Montana Fish, Wildlife & Parks

Bears and Electric Fencing:
A starter's guide for using electric fencing to deter bears

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TABLE OF CONTENTS

Introduction……2

How Electric Fencing Works ……2

Getting Started……3

Energizers……4

How much "power" do you need?……4

Plug-in or battery operated?……4

Grounding Systems……4

All-hot fences……5

Hot/ground fences……6

Wire and Panels……7

Posts……9

Fence Testers……9

General Specifications……9

Application Ideas……10

Tips……10

Resources……11

INTRODUCTION

A properly constructed electric fence is safe for people and pets and has proven to be effective at deterring bears from apiaries (beehives), fruit trees, gardens, livestock pens, rabbit hutches, garbage containers, dog kennels, chicken coups, compost piles, storage sheds, along with numerous other uses. There is an abundant variety of applications and effective fencing designs for deterring bears. Design, construction and proper maintenance will determine the effectiveness of your electric fence.

Safety is always a concern when using electrified equipment. Modern electric fence energizers have been shown to be safe for humans, animals and vegetation. The pulse rate of a modern energizer is so quick that they cannot generate enough heat to start vegetation on fire. While touching an electrified fence is unpleasant, modern energizers are safe to use around pets and children.

HOW ELECTRIC FENCING WORKS

When an animal touches an electrified wire and the ground simultaneously, the electricity passes through them, into the soil, to the ground rod and back to the ground terminal of the energizer. The circuit is then completed and the animal receives a shock (Fig 1.). If too few grounding rods are placed, if the grounding rod(s) is not deep enough, or if soil is generally dry, the electricity will not find the path back to the energizer and the animal will receive little or no shock.

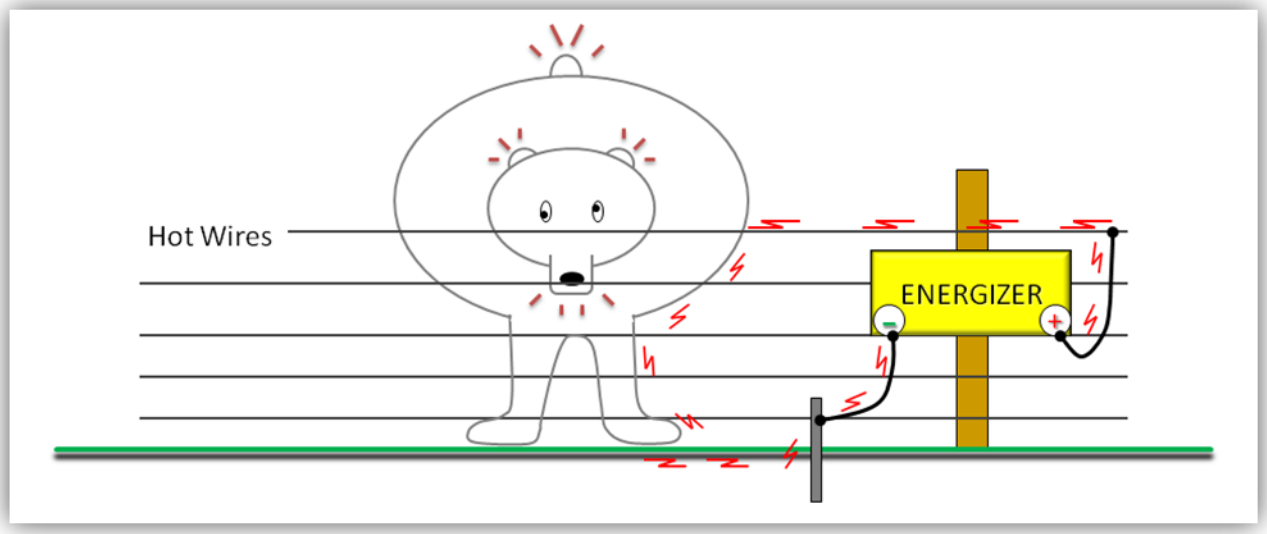

Figure 1. A bear completes the electrical circuit and receives a shock

Bears, and other non-jumping animals, will require a fence design that they cannot climb through or go under. This generally requires using multiple electrified wires (5 or more), a combination of electrified wires and an existing fencing, or electrified wires and rigid wire panels.

Getting Started

A few things to consider before starting:

- **Is your need for an electric fencing temporary (seasonal) or permanent (year round)?** The answer will determine some of your material choices (i.e. aluminum wire vs poly-wire, wooden posts vs T-posts, etc.).
- **How big is the area you want to fence? Does it measure in feet, acres, or miles?** Measure to determine how powerful of an energizer you will need (i.e. 1-14 joules) to cover the distance of large acreages (and the proper guage of aluminum wire that will be needed to prevent resistance), compared to an 0.7-1.0 joule energizer for smaller designs.
- **Prior to purchasing materials, check with your local wildlife biologist, or electric fencing retailer, for information on products that are appropriate for excluding bears.**

The primary components of electric fences are:

1. Energizer
2. Grounding system
3. Wire
4. Posts
5. Fence tester

There are other components that may be necessary for your fence, such as gate handles, drive through gates and on/off throw switches. These can be added as needed for your particular fencing design.

1. Energizers

Energizers (also called chargers or controllers) are the power source for the electric fence. Energizers come in a wide variety of makes and models. The appropriate energizer depends on what type of animal is being controlled and how large of an area it needs to cover. Energizers store energy and deliver very short pulses of electricity, about one pulse per second, through the fence system.

How much "power" do you need?

A energizers *stored energy* is measured in joules, which is similar to a horsepower rating in motorized engines. **The joule rating is the most important factor when choosing your energizer.** Make sure that the energizer has the appropriate joule rating for the animal you are trying to exclude. For example, if you are trying to keep bears out, they will require a joule rating of greater than 0.7 for the electric fence to be effective, while horses may only require 0.1 joules to keep them in.

For small areas, such as gardens, 2-3 fruit trees, compost piles, dog pens, chicken coups, etc., you will generally only need to make sure that your energizer has a joule rating between 0.7 – 1.0. However, for larger areas, such as livestock pastures or orchards, you will need to make sure that your energizer is also powerful enough to deliver its charge over the longer distance. For example, a energizer that is powerful enough to deliver its charge through 20 acres of fencing will not necessarily also have a joule rating of 0.7-1.0 that is needed to exclude bears.

Plug-in or battery operated?

There are 2 types of energizers available: plug-ins and battery operated. A typical plug-in energizer directly connects into a 110 volt outlet (standard household current). Battery operated energizers receive their power from 12-volt deep cycle or marine batteries.

Wherever possible, plug-in energizers are recommended for electric fencing. They require less maintenance, receive a consistent output of power, and are typically less expensive than their battery operated counter-parts.

Battery operated energizers can be just as effective as plug-in units. However, they require more maintenance, as the battery must be regularly recharged for the fence to remain effective. Solar-panels can be added to a battery operated energizer to provide the battery with a continual source of power. However, the location must receive enough sunlight to ensure that the solar panel can provide a sustainable charge for the battery. The solar array must also be powerful enough to charge the deep cycle batteriest that are used.

2. Grounding System

Grounding is the second most important component in the design of an electric fence. Without proper grounding, the fence will fail and the energizer can be damaged in the process. You will need one ground rod for every joule of your energizers output.

Ground rods should be driven in the soil near the energizer to a minimum depth of 6 feet. In very dry soils, the rod may need to be driven even deeper than 6 feet. It is necessary to drive ground rods as deep as possible so that the rod is in contact with the greatest amount of surface area, adequately allowing the current to return to the energizer.

In locations where it is too difficult to drive a ground rod at least 6 feet deep, there are several options. A ground rod can be driven at a shallow depth using a steep angle, or several rods can be placed in a series, 10 feet apart. Frequently watering the soil around the ground rod may also allow for the adequate return of energy back to the energizer.

Ground rods should be ½" -3/4" in diameter and made of galvanized steel. Non-galvanized metals rusts quickly and cause resistance, reducing its effectiveness. Painted rods, t-posts or rusted metal are not effective ground rods, as the paint and rust will act as a barrier. A ground rod clamp will be needed to attach the wire running from the energizers ground terminal to the ground rod.

There are 2 types of grounding systems:
A) All-Hot
B) Hot/Ground

A) All-Hot Fences

In an all hot fencing system, all of the fence wires are electrified, or hot. They are all connected to each other and to the positive (+) or hot terminal on the energizer. The negative (-) or ground terminal is only connected to the grounding rod. The animal only needs to be standing on the ground and to touch one of the wires simultaneously in order to receive a shock (Fig 2.).

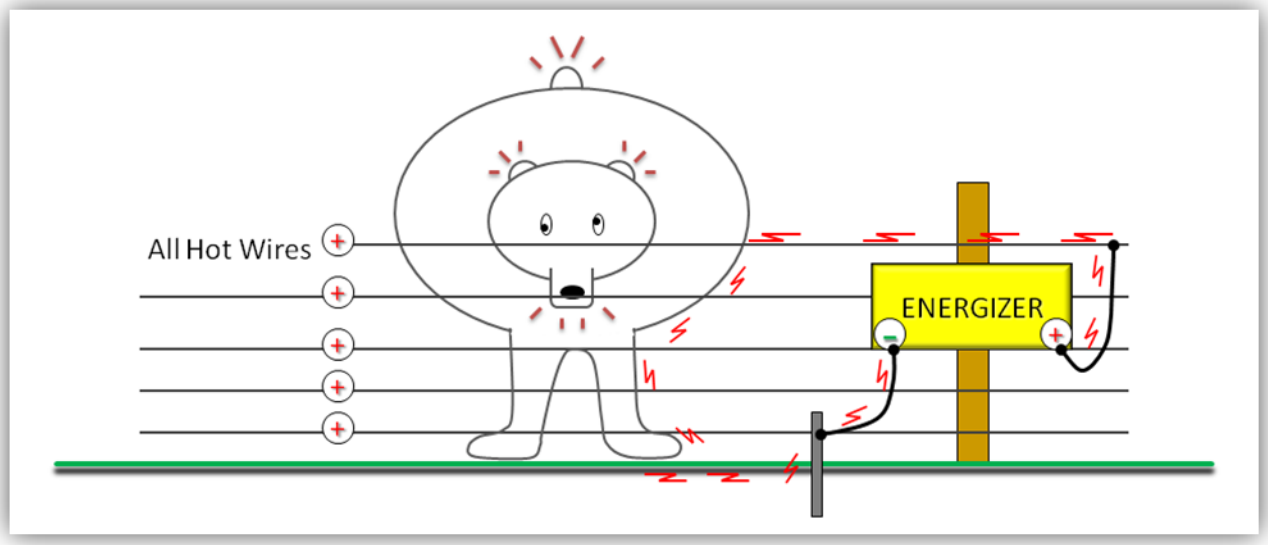

Figure 2. An all-hot electric fence design. All wires are connected to each other and to the positive terminal on the energizer.

This all-hot design is only good for areas with damp or moist soil that will provide sufficient grounding. Areas that are frequently watered, such as gardens or fruit orchards, or areas that are seasonally fenced during rainy/wet times of the year are suitable for this design.

When designing fences to exclude bears, or other predators, it is important to place enough lines so that the animal cannot pass under, through or over them. At least 5 lines are recommended in an all-hot design, placing the lines close enough together so an animal cannot pass between them without

receiving a shock. It is also important to place the wire closest to the ground low enough so that an animal cannot easily dig under it without also receiving a shock.

B) Hot/Ground Fences

A hot/ground fence consists of alternating hot (+) and ground (-) wires (Fig 3.). All hot wires are connected to the positive terminal on the energizer and all ground wires are connected to the negative (ground) terminal on the energizer. The energizers negative terminal must also be connected to the grounding rod. Rather than relying on the soil to complete the electrical circuit, this design directly returns the current to the energizer through the wires. The animal must touch both a hot and a ground wire to receive a full shock. This fence design should be used in dry or rocky soils, in locations where there are poor grounding conditions, and in permanent, year-round fence designs. The bottommost and topmost wires should always be hot (+), therefore you will always need an odd number of wires in a hot/ground design.

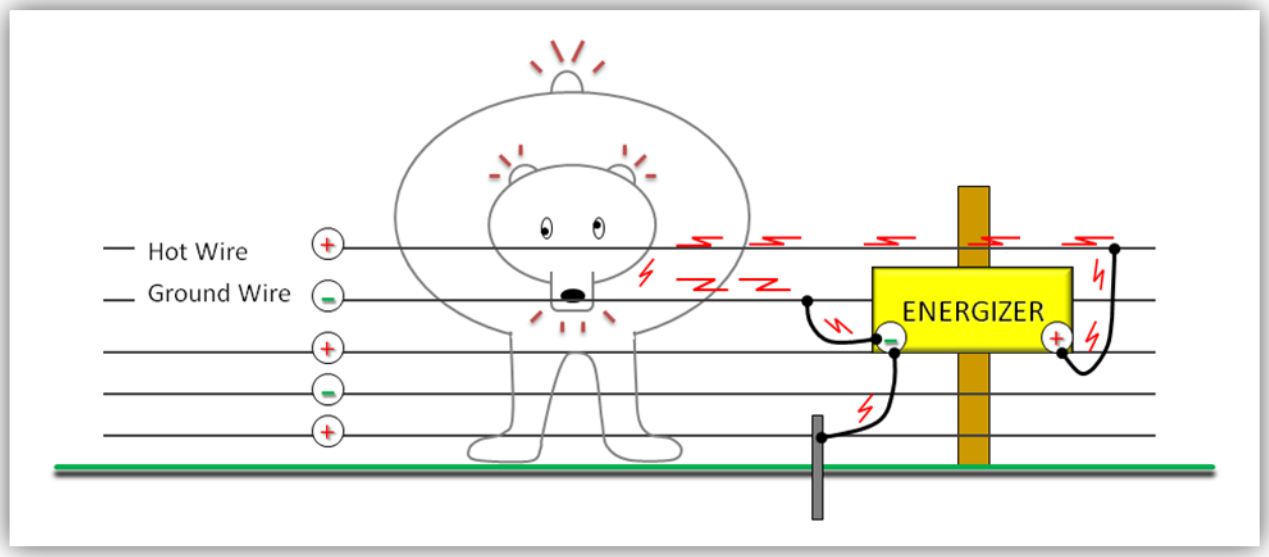

Figure 3. A hot/ground electric fence design. All hot wires are connected to each other and to the positive terminal on the energizer. All ground wires are connected to each other and to the negative terminal of the energizer.

Remember that it is important to place enough lines so that an animal cannot pass under, over, or through them without receiving a shock. When using a hot/ground design, it's best to use at least 5 wires. This way the alternating hot (+) and ground (-) wires are close enough together for the animal to receive an effective shock when it tries to pass through.

There are many fence designs that can be created based on these two different wiring systems. *Just remember, no matter which wiring system or fencing design you chose, you must always connect the energizer to a sufficient grounding rod for the fence to work properly and to prevent damage to the energizer.*

3. WIRE (and Wire Panels)

All metal wire should be used for permanent electric fencing and can be found in galvanized smooth steel or aluminum. Steel wire is more difficult to work with, as it is typically used in high-tensile fencing designs, but it is strong and durable. Aluminum wire is easy to use and more conductive than steel wire, but will break with repeated bending. Steel wire should be at least 14Ga or 12Ga, and aluminum wire should be at least 14Ga.

For temporary, seasonal or portable electric fencing, you may consider using a type of “poly” wire (Fig 4). “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. Because of electrical resistance, it is recommended that your “poly” wire has at least 9 strands of wire imbedded within the polyethylene. “Poly” tape, which is flat, is usually less effective for bear exclusion and is not recommended.

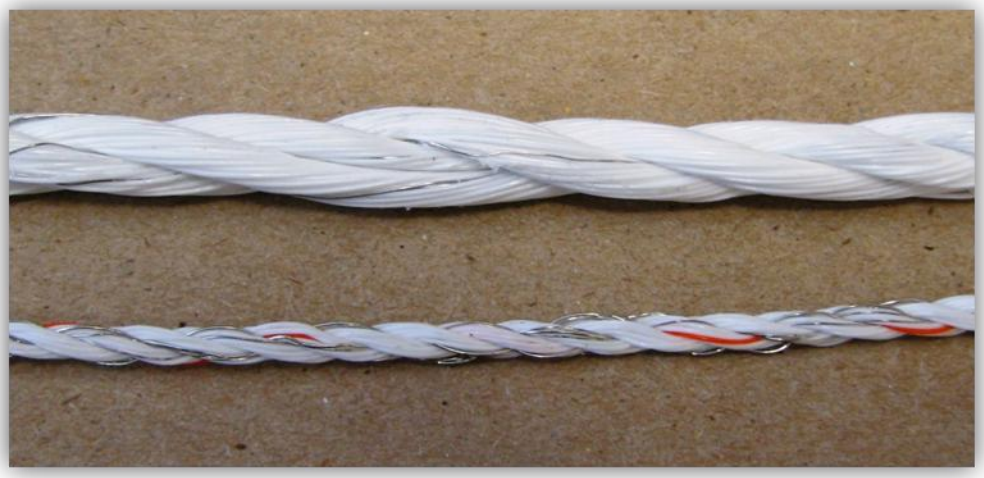

Figure 4. Two styles of electrical fencing “Poly” wires.

Using rigid wire panels

Depending on the size of the fence enclosure and application, rigid wire (cattle or hog) panels can be used in addition to, or instead of traditional wire.

For example, panels can be raised off the ground by attaching them to fiberglass posts. The panels are attached to each other and to the positive terminal of the energizer. The posts insulate the panels to ensure that they remain “hot” (Fig 5.). Or the raised panels can also be used as the grounded wire in a hot/ground fencing system (Fig 6.).

In very dry soil, hard ground, rock or pavement, additional panels can be laid on the ground beneath any raised panels to ensure grounding of the animal. These on-the-ground panels should be connected to the ground terminal of the energizer.

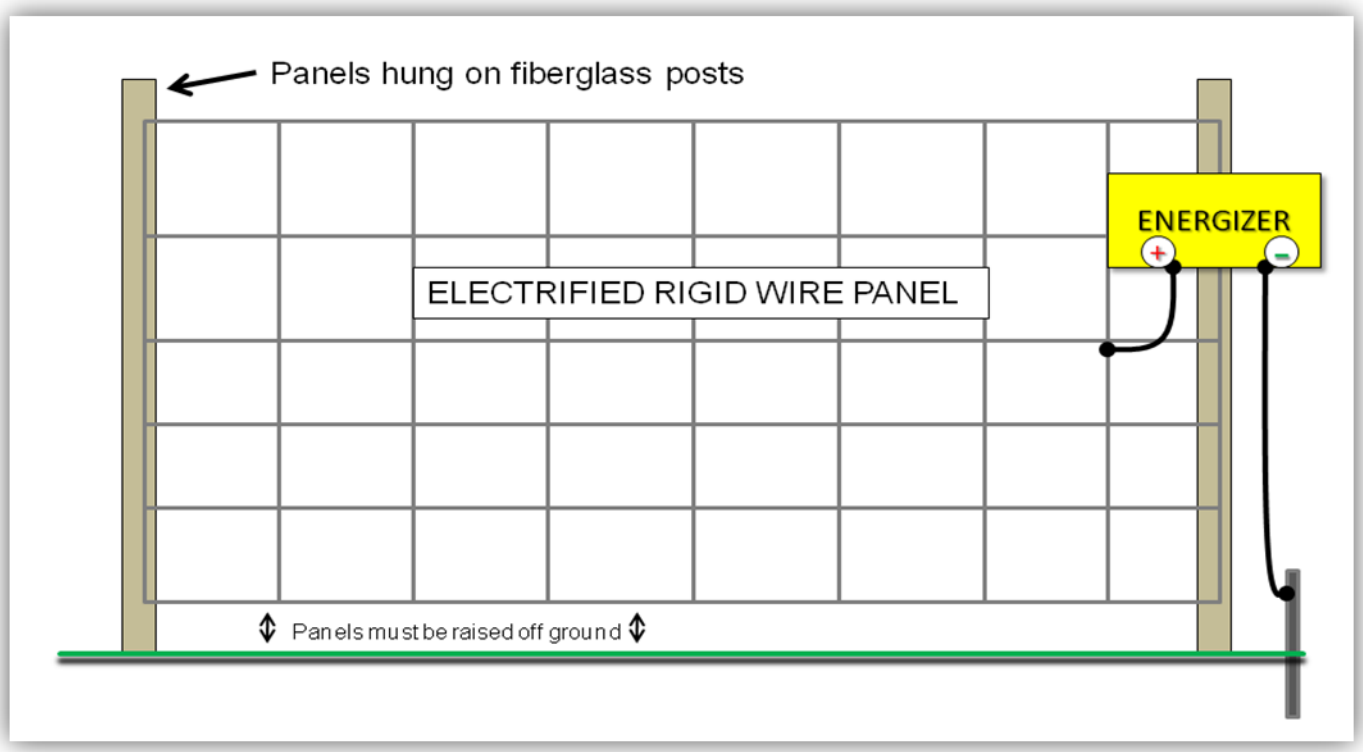

Figure 5. Electrified raised rigid wire panel

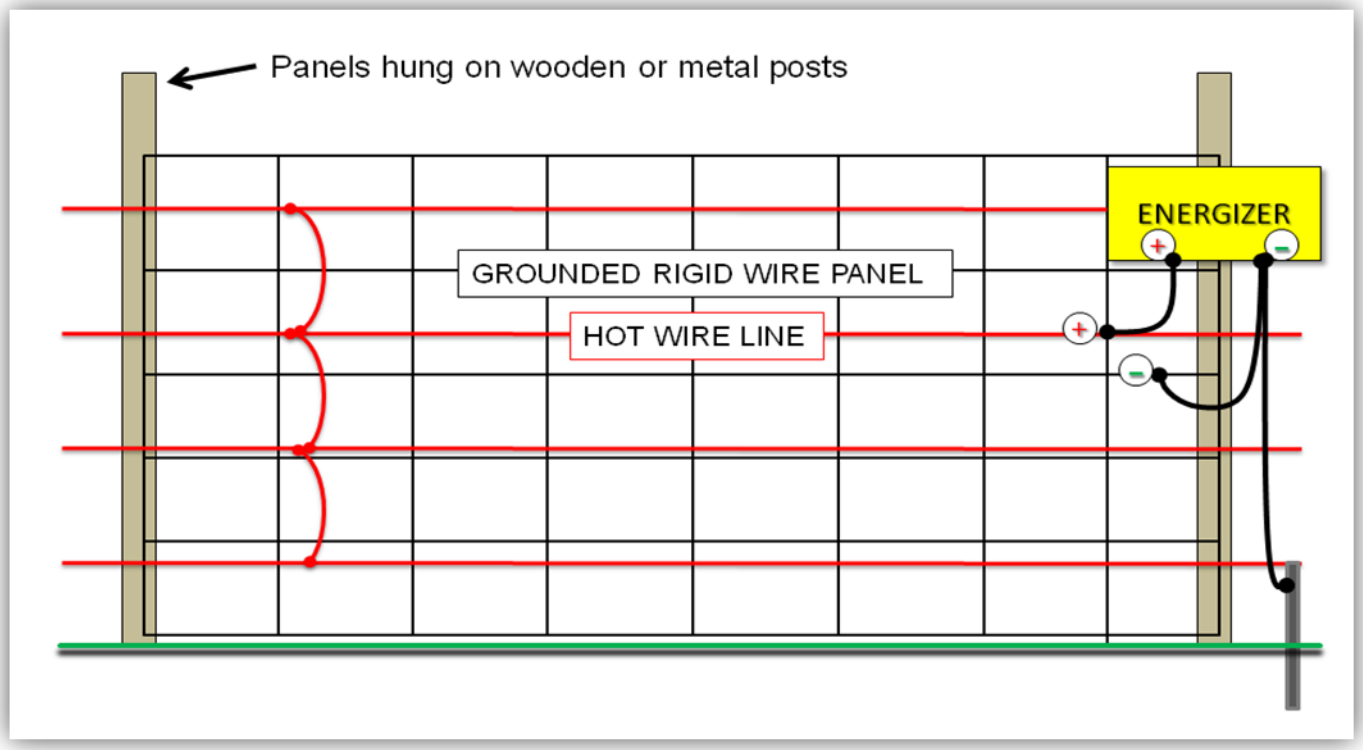

Figure 6. Grounded rigid wire panel with 3 offset electrified hot wires

4. POSTS

There are a number of different post types available for electric fencing, the most common being wooden, metal T-posts, fiberglass and plastic. Wooden and metal posts are typically more expensive and require the added expense of insulators, however they are more durable than plastic and fiberglass posts and require less overall maintenance.

The primary difference between permanent and temporary fencing is the choice of fence posts and the extent to which they are installed. For stable, lower maintenance, permanent, year-round fencing, treated wooden posts are the best choice. Less permanent, year-round fencing can be constructed using fiberglass or T-posts with wooden posts in corners for stability.

Temporary, seasonal or portable fences can be effective and economical, and can be taken down for storage when not in use. They can be constructed with T-posts, fiberglass posts, or step-in-the-ground plastic posts and have a wide range of applications. However, they will not hold up as well, or as long, as fencing that uses rigid posts.

Wire insulators must be used to secure hot (+) wires strands to wooden and metal posts to prevent the wire from grounding out. Plastic and fiberglass posts do not need insulators for the hot (+) wires and may be directly attached to the posts. In hot/ground fence designs, the ground (-) wires may be directly attached to the posts.

5. FENCE TESTERS

An important part of regular electrical 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 passing through your electrical wires. This is not the same as a *voltage reader*, which only tells you *if* electric current is passing through the wire, not *how much*. However, to effectively deter bears, it is the *how much* that matters. Bears require a minimum voltage requirement of 6,000 volts, or more, passing through each hot (+) wire.

Fence testers should be used to test if your fence is functioning properly immediately after setup and then periodically thereafter as part of regular maintenance.

Electric fence specifications for deterring grizzly and black bears

Minimum Joule Requirement:	0.7 or more
Minimum Voltage Requirement:	6,000 or more
Minimum Fence Height:	4 feet
Minimum # wires	5

Some electrical fencing applications for excluding bears

Apiaries	Livestock pens
Garbage containers/dumpsters	Dog kennels
Compost piles	Chicken coups
Orchards/fruit trees	Gardens
Sheds/storage areas	Birdfeeders

Some tips to improve the effectiveness of your electric fence

- ***The joule rating is the most important factor when choosing your energizer.***
- ***Grounding is the second most important component in the design of an electric fence.***
- If using a 12-volt battery operated energizer, check that your battery is charged every week. Make sure battery terminals are free of corrosion and are still connected to the fence and grounding rod.
- Check that hot wires are not grounded out by tall vegetation, fallen branches, broken insulators, etc.
- Check for poor wire connections in locations where wire has been spliced or where wire has become loose.
- When protecting a structure (shed, rabbit hutch, etc.) the fence should be placed 3-5 feet away instead of directly on the structure. This way the bear encounters the fence before reaching the attractant.
- When protecting fruit trees, be sure to place the fence far enough away so that all fruit falls within the electrical fence instead of outside it.
- Check voltage on every hot (+) wire with electric fence voltage tester, particularly in areas furthest from the energizer, weekly.
- Place plastic electric fencing signs around the perimeter of your fence to improve visibility and warn other people.

RESOURCES

Montana Fish, Wildlife & Parks

http://fwp.mt.gov/wildthings/livingWithWildlife/BeBearAware

Contact a MFWP bear manager near you:

Region 1:	Libby	Kim Annis:	406-293-4161
	Kalispell	Tim Manley:	406-751-4585
	Kalispell	Erik Wenum:	406-751-4588
Region 2:	Missoula	Jamie Jonkel:	406-542-5508
Region 3:	Bozeman	Kevin Frey:	406-994-3553
Region 4:	Choteau	Mike Madel:	406-466-5100

Living With Wildlife Foundation

http://www.lwwf.org

2009 Practical Electric Fencing Resource Guide: Controlling Predators

Interagency Grizzly Bear Committee (IGBC)

http://www.igbconline.org