

Fencing System

Lesson 3

Introduction

Fencing, just mentioning the word brings about a wild consortium of emotional thoughts for most livestock producers. There are no “right” fence styles or types for all operations or situations; it is a matter of preference. Economic considerations must be considered when building, replacing or mending fence.

Before you set the first corner post, take time to cover a few non-fence building issues. Contact your local zoning office and find out setback requirements. *You may be subject to new regulations, even if you are replacing an older existing fence.* Also, there may be local requirements on the type or style of fencing. The task of fencing is usually “pleasant” enough the first time; you don’t want to have to do it twice.

There are also legal issues that focus on fencing. State of Minnesota Statute #344 covers fencing. State statues can be found in the law library at the local courthouse. Check this out before you tear out that old boundary fence. It is a good idea to talk over your fencing plans with the neighbor whose property will be next to the fence.

Many livestock producers shy away from electric fences in favor of the five-strand, barbed wire or woven wire fence with metal T-posts. Today, high tensile electric fences are generally more economical fences because they tend to be less expensive and are easier to install and maintain.

The cost of materials for one mile of high tensile fence is site specific. Factors to consider are corner posts, terrain and the type of animals to keep in or fence out. High tensile wire costs about 1.5 cents per foot and is the cheapest part of an electric fence. Posts (either wood, fiberglass or metal) and insulators increase fencing cost the most.

The materials cost for one mile of 3-wire high tensile fence is approximately \$700 with wooden line posts spaced every 50 feet (excluding corners). A 7-wire predator fence would cost about \$1200 or an additional \$500 in wire and insulators. The cost of the energizer is not included in these estimates.

The cost for one mile of five-strand barbed-wire fence with metal T-Posts (every 16.5 feet) is about \$1300.00 per mile for fence and T-posts only. The cost per mile for a woven wire fence with two strands of barbed wire on top is about \$1800 for the fence and T-posts. These estimates

do not include corner posts or braces. Because livestock operators are familiar with the barbed wire fence, this chapter will focus on electric fencing.

There are many good publications and materials on electric fencing systems. Rather than reinventing the wheel we included information already in publication. David W. Pratt, Farm Advisor with the University of California Cooperative Extension Service, wrote the following materials.

Electric Fence Design
Training Livestock to Electric Fences
Quick Guide to Troubleshooting Problems with Electric Fences
Working With High Tensile Fence Wire
Fences That Work: Temporary Electric Fence Materials Evaluation

The following additional resources can be found in the Appendix

Appendix A

Permanent Fencing Costs for Cattle and Sheep, M.V. Rudstrom, West Central Research and Outreach Center

Appendix B

A Stonger Brace

Appendix C

20 Common Mistakes to Avoid When Building a Good Electric Fence, Wayne Burlson, Range Management Consultant, Absarokee, Montana.

Appendix D

Fencing Vendors

A list of fencing supply companies can be found in Appendix D. It is suggested that you contact several of the companies and request materials. Most suppliers have “how to” information covering layout & design and cost estimates.

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ELECTRIC FENCE DESIGN

The effectiveness of any electric fence, whether it's a one wire fence subdividing a pasture or a 9 wire fence protecting stock from predators, depends on the ability of the fence to deliver an unpleasant shock to animals that touch it. The ability of a fence to deliver that shock depends on three things:

1. **The energizer**
2. **Grounding**
3. **The fence design**

The ideal fence is inexpensive to build and effectively control animals. There is no single design that meets these criteria for every application. The effectiveness of any design depends on the type of animal that must be controlled, the materials used in construction and site characteristics (e.g. soil moisture, terrain, etc.)

HOW MANY JOULES DO YOU NEED?

The number of joules needed depends on the length of the fence, the number of electrified wires and severity of conditions. As a general rule you'll need an energizer with a rating of 1 joule for every 6 miles of *wire* you want to electrify. For example, if you install 12 miles of electrified wire (**4 miles of fence with 3 hot wires**) your energizer should have a rating of at least 2 joules (12 miles @ 6 miles per joule = 2 joules).

MINIMUM RECOMMENDED JOULE RATING	MILES OF ELECTRIFIED WIRE
1	6
2	12
3	18
4	24

Under severe conditions (wire passing through heavy vegetation) higher joule ratings may be required.

PULSES

Energizers differ in the size and duration of the pulses of electrons they send into the fence line. A good energizer has an intense pulse lasting for 0.0003 seconds. These short pulses eliminate the risk of fire (the pulse is so short that no heat builds up in the wire). Poorer quality energizers have pulse lengths of 0.003 to 0.3 seconds. This longer "on" time may allow sparks to arc and heat to build up. This can cause fires. This will also shorten the life of polywire. (These long pulses will cause polywire to melt where it comes in contact with grass.)

HIGH IMPEDANCE VS. LOW IMPEDANCE

Impedance means leakage. Generally speaking, high voltage energizers with long pulses are high impedance energizers. The current leaks readily. Low impedance energizers resist leakage.

POWER SOURCE

If mainline power is available and dependable, 110 or 220 volt AC (plug it in the wall socket) energizers are usually most practical for permanent fences. Will they raise your electricity bill? Well, depending on the size of the unit, they typically draw 2 to 25 watts a day. The operational cost of an energizer drawing 17 watts a day would be about \$1.50/month (assuming an electrical rate of \$0.12/kilowatt hour).

AC chargers have several advantages over DC (battery powered) energizers:

- **They require no battery maintenance**
- **They usually have higher joule ratings**
- **They are generally placed in or close to buildings (reducing the risk of vandalism)**

Where mainline power is unavailable or unreliable, battery powered energizers are a practical alternative. Dry cell batteries can power some portable DC energizers. *Beware - manufacturer estimates of battery life are usually optimistic.*

For longer or permanent fences or for short temporary fences passing through tall wet grass (high leakage), larger energizers powered by 12-volt rechargeable wet cell batteries should be used. Deep cycle batteries are the batteries of choice. They can be completely discharged and recharged repeatedly. Conventional car batteries can be used but they are not designed to be totally discharged. They will only recharge up to about 60 to 75% of their original capacity.

SIX TIPS FOR BUYING AN ENERGIZER

1. **Check the joule rating.** Don't pay attention to manufacturer claims as to energizer capacity in terms of volts, amps, or watts. Manufacturer claims of miles of fence a charger will power are meaningless. Remember: you double the shock by doubling the joules.
2. **Buy an energizer with the capacity to do the job.** Remember the Joule Rule: 1-joule/6 miles of electrified wire.
3. **Check the cost per joule.** One way to compare the value of energizers is to calculate the cost per joule. Generally speaking, the lower the cost per joule the better the value.
4. **Buy a low impedance energizer** with pulses of 0.0003 seconds or less.
5. **Look for solid state circuitry with modular service boards.** It makes repair much faster and simpler.
6. **Check the guarantee.** They vary in length and items covered. Some cover lightning damage.

ENERGIZER DON'TS

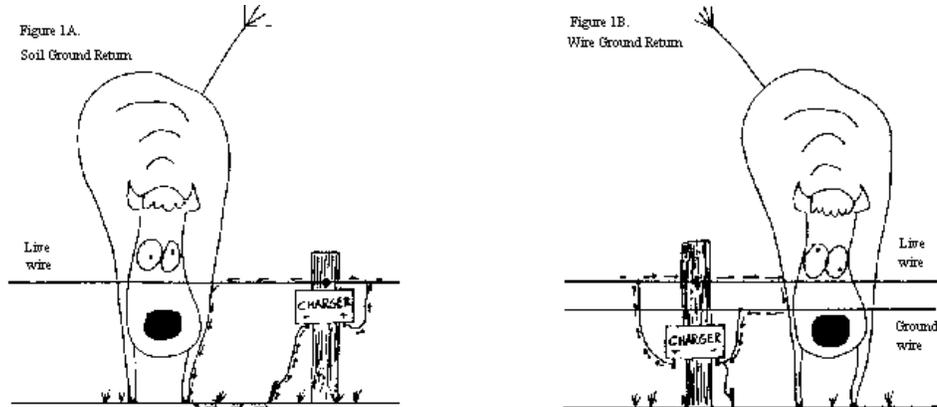
- **Don't buy on price alone.** The energizer with the cheapest price generally turns out to be the most expensive.
- **Don't skimp on the joule rating.** Buying more joule capacity than currently needed will give you the flexibility to charge fences built in the future without having to buy an additional unit.
- **Don't forget to ground the system.** Even the largest energizer in the world is useless without effective grounding.

GROUNDING ELECTRIC FENCES

Poor grounding is the leading cause of electric fence problems. Eighty percent of electric fence problems can be traced to fault grounding systems.

EFFECTIVE GROUNDING COMPLETES THE CIRCUIT

For an animal to receive a shock it must complete a circuit. The circuit can be either from the energizer through a "live" wire through the animal, through the soil, and through ground rods back to the energizer (figure 1A), or from the energizer, through a live wire, through the animal, through a ground wire back to the energizer (figure 1B).

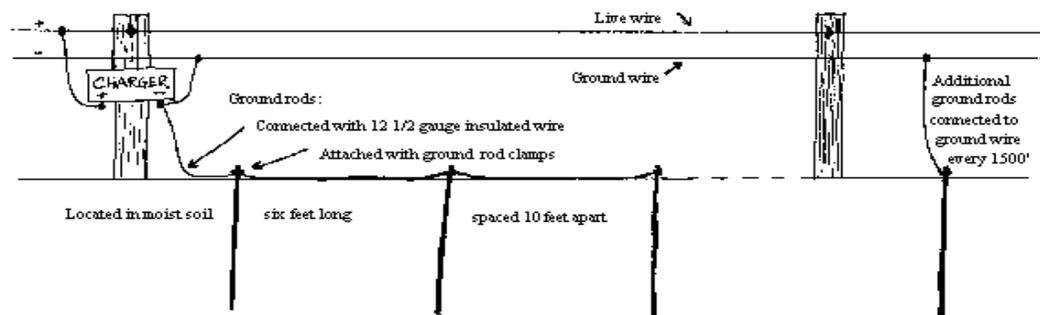


Moist soil is a good conductor of electricity. Therefore, electric fences on irrigated pastures rarely require ground wires. However, when soil moisture is depleted (for example, summer on dryland range) animals will not be shocked by electric fences unless ground wires are included on the fence.

DESIGNING AN EFFECTIVE GROUNDING SYSTEM

The grounding system for an electric fence is a little like a radio antenna. With a radio, the bigger the antenna, the better the reception. Likewise, your electric fence energizer requires a large grounding system to collect enough electrons from the soil to complete a powerful circuit.

A minimum of three ground rods should be used for each energizer. One half-inch diameter galvanized steel rods or 3/4" galvanized pipe make the best ground rods. They should be at least 6 feet long and driven 5-1/2 feet into the soil. They should be spaced at least ten feet apart. More ground rods may be needed in dry areas. If your fence includes ground wires, it is advisable to install additional ground rods connected to the ground wire at 1500 foot intervals along the fence line (3000 foot intervals are adequate where soil is moist year round). Energizers should be connected to ground rods with 12-1/2 gauge wire attached with ground rod clamps (below). The connecting wire should be insulated so that it does not come in direct contact with the soil (i.e. 12-1/2 gauge direct burial cable is ideal). Use one continuous wire to connect all ground rods.



TRAINING LIVESTOCK TO ELECTRIC FENCES

Whether building permanent fences with high tensile steel wire or temporary electric fences with polywire, an electric fence is not finished until animals have been trained to respect it.

The training area should be a small paddock. Keeping the area small will reduce the time it takes animals to learn about the fence. It will also minimize the time needed to gather and return the animals that get out during training and reduce the time required to build and mend the training fence.

When you turn stock into the training area, keep an eye on the animals but leave them alone to discover the fence on their own. Stock are curious and will investigate the fence. As they do, they'll get their first lesson. When first shocked, animals don't know how to react. Some back up. Others bolt ahead and may go through the fence. When stock get out, gather them up and put them back in. If the training fence was built using polytape or polywire, you may need to fix the fence.

When an animal investigates the fence a second time, it usually does so prepared to back up. Rarely do animals challenge a fence a third time. If an animal continues to challenge the fence, cull the animal.

Depending on the number of animals and the size of the paddock, training usually takes no more than one day. Some people put hay or grain across the fence to give stock some incentive to cross the fence. This can increase the speed of training but is usually unnecessary. Do not herd animals into the fence. Stock need an escape route. If crowded into the fence, animals may have no choice but to go through the fence.

Sheep are the most difficult class of livestock to train. Wool is an effective insulator, and therefore sheep are best trained just after shearing. Some producers have trained sheep by attaching cut out aluminum cans containing a little molasses to the fence. When sheep come up to lick the can, they get shocked and learn quickly to respect the fence. Make sure the cans do not touch ground wires!

LEARN FROM OTHERS' MISTAKES

Controlling cattle or sheep with electric fences without first training the stock results in hours gathering stock and mending fences. If you take the time and effort to train stock, the fences are effective. ***If electric fences are to consistently hold livestock, training is essential!***

QUICK GUIDE TO TROUBLESHOOTING PROBLEMS WITH ELECTRIC FENCES

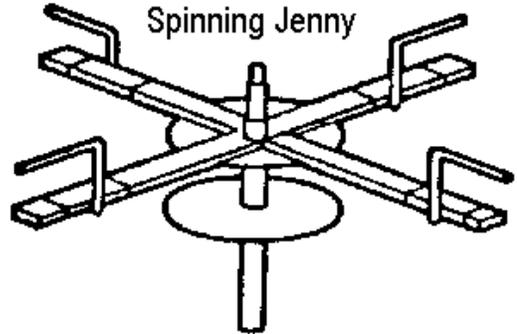
PROBLEM	PROBABLE CAUSES
Energizer not on or no voltmeter reading across energizer output terminals when disconnected from fence.	<ul style="list-style-type: none"> • Mainline power outage • Blown fuse on input circuit • Energizer switched off • Dry cell batteries dead, wet cell batteries discharged • Terminals corroded • Faulty energizer
Energizer on but low voltmeter reading across energizer output terminals when disconnected from fence.	<ul style="list-style-type: none"> • Energizer switched to low setting • Weak batteries • Terminals corroded
Energizer connected & operating but no voltmeter reading on fence.	<ul style="list-style-type: none"> • Ground-return wire disconnected or broken • Feedwire terminals corroded, disconnected or broken • Broken live or ground-return wire on fence
Low voltmeter readings at several places on fence.	<ul style="list-style-type: none"> • Energizer on low setting • Energizer inadequate for length of fence • Weak batteries • Terminals corroded • Ground system inadequate • Soil dried out
No voltmeter reading or low reading at one location on fence.	<ul style="list-style-type: none"> • Broken wire • Dead short across wires • Broken or disconnected jumper wire • Disconnected or deteriorated ground rod
Voltmeter reading on one wire higher than another or no reading from one live wire to ground-return wire or soil.	<ul style="list-style-type: none"> • Broken or disconnected fence wire • Broken or disconnected jumper wire • Broken or disconnected ground wire • Broken or faulty insulator • Ground rod deteriorated
Radio, TV or telephone interference.	<ul style="list-style-type: none"> • Ground system inadequate • Antenna too close to fence • Fence parallel with antenna wires or telephone wires

WORKING WITH HIGH TENSILE FENCE WIRE

High tensile fences are stronger and usually less expensive to build than traditional barbed and woven wire fences. Once you know a few simple wire-handling techniques you'll find they are also easier to build.

SPINNING JENNY

Make sure you have a straight jacket handy on the day you try to dispense a roll of high tensile wire without a spinning jenny. Spinning jenny is a device used to dispense wire smoothly without kinking or tangling. Don't try to work with high tensile wire without one.



START AT THE BEGINNING

There is a lead end and a tail end to each spool of high tensile wire. Both ends may be visible on the spool. When wire is pulled off the spool, start with the lead end. The lead end on new rolls is identified with a tag. If you cut the wire, be sure to identify the lead end of the wire left on the spool.

CUTTING WIRE

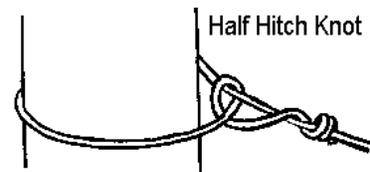
You'll wear yourself out trying to cut high tensile wire with ordinary wire cutters (you'll also ruin your wire cutters). High tensile wire can be cut easily using high tensile wire cutters.

TYING OFF

High tensile wire can be "tied off" to brace posts using knots, nicopress sleeves or wire vises.

HALF HITCH KNOT

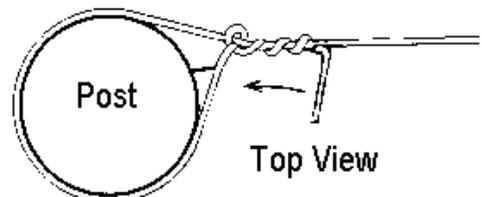
High tensile wire may be stiff, but you'll find it relatively easy to make a simple half hitch knot to fasten the wire to brace posts (figures 2 & 3). The break strength half hitch is over 60% of the break strength of the wire (about 1100 pounds). To tie a half hitch:



1. Pull about 3 feet of wire around the post.
2. Bring the end of the wire underneath and back over the line wire.
3. Bring the end down between the post and the wire that you just wrapped around the post.
4. Bring the tail under the wrap and over the line wire.
5. Make two tight wraps with the tail around the line wire.
6. Break or cut off the tail. Cutting leaves a rough surface.

Breaking wire will leave a smooth surface. To break off excess wire:

1. Put a 90° bend in the wire about 6" beyond the knot.



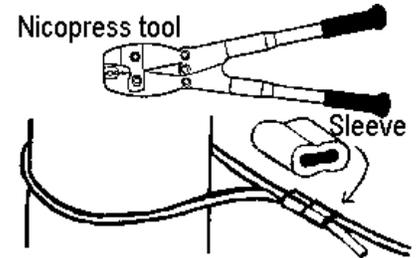
2. Grasp the wire just beyond the bend and crank it parallel to the fence line (back toward the post or splice). The wire will snap right off.

The faster you work, the easier the wire is to break. High tensile wire gets hot when worked slowly. When hot, the wire becomes more difficult to work and break off.

NICOPRESS SLEEVES

Nicopress sleeves can be crimped around high tensile wires with a nicopress tool (figure 4). The resulting connection has a break strength equal to that of the wire. To tie off wire with nicopress sleeves:

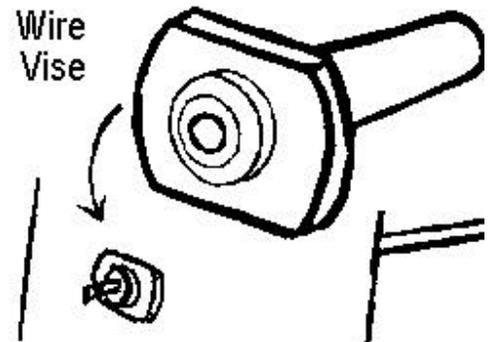
1. Thread two nicopress sleeves on to the wire and slide them back about 2 feet.
2. Feed the wire around the post. Thread the nicopress sleeves on the tail.
3. Slide the sleeves back to within a few inches of the post.
4. Crimp each sleeve with a nicopress tool.
5. Break or cut off the tail.



WIRE VISE

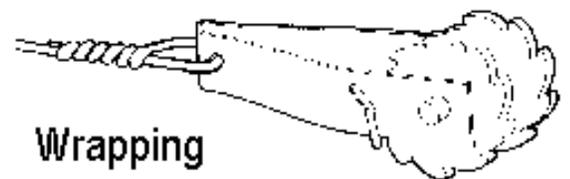
The wire vise has the same break strength as the fence wire. To install a wire vise:

1. Drill a 3/8" hole completely through the center of the brace post.
2. Feed each wire a few inches through the correct hole and into the wire vise.
3. Slide wire vise up the wire and into the hole in the post. When the wire is tensioned, the wire vise will become embedded in the post.
4. Break or cut off the surplus wire.



INSULATORS & IN-LINE STRAINERS

Both insulators and in-line strainers can be installed with two nicopress sleeves or by making at least 6 tight wraps with the tail around the line wire.



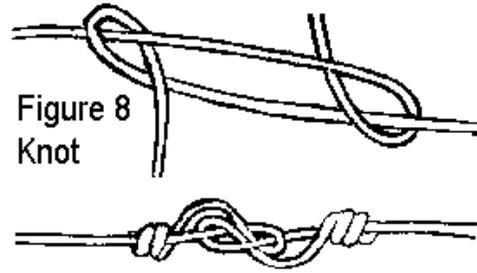
SPLICING

Wire can be spliced using a figure "8" knot, nicopress sleeves or a "wire link".

FIGURE "8" KNOT

The figure "8" is the most efficient knot for splicing high tensile wire (figure 7). It will maintain up to 76% of the strength of the wire. To tie a figure "8":

1. Overlap the wires to be spliced by about 4 feet.
2. In each piece make a small loop around the other wire. Leave yourself an 18" tail on each wire. The tails should be pointing in opposite directions.
3. Tension up the figure "8" so that the tails are touching.
4. Holding the figure "8" secure in the claws of a hammer, wrap the tail back onto the line wire with at least two wraps.
5. Break off the excess wire.



NICOPRESS SLEEVES

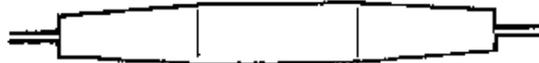
Splices can also be made using nicopress sleeves (figure 8). These splices have a break strength of 100% of the wire strength. To splice with nicopress sleeves:

1. Thread 3 sleeves on the first wire.
2. Thread the second wire through the other side of the sleeves.
3. Crimp the sleeves with a nicopress tool.
4. Cut or break off the tail.

WIRE LINKS

Splices can also be made with "wire links." Wire link splices maintain 100% of the strength of the wire. To splice with wire links:

1. Insert both wires as you can in the ends of a wire link.
2. Tension the wire.



FENCES THAT WORK: TEMPORARY ELECTRIC FENCE MATERIALS EVALUATION

Temporary electric fences give livestock producers a powerful tool for pasture management. They consist of one or more flexible wires attached to insulated posts and charged with an energizer. The fences can be put up and taken down quickly.

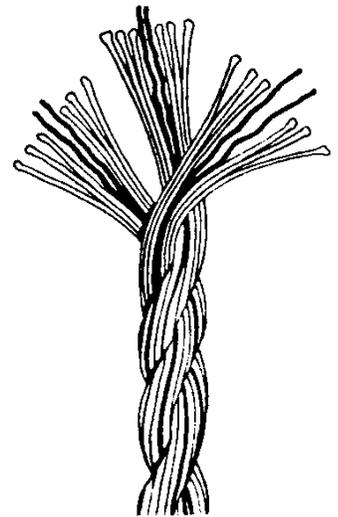
CUTTING THROUGH THE PROPAGANDA

Some of the sales literature fencing companies provide is very informative and can help you design more effective electric fences. The most helpful publications are cited at the end of this report.

Other sales literature can be confusing. Predictably every manufacturer claims their product to be superior to all others.

WIRE TYPE

There are two basic types of temporary electric fence products: polywire and polytape. Polywire is a generic term referring to any of several brands of electroplastic twine. Polytape refers to electroplastic ribbon. Most polywires and polytapes are made up of stainless steel filaments interwoven with some polyethylene, or polypropylene fibers. The number of steel or aluminum strands varies from 3 to 9 depending on the product.



Maxishock cable is also marketed as a temporary portable fence wire. It consists of strands of galvanized steel woven into a flexible cable.

Voltage dropped sharply in steel/polyethylene wires when over 1/2 mile from the energizer. Voltage in a fence with the aluminum/fiberglass material did not drop significantly when measured one mile from the energizer under field conditions. Aluminum is a better electrical conductor than steel. In addition, aluminum does not rust.

Maxishock cable was stronger and more conductive than the other products. It is also heavier, bulkier, and more cumbersome to dispense and rewind.

POLYTAPE

Polytape is more visible than polywire. However, it is also bulkier (a full reel of polywire builds more fence than the same reel full of polytape). Polytape is slightly more difficult to rewind, and it wears out more rapidly than polywire. Polywire is also less expensive (polywire average = \$0.021/foot; polytape average price = \$0.051/foot). Use polytape where visibility is important (horses). Use polywire for all other applications, especially multiple wire fences.

NUMBER OF CONDUCTIVE STRANDS

Predictably the six wire polywires were more conductive than the three strand materials. The nine strand polywires were more conductive than the 6 strand products. The nine strand polywires are stronger than the other products. However, the nine strand materials are bulkier and slightly more difficult to rewind. A full reel of nine-strand wire holds about 300 feet less wire than the same reel loaded with 6-strand material. The nine-strand polywire was also more expensive.

Under most applications six conductive steel filaments is plenty to do the job. While the nine-strand material is stronger, you don't need strength for an effective psychological barrier.

COLOR

If an animal doesn't see the wire they can't respect it. Visibility is critical, especially with poorly trained stock or where wildlife may challenge fences. Polywire comes in several colors and color combinations: white, black and white, orange, orange and black, yellow, and yellow and black. Orange and yellow wires look best on the farm supply store shelf but in the field white has them beat hands down. Against a lush green or dried yellow background, white is more visible. Time and time again untrained animals noticed white polywire from farther away than they noticed other colors. Buy white polywire unless you have to deal with snow for part of the year. In snow country use black and white or colored polywire.

REELS

A reel is essential. Rolling polywire back on the spool, on a stick or around your arm (the way you would roll an extension cord) simply won't work. You'll wind up kicking the dog, yelling at the kids and having nightmares about the money you've wasted and the mess you made.



Reels with steel cranks cost about \$10 more than reels with plastic cranks. Spend the money. A reel should be able to take a little abuse, after all this is for use on a farm, not a china shop.

POSTS

Metal "t" posts are the strongest, but most labor intensive to install and remove--a distinct disadvantage for temporary portable electric fences. The "t" posts also required insulators.

Fiberglass rods are easily tapped in with a hammer. Rod ends splintered when tapped. Fence suppliers sell a cap to place over the end of the rods to protect them when you tap them in. An expended shotgun shell works equally well and doesn't cost anything.

Polywire is attached to the rods using a wire clip or plastic insulators that slide on the rods. There are several types of wire clips. Some clips are difficult to adjust. The plastic insulators are most difficult to adjust in the field. Clips made for use with polytape (with an extra wide area to hold the wire) were easy to adjust and have a useful locking feature.



There are many kinds of tread-in posts. Lightweight fiberglass posts with one stationary and two adjustable clips did not go into the soil as easily as the two other tread-in post styles. Lightweight and heavyweight polyethylene tread-in posts with wire loops molded into the post and a steel spike at the bottom are also available. By stepping on a small platform at the base of the posts the spike tip went in easily and adequately secured the post. Under dry conditions they are difficult and sometimes impossible to install. The premolded loops provide plenty of flexibility for a variety of wire spacings.

For wetter ground it is difficult to beat the convenience of the tread-in posts with premolded loops (either lightweight or heavy duty). However they are more expensive than the fiberglass rods. Fiberglass rods make just as effective a fence but take a little longer to install. They are more versatile since they can be used under all conditions. Carry a shotgun shell or fiberglass rod cap with you to place over the top of rods when you tap them in.