

Fencing FACTSHEET



Order No. 307.100-2
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FENCE WIRE

Dispensing, Stapling, Joining, Tying, Tensioning, and Grounding

This Factsheet outlines handling information for barbed wire, high tensile smooth wire (htsw) and woven wire.

DISPENSING WIRE

Fence wire must be dispensed or played out in a uniform manner that does not damage the wire or its galvanized coating. Wire can either be pulled off a stationary roll or the wire tied to an end post and unrolled along the fence line. The choice depends on the packaging of the wire (loose roll or drum roll), the type of wire and the equipment available.

Dispensing Barbed Wire

Standard barbed wire is sold in rolls on a wire drum. The wire should be rolled off this drum in the same manner it was packaged, by rotating the drum. Do not loop the wire off the side of the drum as it may kink and weaken.

By inserting a rod through the drum, it can be mounted (on a tractor 3 point hitch or pickup truck box) to rotate as the wire is pulled off. Alternatively, two people can carry the rod/drum along the fence line unrolling wire as they proceed. Due to the nature of barbed wire, it tangles very easily. Each strand should be installed on the posts before the next one is played out.

Dispensing HTSW

High tensile smooth fencing wire has been available in two types of packages, loose roll and drum roll. As with barbed wire this wire must be dispensed by rotating the roll not by pulling loops off the side of the roll. This is very important with htsw as it is subject to breakage if kinked.

The loose roll package is not commonly produced because it is less convenient to dispense than the drum roll. Whereas the drum roll only requires a rod inserted through the drum to dispense, the loose roll required a special tool called a "spinning jenny". The drum roll package is now standard in B.C. As with barbed wire, the drum roll can be either set stationary or rolled out along the fence. However, because htsw has no barbs it does not tangle as readily and more than one strand can be dispensed at one time. By dispensing all wires in one pass along the fence line considerable construction time is saved. Refer to Factsheet 307.600-1 *Wire Fence Construction*.

Dispensing Woven Wire

A standard woven wire roll is 330 feet that may weigh from 150 to 400 lb and is not carried by hand. The roll can either be laid on the ground and rolled out (terrain and vegetation permitting) or mounted horizontally or vertically on a tractor for dispensing. Farm-made devices that mount on a tractor 3 point hitch work well. Two rolls (660 ft) should be the maximum length dispensed per fence section to allow for proper tensioning. Longer sections are difficult to handle and tension correctly.

Special Equipment

Wire unrollers and retrieval equipment may be used to aid in construction and recovery of any type of fence wire. Units are available that are tractor mounted and powered or that are truck mounted and electrically powered. Capacities of 500 feet of fence wire per minute are advertised.

STAPLING WIRE

Attaching the fence wire to posts is an important aspect in fence construction. How the wire is stapled onto posts may determine the success of the fence.

Types of Staples

The common fence staple is slash pointed (the point is not centered like a nail point) so it will provide pullout resistance as it enters the post (see discussion below). Where greater resistance is required, a “barbed” staple is available which has a small cut in each leg forming a projecting barb. This barb acts like a fishhook; it will easily enter the post but grips the post if pulled out.

The table below gives the number per pound and per box of standard fence staples.

Fence Staples: Numbers per Pound and per Box

Staple Size (9 ga)	Number per Pound	Approx. Number per 50-lb Box
1½ in	72	3600
1¾ in	61	3050
2 in	58	2900

Stapling Wire. Except when stapling at tie off points, **fence wire should always be stapled loose** as shown in Figure 1, below. To allow for the reduced staple length that can be driven into the post, use a minimum staple size of 9 ga x 1-3/4 in. (preferably 2 in.). Staple cost per mile of fence is very low even when using these larger sizes. Choose hot-dip galvanized (rough surface) over bright, ungalvanized staples for extra life and pull out resistance. By stapling the wire loosely, lateral movement of the wire is permitted. This spreads fence loads over a greater length of wire. In barbed wire fences, stapling loose is preferred but it may have only limited benefit, as the barbs will catch on the staples at some posts. Woven wire fences have limited movement due to the nature of the fabric.

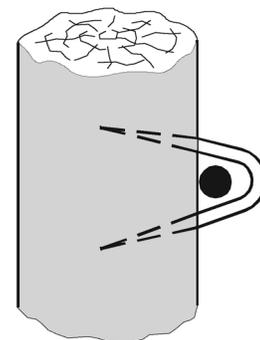


Figure 1 Loose Stapling of Fence Wire

In htsw fences, the wire is free to move from end brace to end brace, transferring fence loads from the entire fence section to the end braces. This allows the elasticity of up to 1320 feet of htsw (versus 30 or 40 feet of barbed wire) to absorb windfall trees, livestock pressure, etc. Note that because of this load transfer, htsw fences require good end brace construction - refer to Factsheets 307.220-1 *Brace Assemblies for Wire Fences - What They Are, How They Work, How to Construct Them* and 307.220-2 *Brace Assemblies for Wire Fences – End, Inline and Change of Direction Braces*.

Wires should be held against the post by the worker when stapling. The staple should not be used to pull the wire to the post. Hitting the wire with the hammer during “misses” will chip off the zinc coating and shorten the wire life.

Positioning Staples

How a staple is positioned on the post before being driven in is a small but important detail often overlooked. Anyone who has a tin of used staples recovered from an old fence will have seen that some staples have their “legs” crossed while others have their “legs” spread open. It’s obvious the staple that spreads out into the post has greater pull out resistance than the one that crosses over on itself (tests indicate 40% increase). How can you ensure this spreading occurs?

Staples are formed with off-centre pointed ends called slash-cut points. Whereas a center pointed nail can be driven straight, slash-cut staples are **expected** to curve as they enter the post, and they **always** curve away from the slash-cut or flat face.

It is well known that a staple should not be driven in parallel to the wood grain (to avoid splitting) but should be turned slightly. Because of the curving nature of the staple legs as they enter the post, **always turn the staple away from the slash-cut** to ensure the staple legs will spread apart providing maximum pullout resistance. Because all staples in a box are made the same this soon becomes second nature. In fact, most staples seem to be made with the same slash point and will be turned slightly clockwise as shown in Figure 2, below.

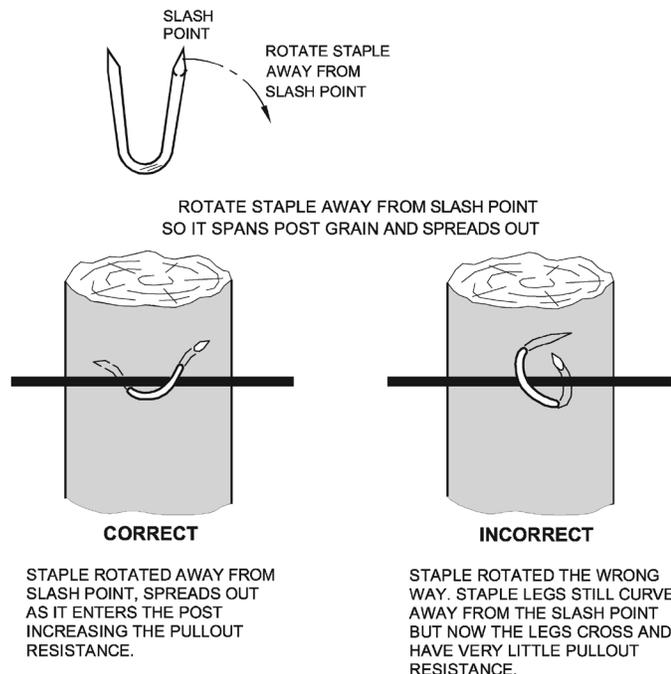


Figure 2 Positioning Staples for Maximum Pullout Resistance

Special Stapling Situations

Whenever the fence wire changes direction at a post (rise, dip or corners) special stapling methods are used. The following points are illustrated in Figure 3, below:

- At rise posts - there is downward wire pressure; angle the staple downward into the post; double staple on steep rises.
- At dip posts - there is upward wire pressure; angle the staple upward into the post; double staple on steep dips.
- At shallow corner posts - there is some friction between post and wire; use a single staple with one slider staple.
- At sharp corner posts; there is significant friction between post and wire; use two staples with two slider staples.

Note that there is a “non-staple” option for htsw fences that are short or those with high pressure on both sides - the line posts may be drilled and the wire threaded through without any stapling required.

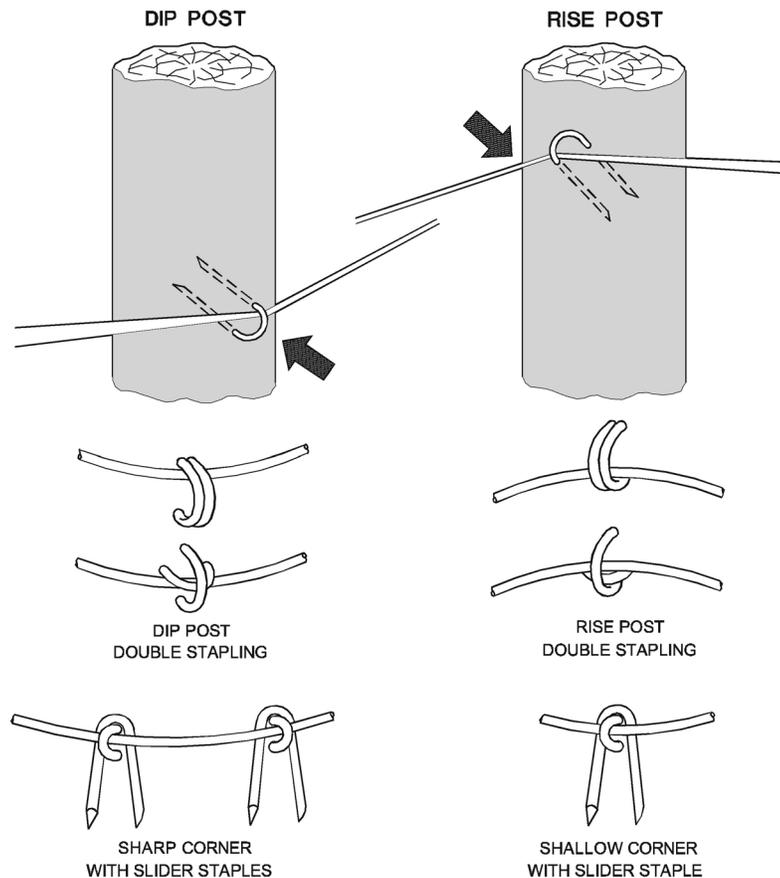


Figure 3 Special Stapling Methods

JOINING AND TYING WIRE

Wire connecting and tying off wire at the end of runs is done using methods dependent on the type of wire. The main differences are between soft, low tensile wire and the more brittle, high tensile wire.

Whenever a knot is used in any wire, the breaking strength of the wire is reduced, or put more simply, **no knot is as strong as the wire it joins**. Only some mechanical splices offer 100% of wire strength.

Tie-Off Rule

The distance between tie-off points for wire fences varies by the type of wire:

Barbed wire - 660 feet - limited due to the barbs catching on posts.

High tensile smooth wire - 1320 feet - longer than other wires due to its elasticity.

Woven wire - 660 feet - limited due to handling difficulties on longer lengths.

Barbed Wire - Joining and Tying Off

The low tensile wire most commonly used in barbed wire can tolerate joints and tie offs made by knotting the wire. These do not vary sufficiently to justify a recommendation for a particular knot. Ease of tying becomes the deciding factor. The knots in Figure 4, below, are commonly used to join and tie off barbed wire and are effective to approximately 80% of the breaking strength of the wire. The “Gripple” mechanical splice (bottom photo) provides 100% of wire strength. Note that the barbed wire cannot pass through the Gripple.



Figure 4 Knots and Mechanical Splice for Barbed Wire

HTSW - Joining and Tying Off with Knots

Knots are not generally recommended for the brittle high tensile wire. However, the wire can be tied off using an end post knot (for 1100 lb or 80% of wire strength) and joined using the figure 8 knot (for 1200 lb or 89% of wire strength) as shown in Figure 5, below. Because of this loss of wire strength and the difficulty in knotting htsw, mechanical splices are generally recommended.

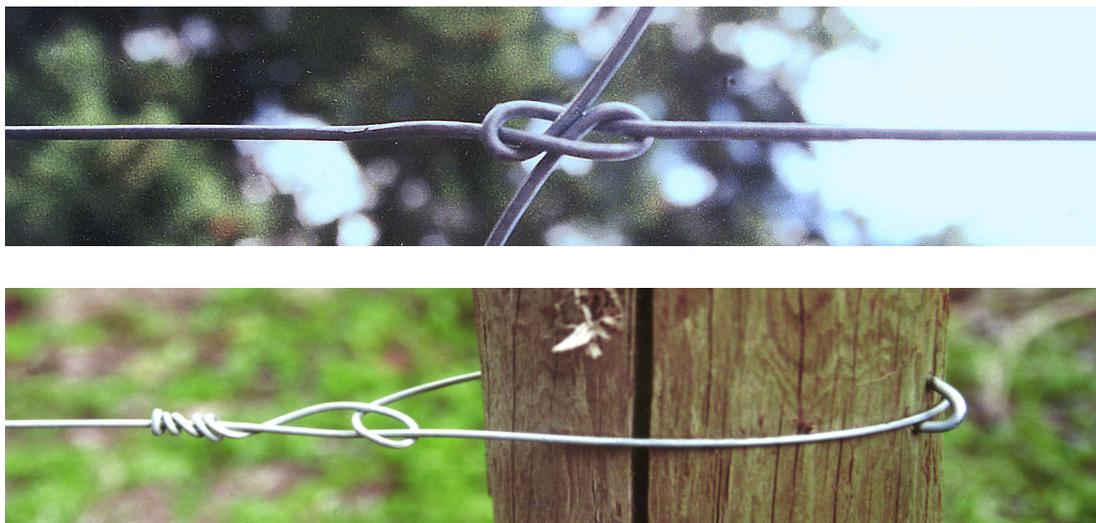


Figure 5 Knots for High Tensile Smooth Wire

HTSW - Joining and Tying Off With Mechanical Splices

To maximize the benefits of this stronger wire, several mechanical splices are available that produce a connection with 100% of the wire strength. Use a splice that is specifically designed for high tensile galvanized steel fence wire.

Four commonly used, commercially available splices are shown in Figure 6, page 7. These mechanical splices all cost more than knots (and some require special tools) but have the advantages of full wire strength, ease of installation and most leave no long “stray” wire ends as do knots. Two types also can be used as wire tensioners.

Nicopress. This is a sleeve that slides on to the two wire ends and is compressed with a special tool. Two sleeves are required for a tie off and three for an inline splice. Use sleeve #FW-2-3 for 12 1/2 gauge high tensile fence wire.

Wirevice/Wirelink. This is a device with spring loaded tapered jaws that allow the wire to slide in one direction but grip it when pulled in the opposite direction. Wirelink has two sets of jaws and is used for an inline splice. Wirevice has one set of jaws and is set in the end post for tie offs. It can be used to tension the wire.

Gripple. Similar to Wirelink but reusable as the wire can pass through the jaws. A special tool allows wire tensioning through the Gripple. A model is available for barbed wire; see Figure 4.

Vineline. This is a one foot long spiral wire that is twisted onto the fence wire. It has a gritty inner surface. One vineline splice is used for a tie off, two (one wrapped over the other) are used for an inline splice, as shown in bottom photo of Figure 6.

Nicopress



Wirelink



Gripple



**Vineline
(partially installed)**



Wirevice



Figure 6 Mechanical Splices for High Tensile Smooth Wire

Woven Wire - Joining and Tying Off

Woven wire is manufactured using both low and high tensile wire so connections can be made using the previously discussed knots and splices. The two commonly used methods are shown in Figure 7, below. If possible the twist-wrap joint should be made where the two verticals meet. End post tie offs will require the removal of several of the last vertical wires (to provide sufficient tie wire) then knotted as in Figure 5, page 6.



Figure 7 Woven Wire Connections: Nicopress sleeves (left) and Twist Wrap Knot (right)

TENSIONING WIRES

There are numerous tools available for stretching or tightening fence wire. Some common ones are the corner-post, in-the-crank, walk-along, tree-and-post, gripchain-walking and rope-and-pulley stretcher. Approximately the same tension (250 lb) is required for all nonelectric wire fences. The tension used on electric fence wires is one-half of this (125 lb) or just more than “hand tight.”

If tensioning is done when the air temperature is approximately half way between the maximum and minimum encountered, it will reduce the effects that temperature variation has on wire tension. But as discussed in Factsheet 307.100-1 *Commonly Used Wire for Agricultural Fences*, the increased tension due to temperature changes is not a major concern.

Tensioning Barbed Wire

New, two strand barbed wire requires pretensioning (refer to Factsheet 307.100-1 *Commonly Used Wire for Agricultural Fences*). It should be stretched up to an initial 600 lb to pull the two strands tightly together and to “set” the barbs between the line wires. The wire is then relaxed to approximately 250 lb of tension. As barbs have a tendency to “hang up” on the staples, it is important that barbed wire be tensioned before it is stapled to the posts.

Tensioning H T S W

This wire is tensioned to 250 lb; tension levels above this are difficult to maintain and serve no useful purpose. Permanent inline wire tensioners are available to tension the wire. They remain on the fence wire and are available for future maintenance tensioning.

Permanent wire tensioners should be placed in the middle of the strain for maximum benefit. For level terrain this would be the center of the fence section. In fence sections where several corners or dips and rises occur (more resistance to wire movement) the tensioners should be closer to the resistance points.

There are several inline tensioners available, divided into two basic designs. Both types use removable handles to operate the tensioner and have pins to secure the tensioner from unwinding. One type requires the wire to be cut and the tensioner is spliced in; refer to Figure 8, below. The disadvantage of the splice-in type is the extra effort required to make the attachment to the fence wire. Also, there is a tendency to place this type of tensioner at the end of a fence section (at the tie off post) which is not usually the preferred location (i.e., which is near the middle of the strain).



Figure 8 Splice-In Tensioner for High Tensile Smooth Wire

The second type is placed over the wire (the fence wire is not cut). Drum or half drum designs have a slot to allow easy attachment at any place along the fence wire; refer to Figure 9, below. Note also that two types of splices (Wirevice and Gripple) may be used for tensioning htsw (refer to Figure 6, page 7).

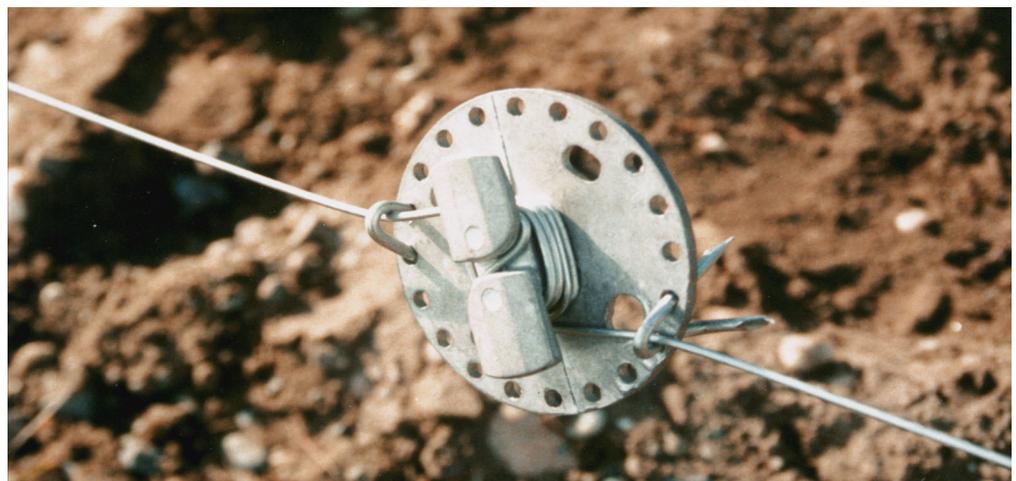


Figure 9 Slotted Drum Tensioner for High Tensile Smooth Wire

Tensioning Woven Wire

The horizontal strands of woven wire are produced with waves or “tension curves” every six inches or so. When woven wire is tensioned, up to one-half of this curve is removed, leaving enough “tension curve” to allow the wire to absorb fence loads. Refer to Figure 10, below.

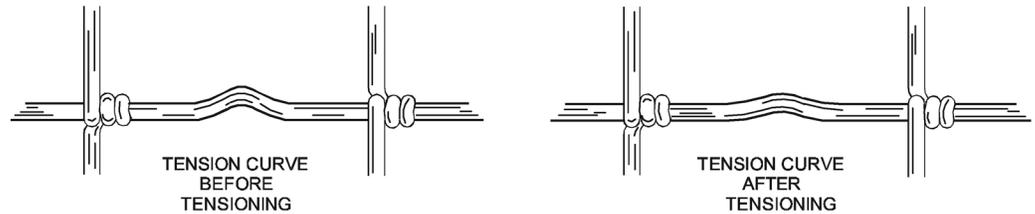


Figure 10 Tension Curve in Woven Wire

Woven wire is tensioned in the upright position. Figure 11, below, illustrates how this wire can be tensioned from one end. To apply tension equally to all line wires, a straining clamp must be used. A typical homemade clamp consists of two hardwood boards (which contact the woven wire) and steel reinforcing to withstand the tensioning load. The straining clamp is pulled using a come-a-long that is suitably anchored, i.e. to a tractor or truck. While a very low “crawl” gear tractor can be used instead of the come-a-long, it is not recommended due to the possibility of over tensioning the wire and the danger to the operator should the wire break.

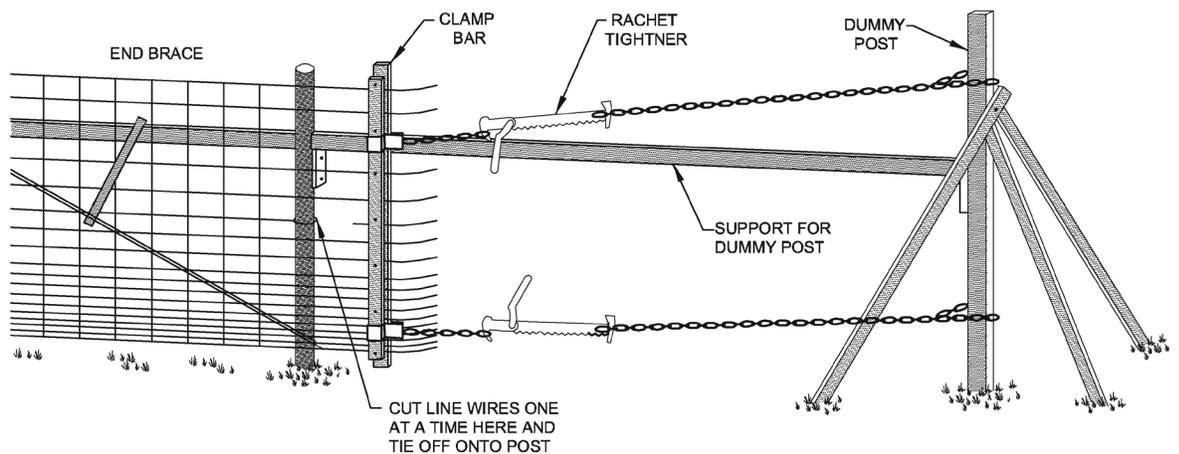


Figure 11 Tensioning Woven Wire from One End

An alternate method is sometimes preferred on long fence sections (greater than one roll - 330 ft) to more easily obtain consistent wire tension. The wires are tied off at each end brace and two straining clamps are used and pulled together as shown in Figure 12, page 11. The distance between the clamps prior to tensioning is determined by the total length of fence, allowing approximately 1 ft per 65 ft of fence. For example, if two rolls (660 ft) are being tensioned, the clamps should be just over 10 feet apart. The joint may be made using either a mechanical splice or knot as shown in Figure 7, page 8.

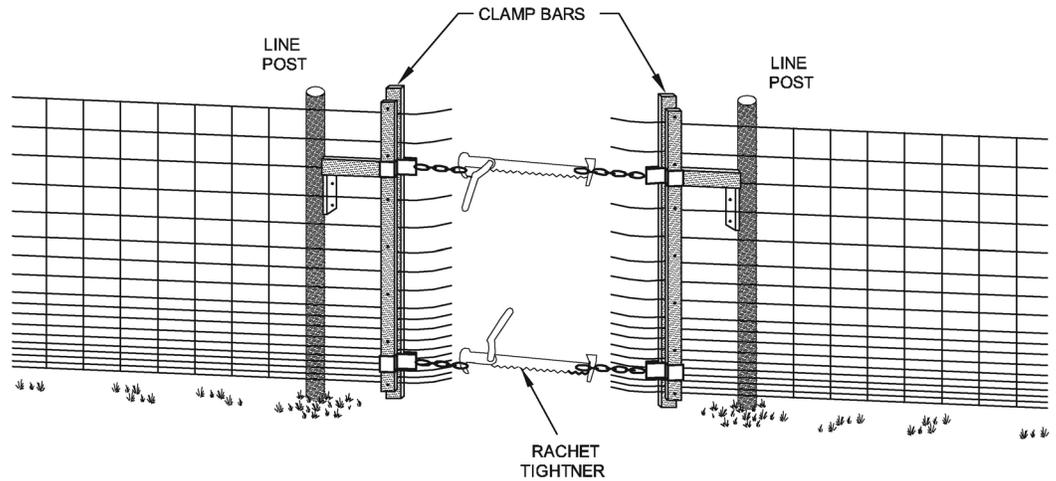


Figure 12 Tensioning Woven Wire from Two Ends

Measuring Wire Tension

Individual fence line wire tension can be measured using a simple homemade device constructed as shown in Figure 13, below. On a board 42 inches long, drive two nails 40 inches apart (nails 1 and 2) along a center line. The third nail, in the center, should be one half inch below the centre line. Using a small spring scale (while touching the wire with nails 1 and 2) pull the wire until it just touches nail 3. Read the scale and multiply by 20 to get the approximate wire tension. For example, if the scale reads 12.5 lb, then the wire is properly tensioned to 250 lb.

An alternate method is to use inline tension indicator springs. A spring is wired into a fence line wire and the compression of the spring is measured as the fence wire is tensioned. Typical springs that are used compress at the rate of one inch per 150 pound load. Therefore a compression of 1 1/2 to 1 3/4 inches approximates a 250 pound fence wire tension. This method is not commonly used.

These springs are left on the fence and have a secondary use as they provide additional elasticity or “give” to the fence wire when loads are applied. The cost and added complexity may not justify either the tensioning or elasticity benefits.

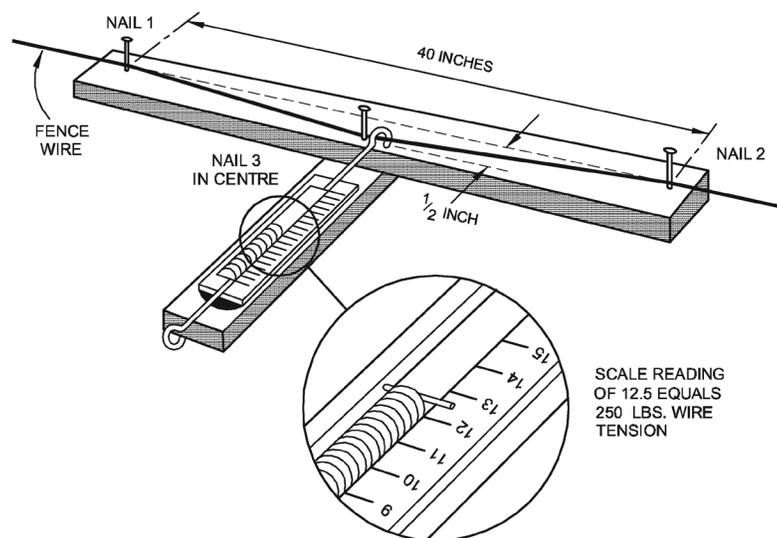


Figure 13 Wire Tension Measuring Device

GROUNDING NONELECTRIC FENCE WIRES

Steel fence wires on nonconductive (i.e., wooden) posts can act as conductors of electrical currents from lightning, fallen overhead utility wires or other sources. To protect humans and livestock from accidental electrocution, these fences should be grounded. Usually this is only done in high-risk areas.

Presently, there is no Canadian or Provincial code which specifies this requirement and at which interval; however, it is probably advisable to go with 660 feet spacings in wet climatic regions and 330 feet in dry regions.

For proper grounding, a 6 foot long, 5/8 inch diameter galvanized steel rod is driven into the ground. A ground rod clamp is attached to the rod. Five strands of wire (approximately 6 feet long) are attached to the clamp and the wires are woven and twisted through all line wires forming the cable so that all line wires and grounding wires touch. After lacing in the uppermost wire, the five wires are twisted together and securely stapled to a line post as shown in Figure 14, below.

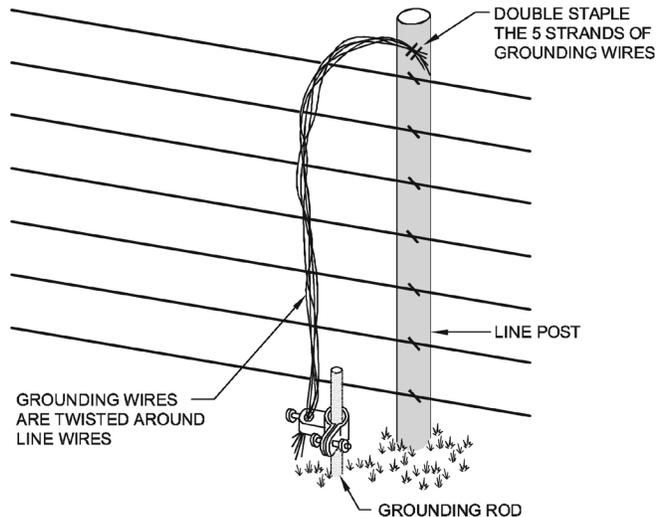


Figure 14 Grounding Nonelectric Fence Wires

Grounding Along Powerlines

For fences that run parallel to, or cross under, overhead powerlines, precautions must be taken to properly ground the fence. The following information is from BC Hydro (check with them regarding the size of powerline). Fences require grounding stations at intervals indicated under the following conditions:

- Fences on the Hydro right-of-way:
 - 200 ft or more of fence and a 500,000 volt line
 - 400 ft or more of fence and a 360,000 or 230,000 volt line
- Fences parallel to and within 250ft of the outside Hydro conductor:
 - 1000 ft or more of fence and a 500,000 volt line
 - 2000 ft or more of fence and a 360,000 or 230,000 volt line

If a fence requires grounding, both sides of every gate or other break in the fence should also be grounded. Contact BC Hydro regarding these situations and they will assist, perhaps actually doing the grounding.

An electric fence cannot be directly grounded but there are special filters that are attached to remove any current developed due to the fence location near a high voltage line. The electric fence still functions normally. Electric fences require filters when:

- Fences cross or are located on the BC Hydro right-of-way:
 - 100 ft or more of fence

- Fences are located parallel to and within 250 ft of the Hydro outside conductor:
 - 500 ft or more of fence

Possible Effects from Lightning

Careful observations in Oklahoma on barbed wire fences from 1941 to 1963 indicates possible loss of wire galvanization due to lightning on ungrounded fences. Fences where a “twist-wire” type of fence dropper had been used (and had good ground contact) had wires in good condition after over twenty years. Most other fences had losses of galvanization, ranging from severe on the top wires to minimal on the bottom wires.

Although conditions may vary in B.C., it could be a worthwhile recommendation to consider thorough fence wire grounding in areas known to experience lightning. It may be that the metal style droppers (twist-wire or sheet metal), with good ground contact, could perform this function when placed in each fence panel. In areas expected to receive limited or no lightning, the standard grounding practices discussed above will be sufficient.

FOR FURTHER INFORMATION CONTACT

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