

Fence

Conservation Practice Specification Guide

MA-382

Criteria

This Specification Guide contains information on acceptable materials for installation of this practice. It is intended to be used as a supplement to NRCS Conservation Practice Standard, Fence (382). Refer to the 382 standard for Criteria and other information pertinent to planning this practice. Also see NRCS-MA standard Engineering Drawings for Fence.

Before beginning fence installation, call **1-888-DIG-SAFE** to ensure safety from buried and overhead utilities.

Lifespan for this NRCS conservation practice is 20 years.

For perimeter fence, High Tensile electric wire fences are preferred over non-high tensile "soft wire" electric fence, due to superior physical strength and longevity.

For temporary (internal subdivision) fence, follow manufacturer's recommendations for installation and materials.

For other types of permanent fence not listed, such as electrified rope or other manufactured (horse) fencing, materials must meet lifespan expectations of 20 years, and be installed in accordance with manufacturer's recommendations for post spacing, types, and bracing. For all fence types, corner and end braces shall be installed in accordance with this specification. Variances may be granted with manufacturer/dealer affidavit.

For livestock control, choose the appropriate fence type from the table below. Fence type must meet or exceed the minimum criteria for its intended purpose. Variances may be approved upon review of justification.

Fence Selection Criteria

Table 1. Fence design and construction must meet the minimum requirements for controlling specific animal types.

Animal Species	Fence Type	Purpose of Fence		Bottom wire distance from ground (inches)	Minimum height (inches)
		Perimeter	Interior		
Cattle	Barbed 3-wire	NO	Meets	18	42
Cattle	Barbed 4-wire	Meets	Exceeds	18	42
Cattle	Barbed 5-wire	Exceeds	Exceeds	18	42
Cattle	Non-Electric 4-wire high tensile smooth	NO	Exceeds	18	42
Cattle	Non-Electric 6-wire high tensile smooth	Meets	Exceeds	12	42

Cattle	Non-Electric 8-wire high tensile smooth	Exceeds	Exceeds	6	48
Cattle	Electric 1-wire high tensile smooth	NO	Meets	32	32
Cattle	Electric 2-wire high tensile smooth	NO	Exceeds	18	36
Cattle	Electric 3-wire high tensile smooth	Meets	Exceeds	22	42
Cattle	Electric 4-wire high tensile smooth	Exceeds	Exceeds	12 minimum 2 hot	42
Cattle	Woven wire plus one or more top wire	Exceeds	Exceeds		47 minimum including wire
Cattle	Wood or Composition boards (6" wide), 4 boards	Exceeds	Exceeds	6, 6, 8, 10 between boards	54
Goats & sheep (1)	Non-Electric 5-wire high tensile smooth	NO	Meets	6	32
Goats & sheep	Non-Electric 6-wire high tensile smooth	NO	Exceeds	6	36
Goats & sheep	Non-Electric 7-wire high tensile smooth	Meets	Exceeds	6	42
Goats & sheep	Electric 3-wire high tensile smooth	NO	Meets	8	30
Goats & sheep	Electric 4-wire high tensile smooth	NO	Exceeds	8 minimum, 2 hot	36
Goats & sheep	Electric 5-wire high tensile smooth	Meets	Exceeds	8 minimum, 2 hot	38
Goats & sheep	Electric 6-wire high tensile smooth	Meets	Exceeds	8 minimum, 2 hot	48
Goats & sheep	Woven wire plus one or more top wire	Exceeds	Exceeds		47 minimum including wire
Goats & sheep	Wood or Composition boards (6" wide), 4 boards	Exceeds	Exceeds	6, 6, 8, 10 between boards	46
Horses (2)	Electric 2-wire high tensile smooth	NO	Meets	10	38
Horses	Electric 3-wire high tensile smooth	Meets	Exceeds	10	48

Horses	Electric 4-wire high tensile smooth	Exceeds	Exceeds	18 minimum, 2 hot	48
Horses	Electric 5-wire high tensile smooth	Exceeds	Exceeds	18 minimum, 3 hot	54
Horses	Electric 1-wire Poly-Coated High Tensile Wire	NO	Meets		34
Horses	Electric 2-wire Poly-Coated High Tensile Wire	Meets	Meets	10	38
Horses	Woven wire w/1 wire HT on top	Exceeds	Exceeds	54 including wire	
Horses	Mesh "No climb" 2"x4" spacing	Exceeds	Exceeds		54 including wire
Horses	Wood or Composition boards (6" wide), 3 boards	Exceeds	Exceeds	12 – 18 between boards,	54
Hogs	Electric 2-wire high tensile smooth	NO	Meets	8	16
Hogs	Electric 3-wire high tensile smooth	Meets	Exceeds	8	24
Hogs	Woven wire w/ 1 electric inside	Meets	Meets		32 + 1 electric wire 8 off ground inside of fence
Deer	Woven wire 96" tall	Meets	Meets		96 including wire
Bison	Electric 4-wire high tensile smooth	NO	Meets	16	42
Bison	Electric 5-wire high tensile smooth	NO	Exceeds	16	48
Bison	Electric 6-wire high tensile smooth	Meets	Exceeds	12	52
Chicken/turkey	Woven wire 2"x4" 1 smooth wire or barb above	Exceeds	Exceeds		72 including wire

Emu and ostrich	Woven wire 6"x6" 1 smooth wire or barb above	Exceeds	Exceeds		72 including wire

*Heights are recommendations, and should be adjusted to the needs of producer and livestock.

- (1) Llamas and Alpacas – use fence types suitable for sheep or goats. For Llamas, minimum fence height should be 47 inches.
- (2) High tensile wire fence can cause serious injury to animals, and therefore is not recommended for horses - *unless* one or more highly-visible strands (such as horse rope or poly-coated wire) are incorporated into the fence. However, fences of 4 or more wires may be more visible, and may not pose a hazard.

Materials Posts

Wooden Posts

Wooden posts and brace members shall be made from cedar, tamarack, or black locust OR shall be treated by a method listed in the table below to ensure that complete penetration of the sapwood is obtained. All bark shall be removed from the cedar, tamarack, and black locust. At least half the diameter of cedar shall be heartwood. The quality of treated wood shall provide sufficient strength and last for the expected life of the fence. Unless otherwise specified, minimum preservative retention values shall be as listed in Table 2.

Table 2. Preservative Treatment Method and Minimum Retention

Treatment Method	Retention (lbs./ft. ³)
Creosote Solution	8.00
Copper Naphthenate	0.055
Pentachlorophenol	0.40
Ammoniacal Copper Arsenate (ACA)	0.40
Chromated Copper Arsenate (CCA), Type A, B, or C	0.40
Micronized Copper Azole (MCA)	0.15
Micronized Copper Quaternary (MCQ)	0.34
Alkaline Copper Quaternary (ACQ or AC2)	0.40

All corner, end, and gate assembly posts shall be wooden with a minimum top diameter of 5 inches. Assembly posts shall be a minimum of 8 feet long for single H-brace assemblies. Wooden line posts shall have a minimum 4-inch diameter.

Plastic Posts

Plastic/composite line posts shall be at least 1 inch in diameter, have a manufacturer's warranty, and be durable for the life of the fence. All plastic/composite posts shall be UV protected for the life of the fence.

Steel Posts

Steel line posts shall have the standard "T" section, nominal dimensions of 1 $\frac{3}{8}$ inches by 1 $\frac{3}{8}$ inches by $\frac{1}{8}$ inch with anchor plate. The posts shall be rolled from high carbon steel, weigh at least 1.25 pounds per foot of length and shall be painted with a weather resistant paint for steel, enameled and baked, or hot dip galvanized. The posts shall be studded to aid in wire attachment. Steel fence posts shall conform to the requirements of ASTM A 702, Steel Fence Posts and Assemblies, Hot Wrought.

Fiberglass Posts

Fiberglass reinforced posts must be at least $\frac{7}{8}$ -inch diameter, or fiberglass reinforced T-post at least 1-inch cross-section and have a manufacturer's warranty and be durable for the life of the fence.

Other Materials for Posts

Other materials may be used for corner, end, gate assembly, line posts, and brace members if they are of equal or greater strength and quality of above. They must be preapproved by the technician.

Wire / Wood Fence

Standard Board Fence

Wood boards shall be well seasoned or kiln-dried to minimize warping.

All composite wood products shall have a manufacturer's warranty for the intended use and life of the fence providing coverage against checking, splitting, splintering, rotting, structural damage from termites, and fungal decay of composite wood.

High Tensile Smooth Steel (Electric and Non-Electric) Fence

The wire will be new, smooth, and meet or exceed the following:

- 12.5 Gauge with a tensile strength of 170,000 psi (minimum) and 1,300 lbs. breaking strength; OR
- 14 Gauge with a tensile strength of 200,000 psi (minimum) and 955 lbs. breaking strength; OR
- 16 Gauge with a tensile strength of 200,000 psi (minimum) and 585 lbs. breaking strength;
- Galvanizing – Class 3.

Standard Barbed Wire Fence

Wire shall conform to the requirements of ASTM A 121, Standard Specification for Metallic-Coated Carbon Steel Barbed Wire with Class 3 galvanizing meeting ASTM 641, [Standard Specification for Zinc-Coated \(Galvanized\) Carbon Steel Wire](#). The wire will be new and consist of 2 twisted strands of 12.5-gauge steel wire with Class 3 galvanizing or 2 twisted strands of 15.5-gauge high tensile wire with Class 3 galvanizing. The barbs shall be minimum 2 point on 5-inch centers.

Woven Wire

Standard woven wire fence (SWWF) shall be made from low-carbon steel wire with Class 3 galvanizing meeting ASTM A 641, [Standard Specification for Zinc-Coated](#)

[\(Galvanized\) Carbon Steel Wire](#), and conform to the requirements of ASTM A 116, Metallic-Coated, Steel Woven Wire Fence Fabric. The woven wire shall have the top and bottom strands 10-gauge or heavier. The intermediate and stay wires shall be 14.5-gauge or heavier. The stay wires shall be spaced a maximum of 12 inches apart.

High tensile woven wire fence (HTWWF) and specialty high tensile woven wire fence (SHTWWF) will be made from high tensile steel wire with Class 3 galvanizing meeting ASTM A 641, [Standard Specification for Zinc-Coated \(Galvanized\) Carbon Steel Wire](#), and conform to the requirements of ASTM A 116, Metallic-Coated, Steel Woven Wire Fence Fabric. The top and bottom strands of the woven wire shall be 12.5-gauge or heavier. The intermediate and stay wires shall be 14.5-gauge or heavier. The stay wires shall be spaced a maximum of 12 inches apart for non-electric woven wire, and 24 inches when the wire is electrified.

Barbed wire used with SWWF and HTWWF shall meet the requirements of Appendix B of this specification, Standard Barbed Wire Fence (SBWF).

High tensile wire used with woven wire fences must meet NRCS MA specifications stated above.

Fasteners

- Staples shall be of 9-gauge galvanized steel or heavier with a minimum length of 1.75 inches for softwoods and a minimum length of 1 inch for close-grained hardwoods.
- Manufacturer's clips or 14-gauge Class 3 galvanized wire meeting the appropriate ASTM for the fencing material specified may be used to fasten wires to steel (if not electrified), plastic/composite, or fiberglass posts.
- For electrified fences, plastic insulators must be of high quality and labeled for UV protection. Ceramic insulators are not

recommended due to cracking and arching may occur. Nails or screws used to attach insulators shall be galvanized, stainless steel, or otherwise treated or coated to prevent rusting.

Energizer Systems for Electrified Fence

A. Electronic energizers or power fence controllers shall be installed according to the manufacturer's recommendations and will meet the following minimum specifications:

- High power, low impedance system with solid state circuitry capable of at least 5,000 volt peak output and a short pulse that is less than 300 mAmps in intensity; pulse must be finished within 0.0003 of a second. pulse rate shall be 35-65 pulses per minute;
- High impact weather resistant cases;
- 110 volt, OR 220 volt conventional powered electric fence energizers, OR 12-volt battery powered capable of operating three weeks without recharging.
- If the length of fence requires an energizer of more than 4 joules, a solar charger will be needed on the battery systems;
- Minimum voltage output by livestock species:
 - o cattle: 1600v;
 - o sheep and goats: 2000v;
 - o hogs and horses: 1200v;
- Utilize a safety pace fuse to prevent over pulsing.

Under normal operating conditions, the energizer should be capable, at a minimum, of producing 1 joule of energy for each mile of wire used. (Joules are units of electrical energy. One joule does about 0.74 ft-lb. of work. Watts x seconds = joules.) When calculating wire length for energizer, multiply number of wires by fence length to get total energized fence length.

If a significant portion of the fence will be exposed to dense vegetation, additional energy requirements may be needed.

Also take into account temporary fence or electric netting that will be electrified, as they will require a significant increase in energizer output. Follow manufacturer/dealer recommendations.

B. Grounding.

All electric fences must be properly grounded. The energizer ground wire shall be connected to a galvanized pipe or rod 0.5 inch or larger in diameter. A minimum of 3 feet of ground rod for each joule of energy output shall be installed to properly ground the fence.

Ground rods shall be placed where soil remains moist for best results. Drive a sufficient number of 6- to 8-foot long rods into the soil 10 feet apart to provide the required length of ground rod exposure to the soil. Connect a continuous ground wire from the energizer to each rod. The energizer terminals, ground wire, and ground rods shall be made of the same material (steel to steel, copper to copper) to prevent accelerated corrosion which could cause a loss of electric continuity.

Additional ground rods may be needed for the system to function properly. Follow the manufacturer's recommendations where they exceed the requirements of this standard.

The ground wire(s) of the fence may be connected to the same grounding system as the energizer or a separate grounding system. Where a combined grounding system is used, the design shall meet or exceed the minimum design criteria specified for both the energizer and lightning protector.

Do not use the grounding system for other existing applications, such as power poles, breaker boxes, and milk barns. At least 65 feet shall separate the fence grounding system from any other electrical grounding system.

C. Spike Protector.

A voltage spike protector is recommended for use with 120- and 140-volt energizers.

Also, a ground rod shall be installed at the electric company's transformer pole (primary ground) and another ground rod installed at the electrical circuit breaker box (secondary ground), if they do not exist at the time of electric fence construction. Additionally, a surge protector shall be installed between the energizer and power supply.

D. Insulation and Insulated Cable.

Insulation used for positively charged wire(s) must be high-density polyethylene with ultra-violet stabilizer.

All underground wire(s) installations must be double insulated; molded; high tensile strength steel, 12.5-gauge or larger wire. The insulation must be high density polyethylene or polypropylene with ultra-violet stabilizer.

Insulators for steel and other conductive material posts shall be capable of withstanding at least 10,000 volts of current leakage and shall be made of high-density polyethylene with ultra-violet stabilizer or porcelain.

Insulators for end, corner, and angle braces shall be capable of withstanding at least 10,000 volts of current leakage and shall be made of high-density polyethylene with ultra-violet stabilizer, high-density polypropylene with ultra-violet stabilizer, or porcelain. Red insulators should not be used as they might attract hummingbirds.

Use insulated galvanized wire to cross gates and areas where electrical shocks to humans and livestock should be prevented (e.g., working facilities). For underground burial, use wire designed for burial. In addition, placing this buried cable inside plastic pipe helps to decrease the incidence of short-circuiting. Do not use insulated copper wire due to the potential for corrosion at the splice and a lack of tensile strength.

Gates

- (1) Prefabricated gates shall be installed according to manufacturer specifications.

(2) Electrified Gates.

Electrified gates may be constructed of a single straight wire, galvanized cable, polytape or electrified rope with a spring loaded insulated handle, or an expandable, coiled, high tensile, 12.5-gauge wire attached to an insulated handle. The number of wires shall be determined by the fence objective. The gate shall be constructed so that it is non-electrified when the gate is open. Overhead or underground transmission lines will be used to carry electricity past the gate to the remainder of the fence.

(3) Flood Gates.

An electrified floodgate may be used in lieu of a non-electrified gate if desired. The electrified floodgate is constructed by stretching an electrified wire across the drainage above high water flow level. Attach droppers of 12.5-gauge high tensile fence wire, galvanized cable, or galvanized chains to the electrified wire at a spacing of 6 inches above average normal water level. Connect gate to electric fence with double insulated cable through a cut-off switch and floodgate controller. If flooding is expected for extended periods of time, switch the floodgate off.

Corner Bracing

All fence end points, gates, and corners will be braced in accordance with the specification for the particular fence type. "H" style braces are most common (Figs. 1 and 2). The horizontal member of an H brace must be 8 to 10 feet long. Shorter lengths cause the brace to be weak and are therefore unacceptable. Horizontal rails are held in place on each post with brace pins. Diagonal brace wires pull the assembly together and give the brace rigidity.

Floating figure 4 braces (Figures 4 and 5) are an alternative for places where it is difficult to get brace posts into the ground. These braces require only one corner post, buried 4 feet. These may be utilized on fences of up to 5 wires. Note: The diagonal member of a Figure 4 brace MUST "float" on a surface stone or block. It is NOT acceptable to bury the end of the diagonal

member in the ground with a Bedlog or Deadman. The diagonal member must be a minimum of 9 feet long, and is attached to the corner post at 2/3 the above-ground height of the post.

For woven-wire fences, fence material is ended and tied off at each corner post, and a new section is begun.

Smooth strand and barbed wires on fences may continue uninterrupted around corners.

In-Line Bracing

Straight fence runs of lengths specified for each fence type (Appendices A-C), require **In-Line Brace Assemblies, also known as "Pull Assemblies"**. These assemblies require that **one section of fence must be**

tied off and terminated, and another length of fence begun. The fence shall not continue uninterrupted past the brace.

In-line brace assemblies are similar to corner assemblies, except that the H braces are in line with one another (straight line end-to-end) rather than at an angle from one another. Generally a double H configuration is used (Figure 1), although a single H may be used in some circumstances for 6 wires or less. The first length of fence is terminated and tied off at the assembly, and the next length of fence is begun. Each length of fence is tied off at the center post of a double H assembly. If a single H brace is used, a wire strainer will be constructed in both directions (i.e., in an "X" formation, as it is for braces at gates. (Figure 2))

Figure 1. Corner Brace OR In-Line Brace. Note position of diagonal brace wires. (For in-line braces, the "Corner Post" will be a "Center Post".)

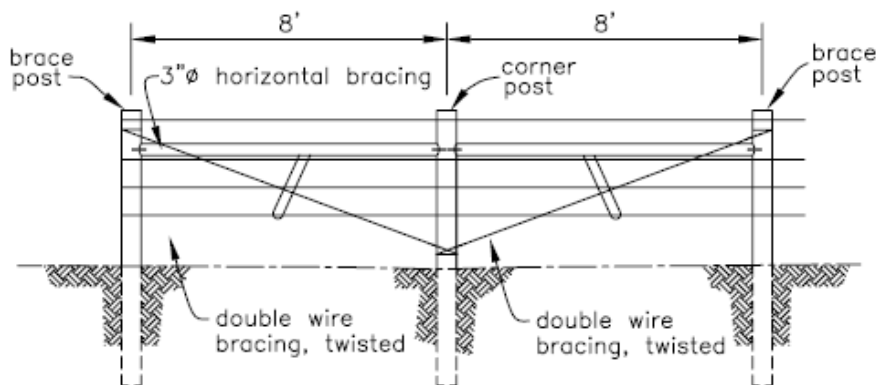
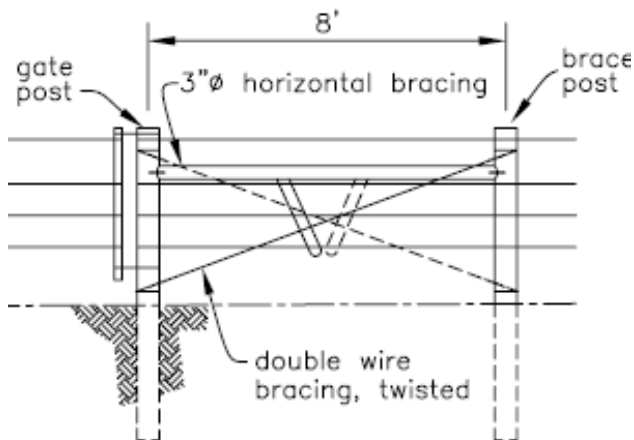


Figure 2. Gate Brace OR Single In-Line Brace. Note position of diagonal brace wires.



Changes of Direction

Changes of Direction of 15 degrees or greater in either the direction of the fence line (horizontal) or in ground topography (vertical slope) will require installation of brace assemblies.

Vertical angles:

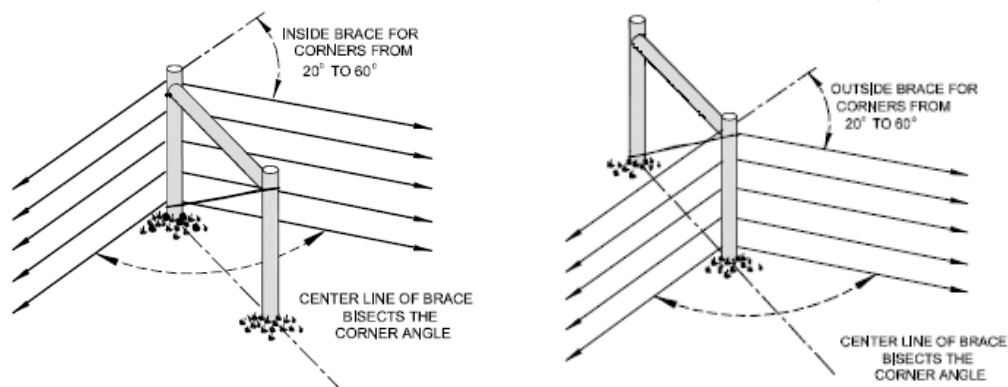
Significant changes in slope require a brace at the top and bottom of the slope, with the fence tied off (ended) at each brace to withstand the upward or downward forces on posts.

Horizontal angles:

For angles of 60 degrees to 90 degrees, always use typical corner brace assemblies in accordance with the appropriate Appendix for the fence type.

“Dogleg” angles of 15 to 60 degrees are generally not sufficiently supported by the double brace assembly typically used at corners. In these instances it may be appropriate to utilize either a single Figure 4 (Floating) brace or a single H brace on the inside or outside of the curve to resist forces.

Figure 3. Support Brace for Dogleg Angles of less than 60 degrees. Note position of diagonal brace wires in each circumstance. (These braces are not suitable for typical 90 degree corners.)



Fence Post Spacing Around Curves

Straight fence lines are easier to install than irregular ones. Bends in a fence line may require more annual maintenance to re-set line posts that move under increased tension caused by linear deviations between braces. Therefore, keep fence lines as straight as possible, using braces described above for corners and doglegs. When the fence line must go around a curve rather than make a simple change in direction, the following procedure may be used to figure post spacing. The sharper the curve, the closer the posts will need to be.

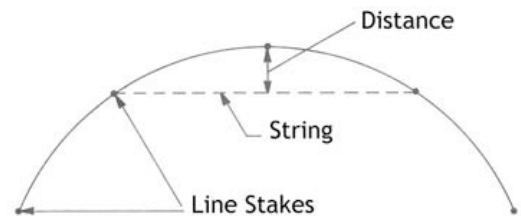
Place survey stakes every 14 feet around the smooth curve. Select three stakes at a

point of maximum curvature. String a line from the first to the third stake (see Figure below). Measure the distance from the center stake to the string, and space the posts as indicated in the table below.

Set the posts in the ground 36 inches, and with a 6 inch lean from vertical to the outside of the curve. Place the fence wires on the outside (curve) of the posts.

Curved fence sections should be kept to less than 330 feet in length. Where a section will exceed 330 feet, install **in-line brace(s)** to break them up. *These braces should not be installed on the curve*, but on a straight section one post spacing distance away from the curve. The fence is "tied off" (ended and begun anew) at each in-line brace. (See "In-Line Bracing", above).

Distance from Center Stake to String (Inches)	Permanent Post Spacing (Feet)
0 - 4	14
5 - 7	12
8 - 10	10
11 - 15	8
16 or more	6



Alternatives to standard H braces

Figure 4 – Single Floating or Figure Brace

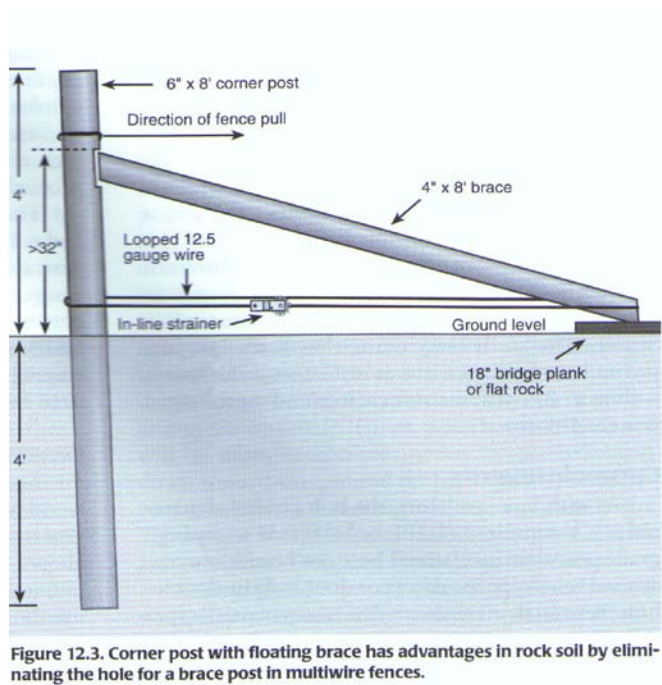


Figure 5 - Corner Post With 5" x 24" Bedlog (Deadman) in Lieu of Brace. Acceptable only in limited applications.

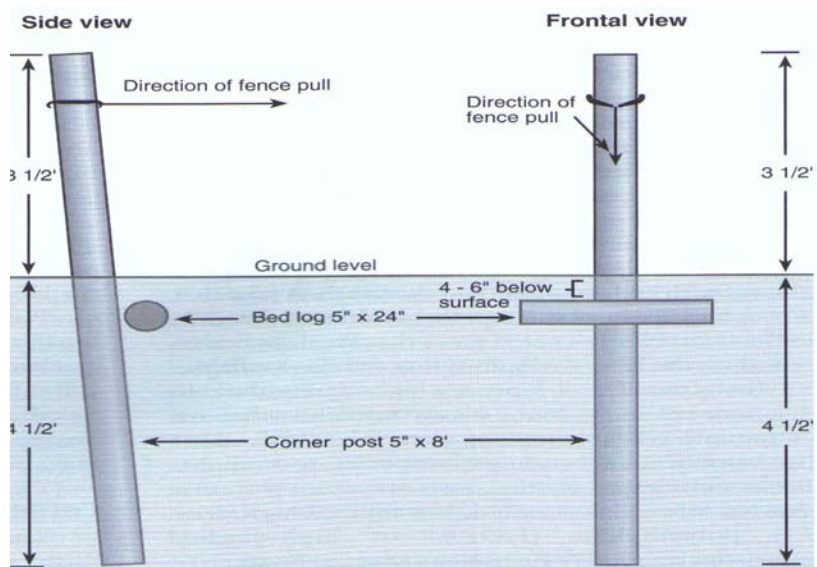
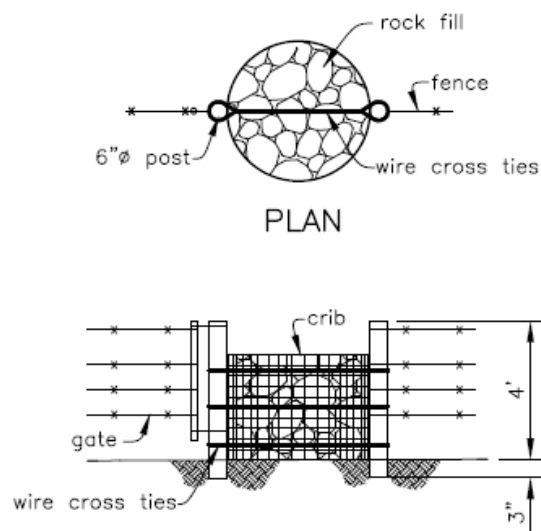


Figure 12.2. Corner post with a bed log brace is best for most one- and two-wire electric fences where wooden posts are available.

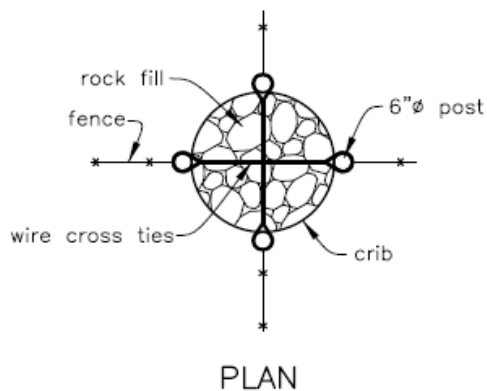
Alternatives to In-Ground Posts

The following are examples of Rock Crib Posts for use on terrain where conventional posts cannot be placed in-ground to the required depth due to restrictions.



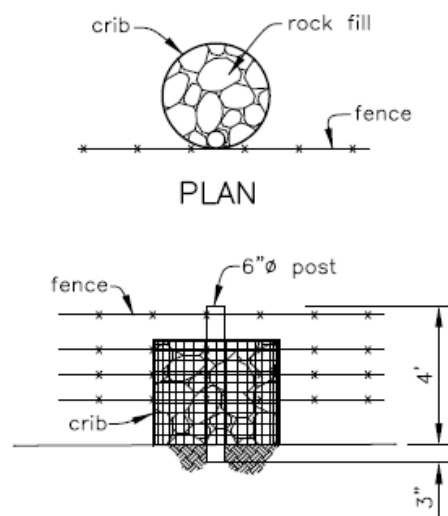
ELEVATION
GATE POST

36" wide wire netting, 13' long,
formed to make 4'Ø crib.



PLAN
CORNER POST

36" wide wire netting, 13' long,
formed to make 4'Ø crib.



ELEVATION
LINE POST

36" wide wire netting, 10' long,
formed to make 3'Ø crib.

Splice netting ends together to
form crib and staple together.
Level bed for crib.

References

- Electric Fencing for Serious Graziers. 2005.
USDA NRCS Missouri State Office,
Columbia, MO
http://www.mo.nrcs.usda.gov/news/pubs_download/out/MO%20NRCS%20Electric%20Fencing_low.pdf
- Fence Instructions. 2011. Premier1
Supplies. Washington, IA
<http://www.premier1supplies.com/instructions.php>
- Fencing Handbook for 10' Woven Wire Deer
Exclusion Fence. 2011. MN Dept of
Natural Resources, Brainerd, MN
http://files.dnr.state.mn.us/recreation/hunting/deer/bovine-tb/fencing_guide.pdf

Appendix A

HIGH TENSILE PERMANENT ELECTRIC WIRE FENCE (HTPEWF) HIGH TENSILE NON-ELECTRIC WIRE FENCE (HTNEWF)

SCOPE

The minimum number of wires is dependent on the use of the fence; see Table 1. High tensile *electric* wire fence shall have a minimum of one strand of high tensile smooth wire for interior fences.

High tensile *non-electric* wire fence (HTNEWF) shall have a minimum of four strands of high tensile smooth wire for interior fence only. The minimum number of wires is dependent on the use of the fence.

Wire is to be placed on the side of the fence to receive animal pressure. In some instances where movement of large wildlife is a concern (moose), wire may be placed on the outside of the posts. In these circumstances, also consider adding physical flexibility to a high tensile fence by using a wide spacing of posts with battens in between.

INSTALLATION

A. Post Installation and Spacings.

Line post spacing shall be a maximum of 50 feet for interior electric fence or 30 feet for perimeter electric fence, except when stays are placed every 33 feet (then, the maximum post spacing shall be 100 feet). Where there are changes in elevation or ground is uneven, post spacing may need to be closer to keep wires at desired height from ground. For high tensile *non-electric* fence, the maximum post spacing shall be 12 feet if the fence is used to restrain animals.

Line post Depth shall be a minimum of 2 feet.

Live trees with a diameter breast height greater than 6 inches may be used as posts, provided they are properly prepared and sufficiently in line for the amount of tension that will be used, such that insulators will not bear too much strain, nor wire be pulled

from the insulator. Insulators shall not be attached directly to trees. A pressure-treated plank shall be anchored to the tree, and insulators will be attached to the plank. Use of pin-lock type insulators will ensure that wire does not move out of insulator. Tube-type insulators stapled to the board should also prevent the wire from being pulled off the tree. Claw-type insulators are not recommended for this application.

B. Corner, End, and Gate Assemblies.

Brace assemblies are required at all corners, gates, and ends.

Corner posts shall be set or driven 4 feet below the ground line, and associated brace posts on an assembly a minimum of 3 feet, unless a restrictive layer prevents installation to the required depth. Where an achievable depth for end and in-line assemblies is 3 feet or less, a double H brace assembly will be used.

Uninterrupted fence sections shall not exceed 1,320 feet for up to 6 wires, not to exceed 660 feet for more than 6 wires. If an uninterrupted section will exceed this length, an in-line brace assembly shall be used. The fence section will be tied off and ended at the assembly, and the next section of fence will attach and begin on the assembly. Double H braces will be used for this purpose, with the sections tied off at the center post.

Brace assemblies will also be used for changes in direction and slope, as described in the Massachusetts NRCS Fence Specification Guide.

One of the following assemblies shall be used for all corners, ends, and gates:

- (1) A single H-brace for up to 6 wires, or double H brace for more than 6 wires.
- (2) A Figure 4 or "Floating" diagonal brace for up to 5 wires.
- (3) A corner 6 inch diameter post with a

bedlog is acceptable for an *interior* fence of up to 3 wires. Corner posts are to be set or driven to a minimum of 4 feet below the ground line, and will lean 2 inches opposite the direction of pull.

All brace members shall be wood and the horizontal member centerline shall be 4 to 9 inches below the top of the post. Other brace material of equal strength may be used with the preapproval of the technician. Floating diagonal braces shall be placed at $\frac{2}{3}$ the height of the fence, measured from the bottom wire up.

Wood horizontal brace members (rails) shall be a minimum of 4 inches in diameter and a minimum of 8 feet in length, 9 feet for floating diagonal braces. A tension wire composed of two complete loops of 9-gauge smooth wire, 12-gauge double strand wire, or a single loop of 12.5-gauge high tensile strength smooth wire shall be used. One end of the tension member shall be at the height of the horizontal brace member and the other end shall be 4 inches above the ground line on the other post.

A corner assembly shall be used when the horizontal alignment changes more than 60 degrees. For changes of 15-60 degrees, see Massachusetts NRCS Fence Specification Guide.

C. Line Post.

Wood, fiberglass, steel, and plastic/composite posts for HTNEWF shall be set or driven a minimum of 24 inches below the ground line for single or multiple wire fences. Wood posts for HTPWF shall be driven a minimum of 24 inches below the ground line for single or multiple wire fences. Fiberglass, steel, and plastic/composite posts for HTPWF shall be set or driven to a minimum of 12 inches below the ground line for a single wire fence and a minimum of 18 inches below the ground line for a multiple wire fence.

If posts are not driven, the backfill around the post shall be well compacted (tamped in layers of 6 inches or less).

In areas where soil depth restricts the post embedment depth, additional anchors or deadman applied against the direction of pull shall be used.

Manufactured battens used between line posts may rest at ground surface. If desired, fiberglass rods may be used as battens, driven to a desired depth. Rods should be coated for long life and UV protection.

D. Fastening.

The top wire shall be at least 2 inches below the top of the wooden post and 1 inch below the top of all other posts. Tension will be applied with an in-line stretcher or other tightener on each strand to achieve no visible sag. All wires shall be fastened to each line post.

For non-electrified wires or for tube insulators, staples shall be driven diagonally to the wood's grain and at a slight downward angle (upward if pull is up) to avoid splitting the post and loosening of the staples. Space should be left between the inside crown of the staple and post to permit free movement of high tensile wire. Barbed staples shall be used for wood posts.

Wire shall be attached to fiberglass and plastic/composite posts using manufacturer's clips or two turns of 14-gauge galvanized wire.

The staples, wires, and clips should allow free movement of the high tensile fence wire.

Wire shall be spliced by means of a manufacturer's recommended splice or knot, or by suitable splice sleeves applied with a tool designed for the purpose.

E. Interior Fences.

For a 1-wire electric interior fence, a brace is not required at corners, gates, pull, and end assemblies. In lieu of a brace, install in accordance with B 3, above.

F. Offset Brackets.

Offset brackets made of galvanized high tensile spring wire with insulator of high density polyethylene with ultra-violet stabilizer or porcelain can be attached to standard barbed wire fence or woven wire fence to provide a transmission line and/or to protect a standard fence. Place the offset brackets no further than 60 feet apart and attach to the wires of the standard fence next to the post. Place offset brackets at chest height of the animals to be controlled.

Ensure that no wires of any existing fence comes in contact with the electric fence wire, as an electrical short will occur.

6. ADDITIONAL SPECIFICATIONS FOR HTNEWF

A. Grounding for Lightning Protection.

Non-electrical wire fences using wood posts shall be grounded at least every quarter mile. Ground rods should be driven not less than 4 feet into the ground. The rods shall be galvanized steel and a minimum of 0.5 inch in diameter. All line wires of the fence must be grounded.

Appendix B

STANDARD BARBED WIRE FENCE (SBWF)

SCOPE

The work shall consist of furnishing all materials required and installation of the fence at the locations shown on the plans. This Appendix applies to Standard Barbed Wire Fence (SBWF). Refer to Table 1 of the Massachusetts NRCS Fence Specification Guide for minimum fence height, number of wires, and wire spacing.

Standard barbed wire fences (SBWF) shall have a minimum of three strands of barbed wire.

Barbed wire shall not be used on electric fences because of the safety hazards created.

INSTALLATION

A. Post Installation and Spacings.

Line post spacing shall not exceed 16 feet for standard barbed wire fence and 25 feet for high tensile barbed wire fence.

B. Corner, End, and Gate Assemblies.

Brace assemblies are required at all corners, gates, and ends. Corner posts shall be set or driven 4 feet below the ground line, and associated a brace posts on an assembly a minimum of 3 feet, unless a restrictive layer prevents installation to the required depth. Where an achievable depth for end or in-line assemblies is 3 feet or less, a double H brace assembly will be used.

Uninterrupted fence sections shall not exceed 660 feet. If an uninterrupted section will exceed this length, an in-line brace assembly shall be used. The fence section will be tied off and ended at the assembly, and the next section of fence will attach and begin on the assembly. Double H braces will be used for this purpose, with the sections tied off at the center post.

Brace assemblies will also be used for changes in direction and slope, as described in the Massachusetts NRCS Fence Specification Guide.

One of the following assemblies shall be used for all corners, ends, and gates:

- (1) An H-brace or double H brace.
- (2) A Figure 4 or "Floating" diagonal brace.

All brace members shall be wood and the horizontal member centerline shall be 4 to 9 inches below the top of the post. Other brace material of equal strength may be used with the preapproval of the technician. Floating diagonal braces shall be placed at $\frac{2}{3}$ the height of the fence, measured from the bottom wire up.

Wood horizontal brace members (rails) shall be a minimum of 4 inches in diameter and a minimum of 8 feet in length, 9 feet for floating diagonal braces. A tension wire composed of two complete loops of 9-gauge smooth wire, 12-gauge double strand wire, or a single loop of 12.5-gauge high tensile strength smooth wire shall be used. One end of the tension member shall be at the height of the horizontal brace member and the other end shall be 4 inches above the ground line on the other post.

A corner assembly shall be used when the horizontal alignment changes more than 60 degrees. For changes of 15-60 degrees, see Massachusetts NRCS Fence Specification Guide.

C. Line Post.

Wooden line posts shall be set or driven a minimum of 24 inches below the ground line. Steel line posts shall be set or driven a minimum of 18 inches below the ground line. If posts are not driven, the backfill around the post shall be well compacted (tamped in layers of 6 inches or less).

In areas where soil depth restricts the post embedment depth, additional anchors or deadman applied against the direction of pull shall be used.

D. Fastening.

The top wire shall be at least 2 inches below the top of a wooden post, and 1 inch below the top of a steel post. The tension on the high tensile barbed wire should be 200 to 250 pounds on each wire. Tension will be applied with an in-line stretcher on each strand. To gauge tension, install a tension spring on at least one strand of wire. All wires shall be attached to each line post.

Staples shall be driven diagonally to the wood's grain and at a slight downward angle, (upward if pull is up) to avoid splitting the post and loosening of the staples. Space should be left between the inside crown of the staple and post to permit free movement of high tensile barbed wire. Barbed staples shall be used for wooden posts.

Wires shall be attached to steel posts using manufacturer's clips or by two turns of 14-gauge galvanized wire.

Wire shall be spliced by means of a Western Union splice or by suitable splice sleeves applied with a tool designed for the purpose. The Western Union splice shall have not less than 8 wraps at each end about the other. All wraps shall be tightly wound and closely spaced.

E. Grounding.

Fences using wood posts shall be grounded for lightning protection at least every quarter mile, with ground rods driven not less than 4 feet into the ground. The rods shall be galvanized steel and a minimum of 0.5 inch in diameter. All line wires of the fence must be grounded. Add 12.5-gauge wire for the lead-out wire.

Appendix C

WOVEN WIRE FENCE (WWF)

SCOPE

Standard woven wire fence (SWFF) shall consist of low-carbon steel woven wire with a single or multiple strands of either barbed wire or high tensile smooth wire with a minimum spacing of 2 to 6 inches starting at the top of the woven wire.

High tensile woven wire fence (HTWWF) shall consist of fixed knot or hinge joint high tensile woven wire with a single or multi strands of smooth high tensile wire, or high tensile barbed wire, 2 to 6 inches above the top of the woven wire. HTWWF may be electrified in accordance with energizer manufacturer recommendations (see power requirements for electric fence).

Specialty high tensile woven wire fence (SHTWWF) shall consist of 49- to 96-inch high woven wire with a single strand of smooth high tensile wire, or high tensile barbed wire, 2 to 6 inches above the top of the woven wire. This type of fence is intended for deer, elk, and exotic animals.

INSTALLATION

A. Post Installation and Spacings.

Line post spacing shall not exceed 16 feet for standard woven wire fence and 25 feet for high tensile woven wire fence.

Line post Depth shall be a minimum of 2 feet.

B. Corner, End, and Gate Assemblies.

Brace assemblies are required at all corners, gates, and ends. Corner posts shall be set or driven 4 feet below the ground line, and associated brace posts on a brace assembly a minimum of 3 feet, unless a restrictive layer prevents installation to the required depth. Where an achievable depth for end or in-line assemblies is 3 feet or less, a double H brace assembly will be used.

Uninterrupted fence sections shall not exceed 660 feet. If an uninterrupted section will exceed this length, an in-line brace (pull) assembly shall be used. The fence section will be tied off and ended at the assembly, and the next section of fence will attach and begin on the assembly. Double H braces will be used for this purpose, with the sections tied off at the center post.

One of the following assemblies shall be used for all corners, ends, and gates:

- (1) An H-brace or double H brace.
- (2) A Figure 4 or "Floating" diagonal brace.

All brace members shall be wood and the horizontal member centerline shall be 4 to 9 inches below the top of the post. Other brace material of equal strength may be used with the preapproval of the technician. Floating diagonal braces shall be placed at $\frac{2}{3}$ the height of the fence, measured from the bottom wire up.

Wood horizontal brace members (rails) shall be a minimum of 4 inches in diameter and a minimum of 8 feet in length, 9 feet for floating diagonal braces. A tension wire composed of two complete loops of 9-gauge smooth wire, 12-gauge double strand wire, or a single loop of 12.5-gauge high tensile strength smooth wire shall be used. One end of the tension member shall be at the height of the horizontal brace member and the other end shall be 4 inches above the ground line on the other post.

A corner assembly shall be used when the horizontal alignment changes more than 60 degrees. For changes of 15-60 degrees, see Massachusetts NRCS Fence Specification Guide.

A pull (in-line) assembly shall be used when vertical alignment (slope) changes more than 15 degrees.

A bend assembly will be used only when it will not affect the integrity of the fence.

C. Line Post.

Wooden line posts shall be set or driven a minimum of 24 inches below the ground line. Steel line posts shall be set or driven a minimum of 18 inches below the ground line. If posts are not driven, the backfill around the post shall be well compacted (tamped in layers of 6 inches or less).

In areas where soil depth restricts the post embedment depth, additional anchors or deadman applied against the direction of pull shall be used.

D. Fastening.

The top wire shall be at least 2 inches below the top of a wooden post, and 1 inch below the top of a steel post. The tension on the high tensile barbed wire should be 200 to 250 pounds on each wire. Tension will be applied with an in-line stretcher on each strand. To gauge tension, install a tension spring on at least one strand of wire. All wires shall be attached to each line post.

Staples shall be driven diagonally to the wood's grain and at a slight downward angle, (upward if pull is up) to avoid splitting

the post and loosening of the staples.

Space should be left between the inside crown of the staple and post to permit free movement of high tensile barbed wire.

Barbed staples shall be used for wooden posts.

Wires shall be attached to steel posts using manufacturer's clips or by two turns of 14-gauge galvanized wire.

Wire shall be spliced by means of a Western Union splice knot or by suitable splice sleeves applied with a tool designed for the purpose. The Western Union splice shall have not less than 8 wraps at each end about the other. All wraps shall be tightly wound and closely spaced.

E. Grounding

Fences using wood posts shall be grounded for lightning protection at least every quarter mile, with ground rods driven not less than 4 feet into the ground. The rods shall be galvanized steel and a minimum of 0.5 inch in diameter. All line wires of the fence must be grounded. Add 12.5-gauge wire for the lead-out wire.

Appendix D

BOARD FENCE (BF)

SCOPE

The work shall consist of furnishing all materials required and installation of the fence at the locations shown on the plans. This Appendix applies to board fence (BF). Refer to Table 1 of the Massachusetts NRCS Fence Specification Guide for minimum fence height. A board fence shall have a minimum of three boards.

Before beginning fence installation, call **1-888-DIG-SAFE** to ensure safety from buried and overhead utilities.

INSTALLATION

A. Posts

Posts shall be spaced to accommodate board lengths. Post spacing for wood fence shall not exceed 8 feet on center. Post spacing, size, and installation for composite wood fences shall meet manufacturer's recommendations for the intended use, and size and number of boards.

Wood posts will have a minimum top diameter of 6 inches for large livestock applications and 4 inches for small livestock. Angular wood posts shall have a minimum top, nominal dimension of 6 inches by 6 inches for large livestock applications and 4 inches by 4 inches for small livestock.

Wood line posts will be set or driven a minimum of 36 inches.

Gate and corner wood posts will be firmly set or driven in the ground a minimum of 48 inches.

Wood posts will be of sufficient length to support the height of the fence and be firmly set or driven in the ground.

B. Boards

Boards for wood fence used for small animals and low pressure areas for large animals shall be a minimum size of 1 inch by 6 inches (nominal). Wood boards used for large animal confinement shall be a minimum size of 2 inches by 6 inches (nominal). Boards for wood fence shall be a minimum of 8 feet in length.

Board size for composite wood fence shall be in accordance with manufacturer's recommendations for the intended use of the fence.

Board length should be twice the post spacing with staggered seams on the posts. The boards shall be placed on the livestock side in corrals and other high pressure areas.

Each wood board shall be attached to each post with a minimum of two 16d hot dipped galvanized steel, stainless steel, copper, silicon bronze, or equivalent proprietary coated nails. For better holding power, use ring-shank, spiral, or screw-shank instead of common nails. Two 3-inch decking screws with like treatments may be used instead of nails. Increase the number of nails or screws by one additional nail or screw per 2 linear inches of board nominal width for board nominal widths exceeding 6 inches.

Each composite wood board shall be attached to each post in accordance with manufacturer's recommendations.