The Art of Fencing

(Farm Style)

By Paul G. Johnson

Good fencing makes good neighbors, really true words of wisdom by Robert Frost. Although he wasn't actually fond of fences, as those of you who have read "Mending Wall" by him know. Regardless of Frost's sentiments, we all know that, our neighbors are more fond of us when we keep our goats at home. Now, what kind of fence do you want to build?

As Robert Frost noted:

"Before I built a wall I'd ask to know
What I was walling in or walling out,
And to whom I was like to give offence."

We are often asked what we use for our goats. We use four (4) foot high (OK, 47 inches to be exact) woven wire field fencing, with a strand of electric on six (6) inch extenders, about one to two feet off the ground, depending on the size of goats in that pen, and how high the weeds get. Our goal with the electric is to keep the goats from standing on the fence, or getting their head stuck, and hopefully to discourage varmints. The field fencing, with smaller squares on the bottom helps remove the head-in-fence problem to some degree.

However, like a lot of folks, we started by simply adding to what was already there. In our case, it was rusty, barbed wire and/or old strands of field fencing designed for cattle, which we reinforced with strands of electric. It often didn't work very well. Some of the old wire was even nailed to and/or grown into trees. This, of course, resulted in some sections where the wire had broken as the trees grew, or was so high off the ground a giraffe could have walked under it. Well, a goat, anyway.

The type of fence you decide to use depends on cost, availability, and how hard you are willing to work. There is fencing such as high tensile woven steel wire fences, that run $2.00 or more per foot—to field fencing at less than 30¢ a foot. Several folks use the so-called "New Zealand" type of fencing, which consist of five to eight strands of wire, with an electric charge through every other wire. The non-charged wires act as grounds. With the wire stretched incredibly tight, it can do a good job of keeping goats in. For low cost and effective goat fencing, it's hard to beat the plain old woven wire field fencing, preferably with at least one strand of electric. Make sure it's tight, and check it periodically. A sagging fence makes a handy goat exit.

I ran across a formula for determining the amount of fencing

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Mending Wall

Something there is that doesn't love a wall,
That sends the frozen-ground-swell under it,
And spills the upper boulders in the sun;
And makes gaps even two can pass abreast.
The work of hunters is another thing:
I have come after them and made repair
Where they have left not one stone on stone,
But they would have the rabbit out of hiding,
To please the yelping dogs. The gaps I mean,
No one has seen them made or heard them made,
But at spring mending-time we find them there.
I let my neighbor know beyond the hill;
And on a day we meet to walk the line
And set the wall between us once again.
We keep the wall between us as we go.
To each the boulders that have fallen to each.
And some are loaves and some so nearly balls
We have to use a spell to make them balance:
"Stay where you are until our backs are turned!"
We wear our fingers rough with handling them.
Oh, just another kind of outdoor game,
One on a side. It comes to little more:
He is all pine and I am apple-orchard.
My apple trees will never get across
And eat the cones under his pines, I tell him.
He only says, "Good fences make good neighbors."
Spring is the mischief in me, and I wonder
If I could put a notion in his head:
"*Why* do they make good neighbors? Isn't it
Where there are cows? But here there are no cows.
Before I built a wall I'd ask to know
What I was walling in or walling out,
And to whom I was like to give offence.
Something there is that doesn't love a wall,
That wants it down!" I could say "Elves" to him,
But it's not elves exactly, and I'd rather
He said it for himself. I see him there,
Bringing a stone grasped firmly by the top
In each hand, like an old-stone savage armed.
He moves in darkness as it seems to me,
Not of woods only and the shade of trees.
He will not go behind his father's saying,
And he likes having thought of it so well
He says again, "Good fences make good neighbors."

...Robert Frost

Art of Fencing

Continued from previous page

The option to add a strand (or two) of electric depends on your circumstance. We use chargers that put out up to 9,000 volts (with ½ amp!). Other than shorting out my watch on one occasion, and a ticked off spouse on another, no permanent harm has occurred to livestock or us. We have had one or two babies over the years get caught between the field fence and electric, but all survived. We manage to hit it also, at least a few times each year, and it's had no long lasting effect on us (I think).

The most important feature for an electric fence is the grounding system. The more ground rods the better. We use three, 8-10 feet apart, connected by heavy ground wire. In a dryer climate you may need more. Ask at your farm supply store or Extension Service. The rods are either zinc or copper. Getting them pounded 6-8 feet into the ground is best done during the wet season!

Disregard the references to how many miles of fence a charger will cover. This figure is based on fantasy, in my opinion. The larger the number, the better for year around voltage at a high enough wattage to discourage critters. In our wet climate with weeds that seem to grow inches each day in the spring, and occasional snow it's easy to drain off electricity. Similarly, during dry spells the current does not go as far.

Remember, there is no current until something grounds the hot wire, such as a person grabbing the wire. The current then comes from the charger through the wire through you back to the ground rods, completing the circuit. Or is it the other way around. Anyway, it smarts!

Goats have to be trained to electric to respect it. It doesn't take kids long to learn—just a zap or two. We had a rather large buck in rut who went through four strands of electric, two on each side, and a four foot, high tensile field fence to get to a doe in heat. He was cured (not "cured" in the same sense as cured ham), by stringing another length of electric, about 35 feet, and hooking it to a separate charger listed for 35 miles. I then put small pieces of aluminum foil in several places. After I put in the ground rod, there were at least 9,000 volts going through it. He cautiously approached the new wire, and started to sniff the aluminum foil. Snot flew for 20 feet, and he developed a new respect for the fence.

For crossing gates, we run the wire underground. The coated wire is placed inside old sections of garden house for protection.

Our corner posts are wood, and we use metal T-posts at 8 foot intervals, closer on certain buck fences. Posts should be braced in an "H" pattern, with a cross-piece between two wood posts, both sides. Then run strong wire from bottom of second post to top of post holding gate, to keep it from sagging. Yes, few of our pictures show them, as our fence was put up fast. It's on our list...

Planning for gates can be a challenge, if you don't plan well ahead of time. Because we rotate pastures fairly often, we have a lot of gates, or so it seems at times. Other times, it seems we don't have enough, as in never one where you need it that day.

You will need to plan gates around the equipment or livestock that will move through the gate. If just you and the goats will use it, a small gate will do. Our small tractor will fit through a six foot gate if approached at just the right angle—an eight foot gate seemed too big in that particular location. Note: gates come in two-foot width increments, starting at four feet. Some gates have wide spaces between bars, so before purchasing, know what the gate will be containing! We have, on occaision, planned poorly and ended up having to attach wood panels to the bottoms of gates to keep kids from slipping through the bars.

There are different types of gates—tubular gates, flat panel gates, mesh gates, and more. Be aware that next year's kids will be looking for places to escape and it doesn't take a very large space to accomodate them. Also, bucks can put more strain on a gate. One of our larger bucks took 43 seconds to hammer through a flat panel

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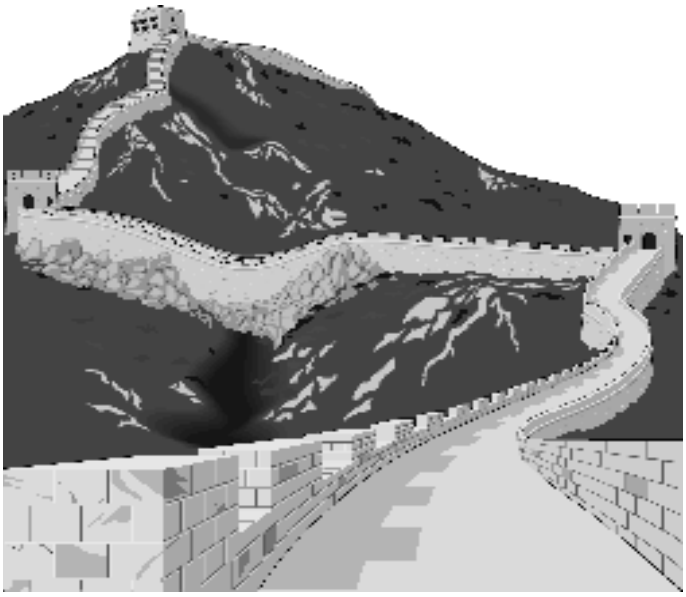

Great Wall of China.
This is a serious fence.

gate labeled “Lifetime Gate” to get to the doe in heat next door.

We utilize gates in our barn as well; usually of the steel mesh type, so the little ones don’t escape. We turn them upside down, so the large opening is on the bottom when they are a few days old, this allows all the kids to play in the center aisle without adult (goat) supervision. This year we had 58 kids playing in the aisle in the evenings.

Latches on gates can be a challenge with goats. They use their nose or lips to play with latches. Be warned!

There is a host of different fencing and fence materials available. Some are now even listed as “goat specific”. Check out some of the web sites at right and see what might work best for you.

It all depends on how much you want to spend!

“When I was younger I could squeeze through these bars.”
C. Katrine remembers the good old days.

Fences
The Good, the Bad and the Ugly

A well-braced gate and a tight woven-wire fence. Goats stay in; neighbors are happy.

Electric only—Good for horses and pretty good for goats, but don’t expect 100% containment.

Fine for cows, but won’t contain goats even on a good day.

17 Mistakes To Avoid With Electric Fencing
By Wayne Burleson

With 30 years of experience building hundreds of miles of smooth-wire electric fence, I've seen just about every fencing mistake possible. And I continue to see folks make many of the same common mistakes. I still make mistakes myself, because I'm constantly challenging myself to make fencing easier, faster, stronger, and safer.

High-tensile, smooth wire, electric fencing is the fastest and most affordable fence that I know about, and its technology has drastically improved over the past 10 years. But many folks are hesitant to use it because they remember old failures—wires breaking, chargers starting fires, wet vegetation shorting out the fence and other troubles.

With a little commitment and a modest investment in time to learn how to use this new technology, you can save thousands of dollars and hours of maintenance time by making electric fencing work for you. So you won't have to learn the hard way, here are 17 common mistakes that you should avoid:

Poor earth grounding. Lots of folks (including me) still think you can skimp when it comes to adequate earth grounding. What we must all learn to do, is install several ground rods—at least three that are 6 to 8 feet long, galvanized, and attached with good ground clamps. The electricity must complete a full circle back to the charger through the ground. Poor grounding gives weak shocks.

Using different types of metals. Don't do it. When you hook up steel wire to copper something called electrolysis happens and the metal becomes corroded, making a poor contact and weakening shocking power.

Inadequate animal training. Each and every animal must learn that the fence hurts. So please build a handy training fence, preferably on heavy wet soil. Flag the fence for visibility, and force the animal to try and cross the fence.

Fenceposts too close together. Well-intended government agencies recommend lots of fenceposts in their fencing specifications. Fifty-foot spacing on flat land is just too close. You want the fence to act like a rubber band. When something runs into the wire, you don't want to break all the insulators or knock posts out of the ground. If the posts are spread apart far enough—say 80 to 100 feet—the wire will just bend to the ground and pop back up.

Too many wire tie-offs. Again, fencing specifications may call for braces every quarter mile wire to tie the wire off. But I have found that even 5,000 feet is OK, and actually adds more elasticity in the fence wire. This reduces the chance of wires breaking.

Wires tied tight to each fencepost. To maintain elasticity (the rubber band effect), wires must float past each line fencepost.

Building new fences near old existing fences. Old fence wires seem to be always moving somewhere and coming in contact with the new electrified wires. This almost always causes a complete short in the fence, and away the animals go.

Bottom wire in contact with heavy, wet vegetation. Wet grass will suck lots of juice out of any fence charger. Hook up the lower wires separate from the other wires, and install a switch for the lower wires that you can turn off when the grass is tall.

Poor-quality insulators. Be careful here. Sunlight deteriorates plastic. So buy good-quality, long-lasting insulators. Usually black ones are treated to resist degradation by ultraviolet light. I have found that poor quality insulators turn white or clear after a few years in direct sunlight.

Staples driven in all the way. When using plastic tubing as an insulator, don't staple it too tight. I once spent several hours trying to find a short in a gate. Finally, I discovered a staple had damaged the tubing next to a ground wire, causing a hidden short.

Solar panels not directly facing the sun. This seems almost too obvious to be a problem. But a solar panel won't function at its potential if not properly installed. Please read the instructions. Don't just guess if you have done it right.

Kinks in high-tensile wire. A small kink in stiff wire will always break. Also avoid hitting this kind of wire with a hammer, as this will easily damage the wire causing a break. Always cut out a damaged section of high tensile wire and splice it. Incidentally, I have found that a hand-tied square knot makes the strongest splice.

Installing in-line strainers close together. Wires will flip together once in awhile. If in-line strainers are installed one above the other, they will sometimes hook up. Separate in-line strainers by a fencepost and they will never catch on each other.

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17 Mistakes
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Wires too close to each other. Keep them at least 5 inch apart.

No voltmeter. Without a voltage meter to check how hot a fence is, you're just guessing.

Wire too small. The larger the wire, the more electricity it will carry. Don't skimp.

Inadequate charger. A wimpy fence charger gives you a wimpy fence. Don't skimp here because animals will think a smooth wire fence is a joke without a strong bite, and they'll walk right through it.

Your fence charger should be low-impedance, come from a dependable supplier, and have a warranty and replaceable components. Please buy one that puts out lots of power. During a rainy year, you may have lots of plant growth touching the wires. That's when you will need extra power to shock through the heavy, wet vegetation. It's also handy to find folks with an extra charger they can loan to you while yours is being repaired. Expect some breakdowns, especially from lightning. Certain fence suppliers offer lightning protection with their warranties.

Don't be afraid to try electric smooth wire fencing. Find a good fence supplier and learn some of the tricks of the trade. I know folks who hate electric fencing. But their pocketbook is not big enough to build a conventional fence, which may cost up to $1 per foot.

The next time your bulls get in a fight with the neighbors bulls and tear down all the fence, remember that most animals will learn not to touch a wire with 5,000 volts running thorough it.

Wayne Burleson is a range management consultant from Absarokee, Montana, and the author of Rutbuster! which describes

Fencing with Power Point

The chart below is a slide in a Oregon State University Power Point presentation, without the attractive graphics and coloring of the original slide. We can't find a link to the original presentation on the web anymore, but here is some of the information included.

The presentation presents a brief overview of fencing comparisons and costs. Issues addressed include costs per mile of fencing components, various paddock designs, trouble shooting tips and required maintenance tools.

Some of the interesting tips and points presented are:

Fences are personal property, not real estate. They can be depreciated, because they do. Fences are never permanent.

Use quality materials and proper installation. If you don't have time and money to do it right, when will you have time and resources to do it over?

Electric fences are the most important innovation in livestock control in history.

Included in this presentation is the chart below which compares the conducting qualities, strength and life of various products used for electric fencing:

Conductor Comparisons

Material	Electrical Resistance Ohms / mile	Breaking Strength pounds	Expected Years of Life
Hi-Tensile Steel, 12 gauge	**64**	**2,000**	**30**
Maxi Shock Alloy	**129**	**160**	**10+**
Poly Twine	**193**	**185**	**5**
Premium Poly Tape	**193**	**200**	**3**
Turbo Polywire, 9-Strand	**209**	**200**	**8**
Super Wide Poly Tape	**253**	**680**	**10**
Poly Tape	**7,286**	**185**	**3**
6-Strand Plywire	**10,000**	**200**	**5**

Managed Grazing Systems and Fencing For Distribution of Beef Manure*

Donald Pfost, Agricultural Engineering Department, James Gerrish, Agronomy Department, Maurice Davis and Mark Kennedy, Natural Resources Conservation Service

Fencing

An appropriate design and type of fencing are required to control grazing and make efficient use of forage. In any pasture, livestock will graze the most palatable plants first, but without adequate control, will leave less palatable plants until later in the season or ignore them altogether. Managed grazing systems may be a fixed system with permanent fences and waterers or a flexible system with portable fences and waterers. Both portable and fixed systems generally have farm boundary fences with woven or barbed wire, or electrified, high-tensile smooth wire to ensure that all livestock are restrained on the farm and excluded from any cropland.

Fixed fencing systems

A typical fixed system may have interior divider fences and lane fences with one or more 12-1/2 gauge, high-tensile electrified wires for cattle, depending on the range of sizes of animals to be restrained. Two "hot" wires will usually suffice for restraining all sizes of cattle in lanes and paddocks (but not in lots or corrals). Small calves may not have to be confined to a certain paddock and be allowed to "graze ahead" where the cows are restrained by one hot wire. On shallow, rocky soils, a two-wire fence with one charged and one grounded may be required for consistent stock control. Advantages of the fixed system: minimum daily labor, low maintenance, and low cost per acre on large installations. Disadvantages: high cost per acre on small installations, and limited management flexibility.

Often, large areas with fixed fences will be subdivided into paddocks with portable fences that can be moved ahead daily, or less often, as the schedule dictates. Having a fixed, electrified fence along one or both ends of the area will provide the charge for the portable fence.

Flexible (portable) fencing systems

A typical portable fence system may use electrified tape or polywire on a reel for the interior divider fences supported on lightweight, step-in plastic posts. Tape shows up better to both cattle and deer but may have a shorter life than polywire since it flutters in the wind. Advantages of the portable system: high management flexibility, low cost per acre on small installations. Disadvantages: more labor, high maintenance.

Electric fences

Electric fences are the key to low-cost and effective fencing for managed grazing and other fencing applications:
Managing pasture and rotational grazing
Constructing temporary lanes
Protecting haystacks or other feed supplies
Extending the life of old line fences
Stopping animals from crowding fences
Adding safety to bull pen or pasture fences
Lowering the cost of feed lot fences
Salvaging of grain (and stover) left in the field

Electric Fence Energizers

In recent years there has been a proliferation of fence energizers (also called controllers or chargers) with increased capability, sophistication and cost. The better controllers can deliver a shock even under unfavorable conditions such as dry ground and with weeds or grass contacting the fence wire. Fence chargers are typically powered by 6- or 12-volt batteries, by solar power, or by mains (120 or 240 volt AC power). Heavy-duty batteries that are designed to withstand a deep discharge before recharging are recommended. Use the mains type of charger if power is available. These models have more capability to deliver the voltage and intensity of shock required under unfavorable conditions in addition to saving the cost of batteries and the inconvenience of checking on and changing batteries. Locate a mains-type charger where it will stay dry, be easily accessible for inspection and protected from livestock and small children. Do not use "homemade" chargers; they may, and often do, kill people and animals. Select a charger that is approved by Underwriters Laboratories (UL), or the U.S. Bureau of Standards. Solar-powered chargers are battery units with a solar panel to keep the battery charged (Figure 2). The larger

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Figure 2. Solar-powered fence energizers use a solar panel to charge a battery.

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battery units may discharge a deep cycle battery in a week. It will take about 7-10 watts of solar panel per joule output, depending on the amount of sunlight and panel orientation. A 10-watt solar panel may cost $100-$300.

Desirable features of chargers include the following:
Indicator to show sufficient input voltage.
Indicator to show correct charger operation.
Solar panel to charge a battery-type fence energizer.
Light or dial indicator showing when the fence is sufficiently charged.
High-low switch or separate output terminals for dry or normal conditions.
Easy mounting and moving capabilities.
Weather-tight case for chargers in remote locations.
Half-power option for battery-powered units.

Electrical Output
Check with the manufacturer to select a controller with output characteristics matched to the length of fence to be energized and expected operating conditions (including dry soil and shorting from weeds and grass). Older-style units (now known as high-impedance energizers) typically have an "on" time of 0.1 second or less, 45 to 60 times per minute, output voltages may be as high as 30,000 volts with currents in the 25 milliampere range. High impedance energizers are satisfactory for clean fences, but if shorted with green growth, the fence is essentially "dead."

A low-impedance energizer, sometimes called a New Zealand-type energizer, may operate at a lower voltage (2,000 to 3,000 volts and up to 6,000 volts on more powerful units) but can deliver a higher amperage (up to 30 to 40 amperes). This characteristic can result in a charged wire past the location of a partial short, such as from green vegetation touching the wire. The line is typically pulsed (energized) approximately every second for about 0.0003 second. The short pulse will not cause grass (or weed) fires. The pulse rate is adjustable on some battery-powered energizers (e.g., 65 pulses/minute (ppm) for fences frequented by deer or for training animals to 45 ppm for trained animals) to conserve the battery.

The required voltage to deliver a shock depends on such factors as ground moisture, wire size, total length of wire, amount of vegetation contacting the wire, and length of hair on the animals being fenced. The "guard voltage" is the voltage present at any point on the fence where an animal may contact it. A minimum guard voltage of 2,000 usually suffices for cattle. Up to 4,000 volts on all portions of the fence may be required for extremely dry conditions or for well-insulated animals such as sheep. Line voltage to ground should be checked with an appropriate voltmeter.

Charger Ratings
Some chargers are rated in miles of fence or in acres. A better rating is in miles of wire under stated conditions, such as resistance to ground. Many chargers are now rated in volts and amperes of output under various resistances (e.g., 100, 500, 5,000 and 50,000 ohms). A common rating is in joules, an energy unit that is a function of voltage, amperage and pulse time (the water analogy would be pressure, flow rate and time). However, a high joule rating may result from a long pulse time rather that a high voltage or amperage rating. One joule is equal to one watt for one second in the British system. As a rough rule of thumb, allow one mile of fence per joule rating of the charger, depending on the quality of the insulators and the grass/weed load on the wires (e.g., a 6 joule charger would energize 6 miles of fence). Manufacturers usually claim up to 6 miles of fence per joule under ideal conditions.

Costs for chargers range from as low as $100 for a typical 1 joule battery-powered charger to $750 for a 240 volt input, 28 joule output charger. Buy a charger with excess capacity to allow for future expansion or buy one or more additional chargers and divide the fence into zones, but do not connect two chargers to one zone.

Grounding
Most electric fences depend on the ground to carry the current that passes through the animal back to the charger and should have very low resistance to ground, preferably as low as 10-25 ohms. Some fences, especially for extremely dry soil conditions, may have alternate wires grounded so that an animal will touch both a hot wire and a grounded wire. The grounded wire(s) will be direct connected to the ground terminal on the charger and should also be grounded with rods to divert lightning from the charger. Follow the operator's manual for grounding the energizer. A rule of thumb is to have 3 feet of ground rod per joule of energizer output. Ground rods may be 1/2 inch or larger diameter rods (copper, copper-bonded, or galvanized steel), or 3/4

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inch or larger galvanized pipe, and usually 6 or 8 feet long. Typically, for the larger energizers, three or four ground rods spaced 10 feet or more apart are connected to each other and to the ground terminal on the energizer with a continuous wire of 12-1/2 gauge or larger. The ground rod wire and clamps should be of a material that will not cause corrosion. If possible, locate the ground rods in an area with moist earth, such as on the north side of a building near the drip line of a roof. Do not ground to the service entrance ground. The ground rods should be at least 30 feet from other grounds and from underground metal pipes. In rocky soils, ground rods may have to be laid in a trench. It is critical that these rods be located in a moist area or kept moist.

Lightning and Surge Protection
High-line (mains-type) energizers should be plugged into a surge protector. On the output side, an induction coil, typically consisting of 8-10 turns of heavily insulated wire taped together in a coil 10-12 inches in diameter located at least 20 feet from the energizer, will serve as a lightning brake (choke). A lightning diverter (arrester) located where the lead-out wire joins the fence and other diverters at the far end of the fence and at high spots along the fence, will divert lightning charges to ground. The diverters should each be as well grounded as the charger. For further protection, a switch between the diverter and the choke can be opened when a storm approaches (it usually takes a while for livestock to discover an electric fence is turned off).

Wire
High-tensile Wire
Twelve and one-half gauge smooth high-tensile wire (typically rated at 180,000 to 200,000 psi strength) is commonly used for the permanent portion of electric fences. The galvanized coating is usually Class 3, which is three times as thick as the Class 1 coating on ordinary barbwire. High-tensile wire can be easily unrolled by using a reel called a "spinning jenny." This wire may be spliced by using a figure eight knot but easier and better by using two crimped sleeves.

Wire Spacing
The number and spacing of wires in an electric fence depend on the kind of animals to be constrained.

Wire Tighteners (Strainers)
Each high-tensile fence wire should have an in-line tightener in each 1/4 mile of straight run to adjust tension. Each strainer consists of a reel to take up the excess length and a locking mechanism. Some form of a lever must be used to rotate the reel. In short stretches and around lots and other "pressure regions," a tension spring may be needed (Figure 3).

Polywire and Polytape
For short-term grazing (strip grazing), polywire and polytape are lightweight and easily moved and hand stretched. Polywire looks like colorful polyethylene binder twine laced with several strands (usually 3, 6 or 9 strands) of wire to carry the electrical current. Polywire with 6 or 9 strands of stainless steel wire is most common and can be used for longer runs without excessive voltage drop. Due to the high resistance of these conductors, they are usually used for short runs of less than 2,000 feet. Polywire is easily spliced by tying a knot. Knots in polytape may not make good wire contact. Commercial splice buckles are available, or a 7/16-inch lock washer may be used as a connector.

The polytape shows up better to animals than the polywire Both types of conductors are usually handled on reels that can be easily carried in one hand while being reeled in or out.

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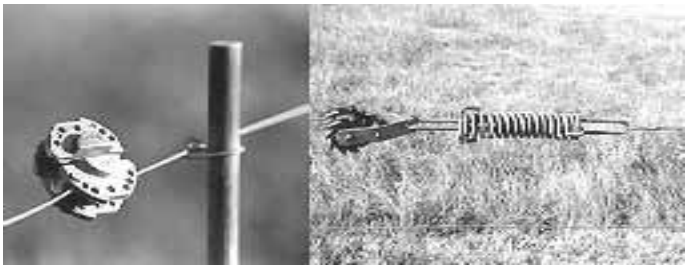

Figure 3. In-line tighteners for high-tensile wire fences. They include a locking mechanism and (on right) a tension spring.

Figure 5. Geared reels for polytape or polywire allow easy installation of temporary electric fences in paddocks.

Reels

The reels are usually locked and hung on a high-tensile boundary wire until the next move. Capacities vary from 300' to 1,320' of polytape and from 660' to 2,640' of polywire. To minimize the electrical resistance and the reel weight, the length of the conductor on the reel should be not be greatly longer than necessary. Two types of locking systems are used, the cog and lever system (positive) and the friction washer type (non-positive). A geared-up reel that has a 3:1 ratio can save time when rewinding of the tape or wire (Figure 5).

Posts

A variety of plastic posts are available. Small plastic step-in posts with several molded-on wire/tape clips are commonly used for strip grazing, the highest clip being about 3 feet above the ground (Figure 6, next page). New and used fiberglass sucker rods in a variety of sizes from 3/8", 1/2", 5/8" and larger are used for posts without insulators. Wire spring clips are used to attach the tape or wire to the small posts (Figure 6); holes are drilled in the larger posts to support the wires. Common wood posts and steel posts are used with insulators for more permanent electric fences. Certain types of imported wood posts are used without insulators. Well-seasoned hedge (osage orange) posts may be used without insulators if prolonged wet conditions do not seriously reduce the guard voltage. Line posts on level or uniformly sloping ground can be spaced up to 100 feet apart. Spacings of 40 to 60 feet are more common on rolling Missouri land. For corners and ends of high-tensile fences, 8-foot wood posts with tops at least 5-6 inches in diameter should be set 4 feet into the ground and provided with adequate H-bracing. Floating braces are excellent for multiwire fences and are lower-cost and easier to construct than H-braces, especially in rocky soils.

Insulators

For permanent electric fencing, select only UV stabilized high-density polyethylene or polypropylene insulators for use on steel posts or conventional wood posts (ones that will seldom be knocked off by deer). Steel posts should be kept to a minimum to avoid potential shorts when insulators break or deteriorate. High-quality insulators for corners and ends are especially critical (Figure 7).

These can be the wrap-around tube-type insulators or double-U or double-hole terminal insulators. Porcelain insulators will work if they are of good quality. Many "farm store" insulators may crack under the strain from hi-tensile

Figure 6. These posts do not require insulators. (Left) Plastic fence post with molded-on wire/tape clips. (Right) Fiberglass rod with wire clips.

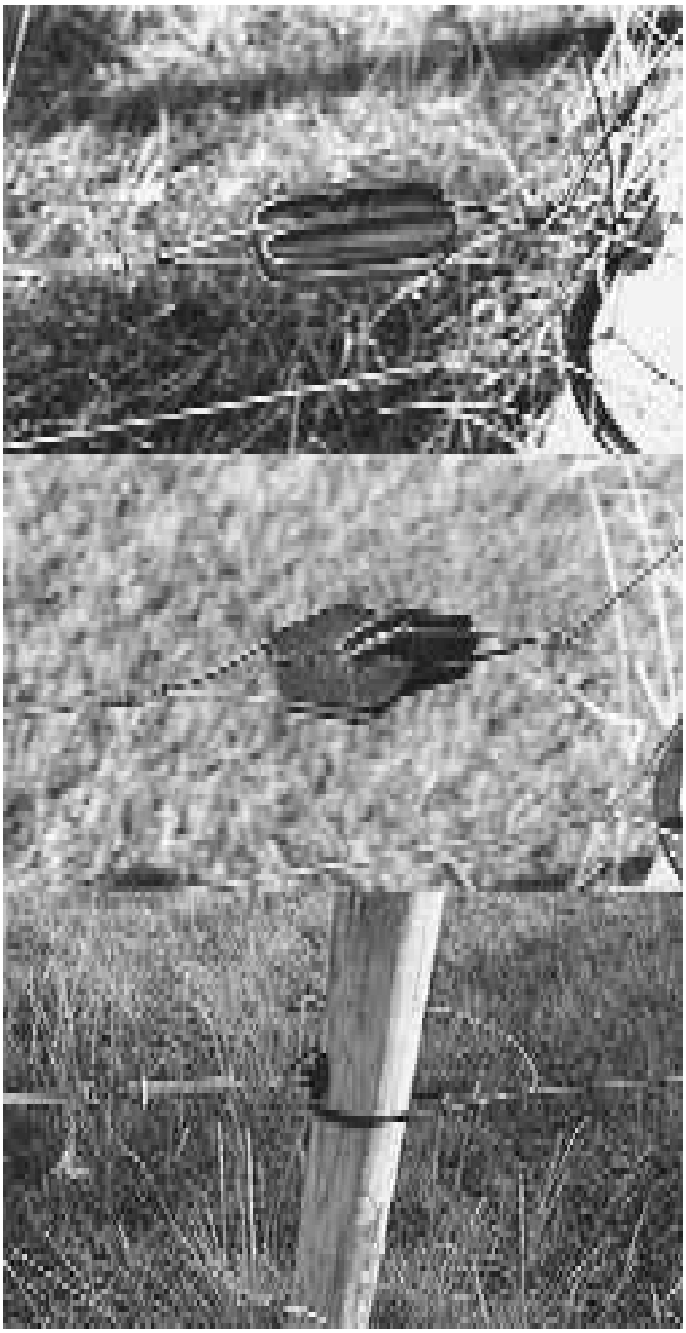

Figure 7. Three types of insulators for corners and ends of high-tensile wire fences. (Top) Ceramic. (Middle) Polyethylene or polypropylene. (Bottom) Wrap-around tube-type insulator.

Designing a Fence
Tips for Small Acreages in Oregon

Fact Sheet from the Washington County Soil and Water Conservation District and the Small Acreage Steering Committee (SWCD). The Governor's Watershed Enhancement Board, the Oregon Association of Conservation Districts, and the USDA Natural Resources Conservation Service funded the product.

"Good fences make good neighbors." (American proverb)

A Strong Fence Equals Peace of Mind
Fencing can be the third highest investment, after buildings and property. Yet it's comforting to know where your animals are and that they will be there when you come back. Fences control animal movement, define property boundaries, and increase property value. However, fences can also create new problems. Consider how a planned fence may harm wildlife, limit equipment access, harbor weeds, and affect adjoining neighbors. Read on to find out about fence types, layout, and safety for you, your animals, and wildlife.

What Type of Animals are You Keeping In or Out?
The kind of fence you choose will depend on your resources and the animals you are controlling:

Certain animals require strong fences. Coyotes and young cattle require a stronger fence than sheep or goats. Sheep with heavy coats need multiple wires to hold them. Pigs need low wires to keep them from rooting out. Dairy cows need less of a fence. Animal groups with mixed sizes may need a higher or lower height with closer wire spacing.

Horses and llamas have special needs. Horses are fast, physical animals that see small items poorly and need tall, highly visible fencing. A startled horse can run into a single wire and be severely injured. Llamas will not challenge a fence as much, but have large, protruding eyes that can be injured by sharp points. For these reasons, barbed wire should never be used with horses or llamas.

Wildlife may be injured or killed by barbed or woven wire. Smooth wire is safer for wildlife than barbed or woven wire. Space smooth wire at 16, 22, 28, and 40 inches from the ground to allow antelope, deer, and elk to get through with reduced damage to themselves and the fence. The 12-inch gap between the top two wires keeps animals from getting tangled in the wires. Determine whether this wire spacing will hold your livestock.

A high number of animals in a small area will need a stronger fence. Permanent, wooden fences are often used for corrals and barnyards. Temporary electric fences, with two to three wires, are effective in larger areas such as pastures.

The stronger the temptation on the other side of the fence, the stronger the fence needs to be. Strong fences are needed to separate cows from weaning calves, intact males from breeding females, and hungry animals from lush crops.

Fence Laws in Your Community
Fences keep animals off roads and out of crops. On designated "open range," the property owner is responsible for fencing neighboring livestock out. On designated "closed range," the livestock owner is responsible for fencing livestock in and will be liable for loose animals that damage crops, cars, or people. Contact the Oregon Department of Agriculture at (503) 986-4681 to find out the range designation in your area.

When installing a new fence, maintain good neighbor relations by surveying your property lines and installing a legal fence. Some local ordinances may require permits, prohibit fence chargers, and specify fence types, heights, and setbacks next to roadways, railways, and between neighbors. Contact your local building official for more information.

Designing Paddock Fencing
Your property is unique and will require a fence layout that fits your resources, animals, and site conditions. Here are some key points:

a) Paddock location. Never locate a paddock over the septic system. The drainfield needs uncompacted soil and vigorous grass to work properly. Locating paddocks on the south, east, or west sides of buildings will dry out paddocks quicker than those located on the north sides.

b) Paddock shape. The more square, the better. Livestock will group near the gate in a long, narrow paddock. The result is uneven grazing. Temporary electric wires can shorten up long fields. However, when space is limited, long paddocks make better exercise areas for horses.

c) Paddock position on slopes. Run paddocks across slope. If paddocks run up and down a hill with water at bottom, animals will tend to undergraze the top half and overgraze the bottom. If bottomlands are wet, livestock will tear up the sod. Instead, separate hilltops from valleys and run paddocks across the slope.

Continued on next page

Designing a Fence
Continued from previous page

d) Gate location. Put the gate in the paddock corner nearest the barn. Here's what happens when gates are placed in the corner away from the barn: animals see the herd heading down the lane, head for the ungated corner, and mill around.

e) Lanes. Short and narrow lanes will leave more room for growing forage. A 12-foot wide lane will serve a herd of 35 cattle or 350 sheep. An 18 to 24-foot wide lane serves larger herds. Locate lanes in dry areas and install the lane using a gravel layer over geotextile fabric.

f) Stockwater location. Locate watering sites away from ditches, streams, and ponds. Watering sites often concentrate livestock, manure, and mud. Livestock will graze more evenly and trample less forage if water is provided in each paddock. For an inexpensive and portable stock tank: cut a 55-gallon, plastic barrel in half and outfit it with a water float and garden hose. See the fact sheet Managing Stockwater in Pastures and Streamside Areas in this series, for more details on providing stockwater.

Designing Near Stream Fencing
Animals wade in streams for water, shade, and fly relief. However, livestock can contract hoof rot and water-borne diseases, trample wildlife habitat, destabilize streambanks, and cause water pollution. A fence creates a buffer between the land and open water with many benefits. Keep these tips in mind when designing a near stream fence:

a) Fence location. The wider the buffer, the greater the benefits will be for cleaner water, wildlife habitat, and reduced streambank erosion. Place the fence as far from the stream as possible. Fences placed closer than ten feet will bring few benefits and are more likely to be damaged from floods. Cost-share programs will require a generous buffer. See the fact sheet Managing Near Streamside Areas with Buffers in this series, for more information on designing buffers.

b) Fence type. Fencing areas that are frequently flooded can be a challenge. The most economical option is to install a temporary one-strand or permanent high tensile electric fence. Don't use woven wire fence that is more likely to trap debris, injure wildlife, and be damaged in a flood.

c) Fence features. When you install electric fence in a frequently flooded area, include line switches. The switches allow you to shut off power to wires until floodwaters recede. Use pinlock insulators to reduce trash collection on wires and damage during floods. The insulators allow you to place wire on top of posts or to drop wire to the ground. Mow grass under electric fences, as needed.

d) Riparian pastures. In some situations, a near stream or riparian pasture may be created to control weeds and produce forage. Work with a grazing professional to successfully carry out this special practice.

Shocking Facts about Electric Fencing
An electric fence creates a fear barrier rather than a physical one for animals. Electric fences are often used in permanent high-tensile fences along the perimeter and as temporary single or double strand fences to divide pastures. Points to keep in mind about electric fences include:

The main components are posts, wires, and insulators. Accessories include the charger and grounding rods. New Zealand chargers are more efficient with less fire danger than "zapper" chargers. The fence creates an electric circuit that runs from the energizer, over the wires, through moist ground and returns to the grounding rods. In this example, the wet earth is half the circuit. Sandy or dry soils don't conduct electricity very well. In these areas, a grounded return wire may be needed to close the circuit. Anything touching the wire can drain the charge to the ground and decrease the shocking power of the fence. Electric fences need to be inspected periodically to remove grasses and tree limbs that are touching the wires. Animals need to be trained to respect electric fences. A single wire inside a small pen will quickly teach animals. Horses monitor fence current and need a fence that is continuously charged.

Fencing – Key Parts
End Posts – Wire fences can exert up to 4000 pounds of pressure on posts located at the end of a fence line. End posts need to be braced, made of steel or stout wood, and buried deeply to withstand this kind of pressure. Bury posts with half the post length above ground and half below ground. If setting posts by hand, return in a month to tamp settled soil. Driven posts are up to five times stronger than if hand set.

Brace Posts – The brace post (H-brace) is the anchor that provides the strength to end posts. Brace posts are needed at the ends, corners, and on long runs on all fences, except wood rail and plastic types. A double brace (HH-brace) assembly will take wire pull in both directions.

Line Posts – Line posts are used to withstand animal pressure and maintain wire spacing. They may be made out of wood, steel, plastic or fiberglass.

Continued on page 28

Designing a Fence
Continued from page 21

Gates – Gates should be sturdy and at least 16-feet wide for field equipment and lime, hay, or gravel trucks. Provide a people entry gate next to the main one to discourage fence climbing. For horses, consider secure latches that are "horse proof," but are easy to reach from horseback.

Safe Fences For You:
Locate underground and overhead utilities before installing a fence. Call the Oregon Utility Notification Center at (800) 332-2344, to make sure there are no gas, water, or electric lines where you plan to dig postholes. Wear heavy leather gloves and eye protection when installing a fence. Wear a dust mask and hearing protection when sawing or driving treated wood posts. Never install electric fences under power lines. Notify neighbors, visitors, and small children about electric fences and instruct others on disconnecting the energizer in an emergency. Post warning signs on electric boundary fences as required by law.

Safe Fences For Livestock:
Avoid sharp edges on gates, fences, and chutes that can cause injuries. Signs of hazardous fencing are shiny skin or bruises found under hair tufts. Sharp edges are found on nails, bolt ends, exposed pipe ends, and the tops of metal T-posts. Pipes with diameters larger than 3 inches are less likely to injure animals. Equip gates with tiebacks to prevent gates from swinging into alleys and catching animals between gate end and fence. Horses and llamas are inquisitive and will injure themselves on a poorly designed fence. Horses can get their legs caught between brace posts and fence wire. Block off this space or run woven fabric on the occupied side of the fence. Ask your fence dealer for more information on protecting these animals.

For More Information:
Local farm supply store or fence material catalogs may have details on installing a fence. Fence contractors install fences. Look in the yellow pages in the phone book under "Fences." Get several bids and check references.

The local soil and water conservation district (SWCD), USDA-Natural Resources Conservation Service (NRCS), and local watershed council may provide on-site technical advice and cost-share funding for fences that manage pastures and protect near stream areas. Contact your local SWCD, NRCS, and watershed council offices for details. Or-

Comparison of Fence Types, Features and Costs

Fence Type	Features	Initital Cost and Maintenance
Wood Plank	High strength, visibility Attractive, often used for horses or cattle near buildings Use offset electric wire to prevent horses from chewing on wood	Expensive High upkeep for wood and paint
Woven Wire	High strength, visibility, available in different mesh sizes Add top board or wire for tall animals, add electric wires for sheep and goats with horns Unsafe for wildlife, consider using only in small areas close to buildings	Expensive Moderate upkeep
Plastic	Moderate strength, not for cattle Safe for horses and llamas	Expensive Low upkeep, no painting
High-tensile Electric	High strength, lower visibility Used for wide variety of animals Cost-effective compared to others	Moderate Moderate upkeep to retighten wire and cut back vegetation
Barbed Wire	High strength, low visibility Never electrify barbed wire Unsafe for horses, llamas, and wildlife	Moderate Low upkeep to retighten wire
Electric Wire	Psychological not physical barrier, animals need to be trained to respect wire Low visibility, electric "tape" may help visibility Permanent or temporary fence. Ideal for subdividing fields into smaller paddocks for pasture management.	Inexpensive Moderate upkeep to retighten wire and cut back vegetation

Fences: We don't build them like this any more (sigh...)

"Fence built on contour between pasture and strip cropped fields which affords more uniform strips and row crop cultivation." Caption from photograph no. Va-30229 taken in Albemarle, Virginia, by I. W. Cousins, September 21, 1938
Series VII.1, Photographs, Box 7.1/4, file "II. Photographs—Fences," USDA History Collection, Special Collections, National Agricultural Library.

A few strands of sagging barbed wire—You may think this is called an old fence. Actually, it's called an exit for goats.