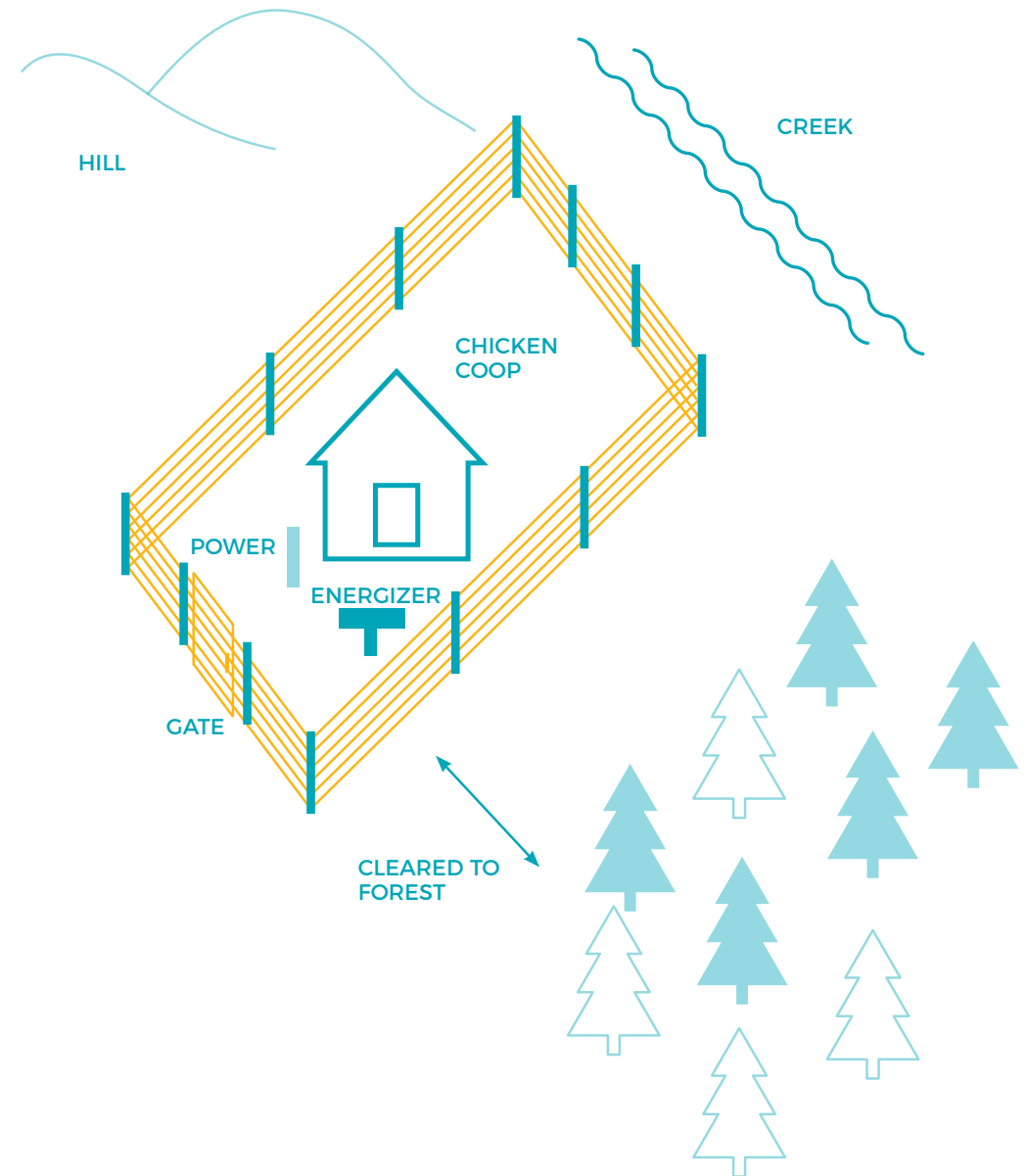
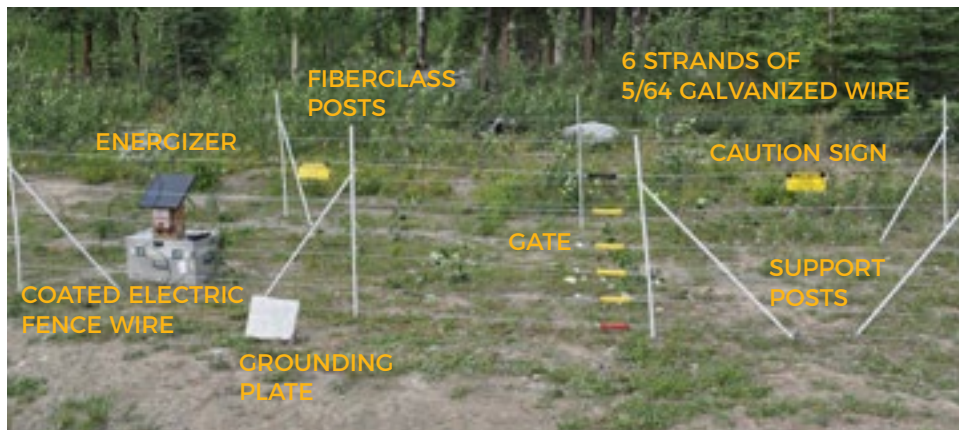


Figure 2: Choosing where to put your fence

ELECTRIC FENCE COMPONENTS

PRIMARY COMPONENTS

- **Energizer** (also called chargers or controllers): The energizer is the source of electricity for your electric fence. Choosing the right type is critical for making an effective barrier.
- **Grounding System:** Grounding is essential to allow the electrical pulse to pass from the hot (+) wire to the animal and back – completing the electric circuit and providing a shock. Additional grounding may be required, particularly in very dry soil.
- **Wire and Wire Mesh:** There are many types of wire and wire mesh that can be used for fencing, each with their own benefits and drawbacks.
- **Posts and Insulators:** Much like wire options, there are many post and insulator options, each best suited for a particular type of fence.
- **Fence Tester:** Proper maintenance of an electric fence is critical. An electric fence tester will allow you to monitor your fence and ensure it is working properly.



Electric fence parts

ENERGIZERS

Energizers are the power source for the electric fence. The appropriate energizer depends on the type of animal you want to deter and the length of fencing. Energizers store energy and deliver very short pulses of electricity through the connected wires. To be effective at deterring wildlife, your energizer needs to have a pulse rate of 45 to 60 pulses per minute (1.0 to 1.5 pulses per second).



Energizer

How much “power” do you need?

An energizer must provide at least 7,000 volts in order to consistently deliver a painful shock that teaches animals to avoid the fenced area in the future. Less than 5,000 volts is not enough to reliably deliver a painful shock.

What type of energizer should you use?

There are two types of energizers: plug-in and battery operated.

Typical plug-in energizers directly connect to a 120 volt AC outlet (standard household current). Battery operated energizers receive their power from 6 or 12 volt DC power sources, such as deep cycle or marine batteries.

Whenever possible, plug-in energizers are recommended for electric fencing. They require less maintenance, produce a consistent output of power, are generally cheaper, and most deliver more power than their battery operated counterparts. The largest energizers on the market may

pull a maximum of 50 watts. That's the equivalent of running a 50 watt light bulb, which amounts to just a few cents per month.

A properly set up, battery operated energizer can be just as effective as a plug-in unit. They require more maintenance, as the battery must be regularly recharged and may need to be replaced every three to four years. Solar panels can be added to a battery operated energizer to maintain the battery at full power, but the location must receive enough sunlight to ensure the solar panel can provide a sustainable charge for the battery. The solar array must also be powerful enough to charge the batteries you use. In winter, snow on solar panels and cold weather can impair battery life.

GROUNDING SYSTEMS

Without proper grounding, an electric fence will fail to provide an adequate shock to deter wildlife. In addition, improper grounding may damage the energizer.

Electric fences should have at least one six foot grounding rod or plate installed at the energizer. Additional grounding rods should be used in areas with dry, sandy ground or gravel.

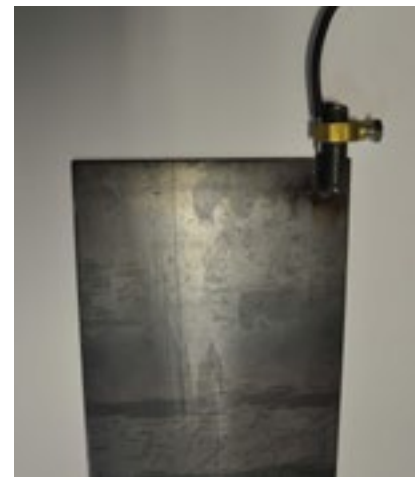
You will need additional grounding rods for every 300 metres of fence. Grounding rods act as an antenna to collect the energy through the soil needed to create the shock. The more surface area created by installing grounding rods, the bigger the shock.

Drive a grounding rod into the soil near the energizer to a depth of 1.83 metres (6 feet). In locations where it is too difficult to drive a grounding rod in that deep, try driving it in at a steep angle; or several rods can be placed in a series, 3 metres (10 feet) apart, and connected in tandem. In very dry or rocky soils, frequently watering the soil around the grounding rod and using calcium chloride or common road salt may help to improve the conductivity of the soil.



Grounding system

Grounding plates are another excellent alternative where the terrain makes it difficult to use grounding rods. A ground (-) wire (see “wires and wire mesh” on page 12) may also be run along the length of the bottom of the fence, touching the ground. This will enhance the grounding of the fence in addition to a grounding rod or plate.



Grounding plate and clamp

Grounding rods should be 1.27 to 1.90 cm ($\frac{1}{2}$ to $\frac{3}{4}$ inch) in diameter and made of steel. Painted rods, T-posts or rusted metal are not effective grounding rods. Paint and rust will act as a barrier to the electric current. You must have good metal-to-metal contact. Be sure to use a bona fide grounding rod clamp to attach the wire running from the energizer's ground (-) terminal to the grounding rod. Makeshift grounding rod clamps are not effective.

WIRE AND WIRE MESH

You can construct an effective electric fence with either multiple single strand wires, wire mesh, or a combination of wire mesh and single strand wires. An electrified mesh-wire fence presents a greater physical barrier to small animals like coyotes and foxes. It is important that single strand wires are always pulled tight.

There are typically two ways of designing an electric fence:

1. Ground-return fences

Where fences consist of alternating hot (+) and ground (-) wires.

One hot (+) wire is connected directly to the positive terminal on the energizer and all remaining hot (+) wires are connected to this wire in series. One ground (-) wire is connected directly to the energizer's ground (-) terminal and all remaining ground (-) wires are connected to each other in series. Another ground (-) wire connects the energizer's ground (-) terminal to the grounding rod.

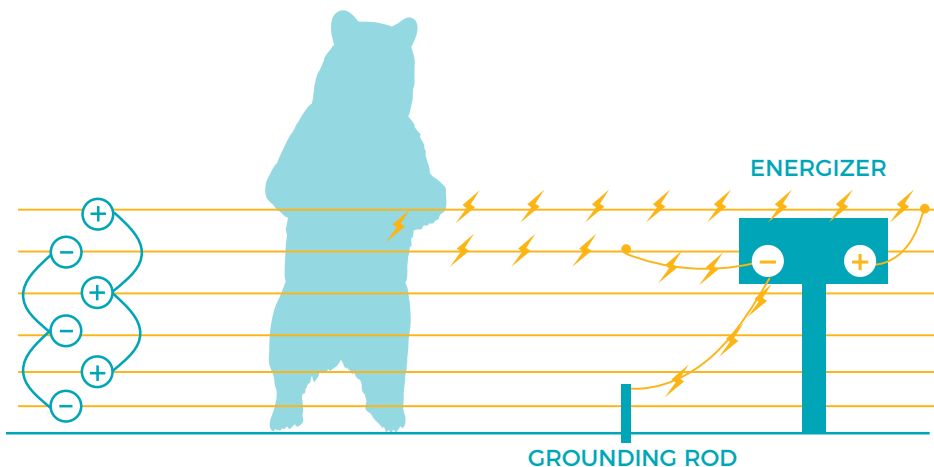


Figure 3: Ground-return fence

This design will deliver a shock to an animal that completes the circuit by touching both a hot (+) and ground (-) wire. This design is not solely reliant on completing the circuit back through the ground and grounding rod. If an animal touches any of the hot (+) wires and completes the circuit through the ground, they will also receive a shock. **This design is often used when the soil is dry.** The top wire must always be hot (+) for this design. A ground (-) wire can also be strung along the bottom within 3 to 6 cm (1 to 2 inches) of the ground.

We recommend this system, as it provides two opportunities for animals to receive a shock.

2. All-hot fences

Where all wires have a hot (+) charge running through them.

One wire is connected directly to the positive terminal on the energizer and all remaining wires are connected in series. The ground (-) terminal on the energizer is connected to only the grounding rod. With this design, if an animal touches one of the electrified wires while standing on the ground it will receive a shock. An all-hot fence relies on the system being well-grounded. **It is not ideal for dry, rocky soils, or if the fence crosses asphalt, concrete or wooden surfaces.**

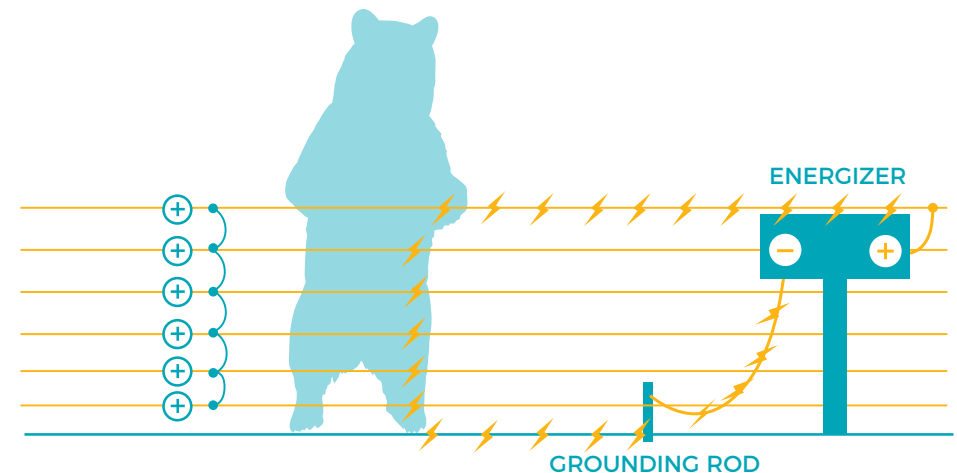


Figure 4: All-hot fence

For **permanent electric fencing**, use **all-metal wire or wire mesh** – either galvanized stranded wire or galvanized solid steel. Galvanized stranded wire is easy to use and more conductive than solid steel wire. High-tensile galvanized solid steel wire is more difficult to work with, but it is strong and durable. Regardless of the wire you choose, it should be at least **12 to 14 gauge**.

For **temporary or portable electric fencing**, you may consider using **poly-wire or poly-wire mesh**. Poly-wire consists of multi-stranded aluminum or stainless steel wire braided within polyethylene. Poly-wire is flexible yet strong and can be unrolled and re-rolled multiple times without breaking. Pay attention when connecting sections of poly-wire to ensure there is good wire to wire connectivity. Poly-wire mesh is available in an all-hot design or a ground-return design. This product will degrade over time in the sun.

Poly-tape, which is flat, is designed as a visual barrier for livestock and is not effective for deterring wildlife. It does not easily separate the fur to deliver a shock to the exposed hide.

The top wire of an electric fence should always be hot (+).



Wire mesh, credit: Montana Fish, Wildlife and Parks

POSTS AND INSULATORS

There are a number of different post types available for electric fencing. The most common are treated wood, metal T-posts, fiberglass, and plastic.



Post and insulators

Treated wooden and metal posts are typically more expensive and require insulators for hot (+) wires; however, they are more durable than plastic posts and may require less overall maintenance. Fiberglass posts are more durable than wood or metal posts. Using trees is not recommended, predators can climb them and jump into the fenced area.

The primary difference between permanent and temporary fencing is the choice of fence posts and how permanently you install them. For permanent, lower-maintenance and year-round fencing, wood or

fiberglass posts are the best choice. Temporary, seasonal or portable fences can be constructed with T-posts, fiberglass posts, or step-in-the-ground plastic posts. They can be effective and economical and can be taken down for storage when not in use.

Corner posts generally require reinforcement to prevent movement when fence wires are pulled tight. Reinforce corner posts from within the fenced area using another diagonal post. If anchoring them from the outside consider running a hot (+) wire out along the length of the support to prevent wildlife from compromising the fence.

There are many different insulators on the market, all with a different purpose. Some insulators are designed to offset electric fence wire from existing fences or structures, while others are designed to simply support a wire at a set height. Whatever type you choose, insulators must secure hot (+) wire strands to wooden and metal posts so the wire doesn't ground out. Plastic and fiberglass posts do not need insulators. SnapMax spring clips are useful for attaching wires to fiberglass posts and are easily adjustable. Rubber tubing can also be used as an insulator by running wire through it. In ground-return fence designs, you may directly attach the ground (-) wires to the posts using wire or staples. Select an insulator that is strong, easy to install and serves your purpose.



Various insulators



SnapMax spring clips



Rubber tubing

FENCE TESTERS

An important part of regular electric fence maintenance is the use of an electric fence voltage meter, commonly referred to as a fence tester. This small device not only tells you if your energizer and grounding system is working, it tells you the amount of current (voltage) passing through your electrical wires. A fence tester is not the same as a voltage reader, which only tells you if electric current is passing through the wire, not how much.

A minimum of 5,000 volts pulsing through the positive wires of the fence will deter most predators but **7,000 volts or more** is recommended.



Fence tester

You may want other components for your fence, such as gate handles, drive-through gates or on/off throw switches. Add these as needed to your particular fencing design.

WILDLIFE-SPECIFIC ELECTRIC FENCE DESIGNS

BEARS

Fortunately, bears are not good jumpers. Therefore, electric fences designed solely for deterring bears are simpler to design.

Bears are usually very cautious and curious. However, food conditioned bears can be much more difficult to deter.

- **Portable Fencing:** For remote, short term camps (e.g., hunting/recreational camps), a three wire fence can effectively deter bears. Wires are spaced at 25 cm (10 inches), 58 cm (23 inches) and 91 cm (36 inches) from the ground up. Lightweight, compact energizers are available and you can run them off of D cell batteries. Fiberglass or plastic posts are the lightest and most effective for this system. Tie flagging tape to the top wire so that bears can see it and focus their curiosity to that point.
- **Temporary or Permanent Fencing:** For fencing attractants such as poultry, beehives, remote cabins or landfills, a six wire ground-return system is recommended. The bottom wire is a ground (-) wire and placed 5 cm (2 inches) off the ground. This wire can even contact the ground to increase fence grounding. The second wire from the bottom is hot (+) and spaced 10 cm (4 inches) above the first. The third wire from the bottom is ground (-) and spaced 15 cm (6 inches) above the second. The remaining three wires are spaced 25 cm (10 inches) apart to a total height of 107 cm (42 inches).

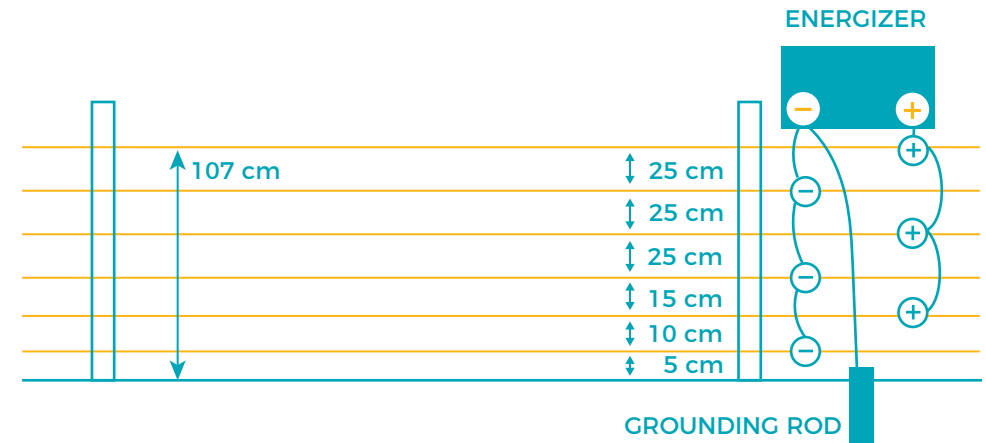


Figure 5: Permanent bear design

WOLVES, COYOTES AND FOXES

Coyotes and foxes usually penetrate fences by digging or crawling under the bottom wire. It is extremely important to level the fence line properly. The fence line must be even enough to run a charged hot (+) wire a maximum of 8 to 10 cm (3 to 4 inches) above the ground. An uneven fence line may allow coyotes and foxes to get under the wire. If the charged hot (+) wire touches the soil or snow, the voltage may be inadequate to keep animals out. Maintenance is required to keep vegetation off the bottom hot (+) wire. In winter, you can install a relay switch to change the bottom wire(s) from hot (+) to ground (-) as needed with compacting snow loads.

A nine-wire electric fence is recommended to deter wolves, coyotes and foxes. A fence of this nature will also work to deter bears, but not cougars.

For cougars, the same principles apply; however, add wires to bring the fence to a height of 10 feet.

The fence should have wires spaced (from bottom to top) 8 cm, 13 cm, 13 cm, 15 cm, 15 cm, 20 cm, 25 cm, 36 cm, 38 cm (3 inches, 5 inches, 5 inches, 6 inches, 6 inches, 8 inches, 10 inches, 14 inches, 15 inches) apart for a total height of 2 m (6 feet). This is the minimum height needed to prevent wolves, coyotes and foxes from jumping the fence. Make sure the mesh or single wires are taut.

A ground-return fence design is best for wolves, coyotes and foxes. Wires should alternate between hot (+) and ground (-), beginning with a hot (+) wire at the bottom. If the wires are placed with the correct spacing, they will split the fur of the animal and touch the skin, completing the circuit and delivering a shock even if the animal is not touching the ground.

In very dry soil, hard ground, rock or pavement, you can lay additional mesh on the ground so the animal receives a shock when it steps on the mesh and touches a wire. Connect the on-the-ground mesh to the ground (-) terminal of the energizer.

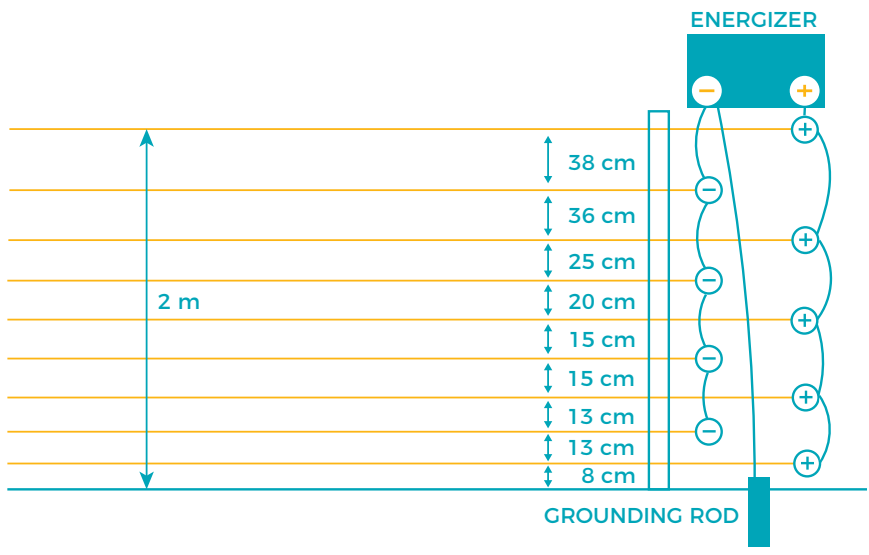


Figure 6: Small predator design



Lightweight, portable electric fence, credit: Arctic Oven Tents

WIRE MESH FENCING

Galvanized, high-tensile mesh or mesh panels can be used as all-hot (+) wire mesh electric fencing or to design a ground-return system. Mesh is available in a variety of designs and mesh sizes. Smaller mesh sizes can be very effective at deterring smaller animals like mink, marten and weasels as well as larger ones like bears. Galvanized mesh at least 2 m (6 feet) high with smaller spacing near the ground is recommended.

To deter mink, marten and weasels from crawling through a fence, the spacing in the mesh wire must be 4 cm by 3 cm (1.5 inches by 1 inch) or smaller. A single strand hot (+) wire can be placed 15 cm (6 inches) up from the bottom of the fence and 4 cm (1.5 inches) out from the wire mesh to keep mink, marten and weasels from climbing a wire mesh fence. **If using an all-hot (+) wire mesh system, make this wire a ground (-) wire.**

- Use insulators to support all-wire mesh fencing so that the mesh doesn't ground out by touching the posts or soil. The mesh is then connected to the positive (+) terminal of the energizer, and the ground (-) wire is connected to a grounding rod. You can cut a plastic pipe in half and place it under the bottom of the fence to allow it to rest on the ground and stop smaller animals from going under the fence.
- Ground-return mesh fencing allows the mesh to rest or be trenched into the ground. Hot (+) wires are then installed using offset insulators. The lowest wire should start at 10 to 15 cm (4 to 6 inches) above the soil on the outside of the fence and additional wires should be spaced at 20 to 25 cm (8 to 10 inches) apart. The positive (+) terminal of the energizer is connected to the hot (+) wires and the ground (-) terminal is connected to the mesh fencing and to a grounding rod. This design effectively deters both small and large animals.

PREVENTING TUNNELING UNDER FENCES

Animals may go to great lengths to get at what you are trying to keep them away from. To reduce the chance of animals digging under your fence, place a charged hot (+) wire 10 to 15 cm (4 to 6 inches) above ground level and 10 to 20 cm (4 to 8 inches) in front of your fence. You can also bury wire mesh under the ground 90 cm (36 inches) out from existing fencing and connect it to the ground (-) terminal of the energizer for greater protection.

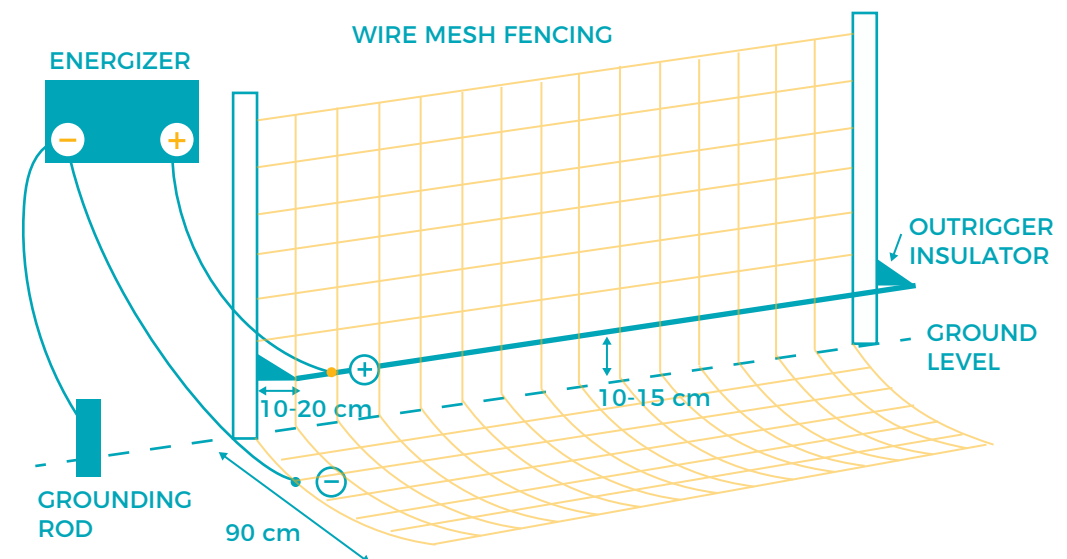


Figure 7: Burying wire to prevent tunneling

RETROFITTING EXISTING FENCES

You can attach electric fencing to an existing fence structure. Attach outriggers to the old fence. These hold the electric fence a few inches from the existing fence. This system can be highly effective if used with an animal-proof chain-link or page-wire system.



Retrofit fence

GATES

Gates are the weakest point in an electric fencing system. They require extra care and construction.

Gates should always be electrified and mirror the design of the fence you are using. You can simply construct gates for temporary electric fencing by using commercially available, expandable spring coils with handles or by extending wires or wire mesh across an opening and attaching insulated gate handles. More robust systems are recommended for permanent electric fences. Use prefabricated wire panels or build wooden gates and attach electric wire or mesh. Insulated electric fencing wire can be run in the ground under a gate or over an archway to connect two sections of fencing interrupted by a gate.

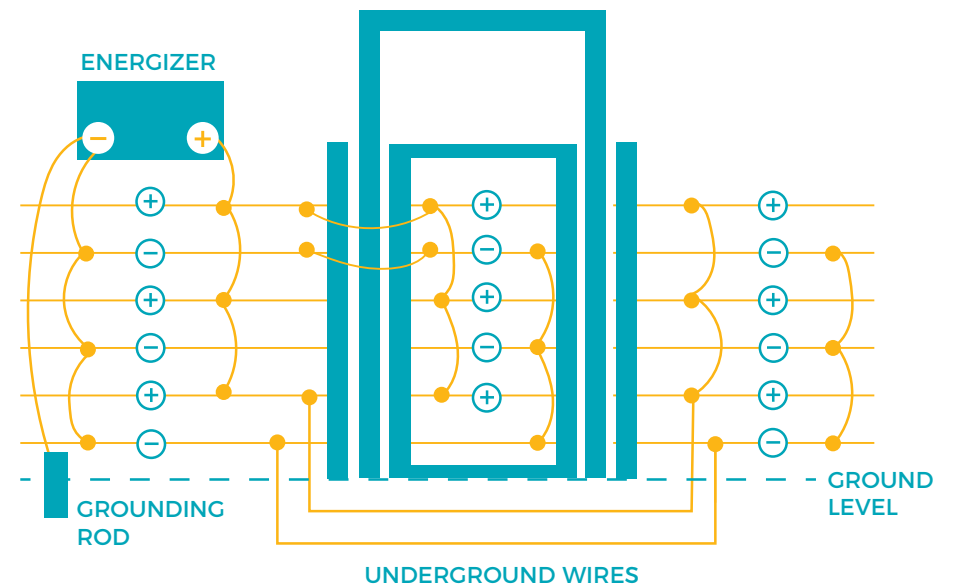


Figure 8: Gate

Fill the area under the gate with hard material (e.g., gravel, concrete) to prevent an animal from digging beneath it. A wooden sill or wire mesh embedded into the soil can also prevent digging. Any deterrents to stop digging should extend out a minimum of 90 cm (36 inches) from the gate.

You can also construct or purchase current carrying mats and place them in front of gates. Another option is installing cattle guards on permanent fencing systems, but these should also include an electrified gate that you keep shut when the cattle guard is not monitored. Some animals can learn how to jump over a cattle guard if given time.



A properly-maintained electric fence around a chicken coop, credit: Margo Supplies Ltd.

MAINTENANCE AND TIPS

Electric fence specifications:

- Minimum voltage requirement: 7,000 volts
- Minimum fence height: 0.9 metres (3 feet)
- Minimum number of wires: 6 for bears, 9 for wolves, coyotes and foxes. Three wires may be used for portable camp systems.

Check fences regularly to ensure proper operation along the entire fence. Use a proper electric fence tester to check that there is a charge of at least 7,000 volts from every hot (+) wire. If there isn't, search out and fix the problem. A suitable energizer should easily deliver 7,000 volts. Make sure there is no vegetation or debris touching the hot (+) wires of your fence.

Here are a few tips to improve the effectiveness of your electric fence:

- If fencing large areas, you may require an energizer with a higher joule rating, especially if your fence has multiple hot (+) wires or is constructed of wire mesh.
- Check voltage on every hot (+) wire weekly with an electric fence tester, particularly in the areas farthest from the energizer.
- If you are using an all-hot design and not getting an adequate charge, check your grounding. You may require additional grounding rods around the perimeter of your fence, or your soil may not be conductive enough for this design. Consider switching to a ground-return design if additional grounding rods don't solve the problem.
- If using a battery operated energizer, check your battery weekly and recharge as necessary.
- Make sure battery and energizer terminals are free of corrosion and have good metal-to-metal connections to the fence and grounding system. Use clamps or ferrules where possible, and insulated electric fencing wire.

- Check that hot (+) wires are not grounded out by vegetation, fallen branches, broken insulators, snow, etc. Consider installing relay switches on hot (+) wires that may be grounded by snow in winter.
- Check for poor wire connections in locations where wire has been spliced or where wire has become loose.
- When protecting a structure (cabin, chicken coop, etc.), the fence should be placed 1.0 to 1.5 m (3 to 5 feet) away instead of directly on the structure. This way, an animal encounters the fence before reaching the attractant.
- If protecting fruit trees, be sure to place the fence far enough away so that all fruit falls within the electric fence instead of outside it.
- Place plastic electric fencing signs around the perimeter of your fence to improve visibility and warn other people.
- Repair damaged wire and other components as soon as possible.



Use of electric fence wire taps and ferrules will greatly improve the operation of your electric fence

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