

NATURAL RESOURCES CONSERVATION SERVICE CONSTRUCTION SPECIFICATIONS

FENCE - PERMANENT ELECTRIC HIGH TENSILE

(Ft.)

CODE 382

Permanent Electric High Tensile Fence

(See Standard Drawing Number FEN-382-EL2.)

A minimum of one wire in the fence shall be electrified. Barbed wire will not be used on electric fences because of safety hazard.

A. Wire Spacing

The number of wires and spacing shall be designed to accomplish the desired result of the fence. **Table 1** suggests wire spacing and electrical charge for different kinds and classes of animals. Two wires or more electric fence wires are recommended when the land manager desires to control calves or other small ruminants. When multiple wire systems are used, spacing of wires should be designed to ensure facial shock when animal attempts to place head between wires.

In instances where ground moisture is high, an all-positive charged fence would normally suffice. If experience shows that the soil on site will dry to the point of not causing a shock to the animal, then a combination of positive (+) and negative (-) wires should be used.

Place positive and negative wires a minimum of 6" apart.

Farm border fences and roadside fences must be constructed of at least four wires, with the total height to the top wire not less than 42 inches.

Cross fences can be constructed of one or more wires, with the fence height being two-thirds of the shoulder height, or nose height of the resting grazing animal. Cross fencing with one- and two-wire electric wires may be used for within-farm uses such as streamside fencing and subdividing pastures, but may not be used for property line or roadside fencing. Property line fencing may be one- or two-wire electric fence, when the farm boundary is on a floodprone stream.

TABLE 1. Recommended Wire Spacing

Wires	Animal Type	Spacing from Ground (Inches)
1	Cattle, Horses	30
2	Cattle with Calves Creep Grazing, Horses	32, 42
3	Cattle, Calves ----- Cattle, Horses	18, 30, 42 ----- 22, 32, 42
4	Cattle, Calves, Horses ----- Cattle, Sheep, Goats, Hogs	12, 22, 32, 42 ----- 7, 14, 22, 34
5	Cattle, Horses, Sheep, Goats, Hogs (add a 4" high wire for hogs)	7, 14, 22, 32, 42
6-8	Deer, Predator Control	6, 12, 18, 26, 36, 46, 56, 68 Needs to be positive ground on every other wire.
For hogs place a wire 4" above ground in addition to a second wire 10" to 12" above ground.		

B. Type of Wire

Wire shall be high tensile, a minimum of 13 gauge, single strand, tensile strength of 110,000 psi minimum breaking strength, with Type III galvanizing or be aluminum or copper clad. Typically, triple galvanized 12.5-gauge wire with 170,000 psi minimum breaking strength is installed. The

170,000 psi wire is much easier to work with than the 210,000 psi wire.

C. Pull Assemblies

For high tensile fence, two posts with brace and brace wire shall be spaced at intervals not to exceed 2,000 feet in straight sections of the fence. Where turns are encountered, additional wire strainers will be installed for proper tension on fence. One- and two-wire cross fences do not require brace assemblies, but wire should be tied off a minimum of every 2,000 feet.

D. Line Post Spacing, Length, and Depth

Install line wood posts in dips and rises first. Spacing of line posts and stays depends on terrain and number of wires. Maximum spacing is as follows. Fences may have line posts spaced up to 75 feet apart with no stays required (Typical line post spacing is 40' to 50'.) Line posts may be spaced 150 feet apart with stays or light posts at 50-foot spacing between the posts. Do not use stays with single wire fences. In undulating terrain, space posts and stays so that fence height is maintained. Posts in dips shall be constructed so that they will not pull out of the soil. Posts will be anchored or set to sufficient depth to resist pullout.

Posts shall be long enough to be set at least 24 Inches in the

ground. All wood posts will be at least 2 inches higher than the top wire of the fence to prevent splitting when attaching insulators. All posts of other materials shall be at least 1 inch higher than the top wire of the fence.

Steel posts and other line post shall be driven minimum of 12" deep or to the top of the flange. Use standard "T" shaped steel posts minimum of 5.5 ft. long.

Post spacing in areas shallow to rock may vary based on availability of post sites. Probe with a rock probe to determine desirable post sites. Steel pipe and steel posts are recommended to use in cracks between rocks. Concrete in posts where possible. Rock bits are available in some areas for drilling rock. Use stays to maintain post spacing. Post set in concrete 30" diameter and 8" deep may be used as a line post. Bury as deep as possible. Use live trees as post where needed. (See section F.)

E. Line Post and Stays

1. High density wood, 1"x1.5".
2. Fiberglass, rigid plastic at least 5/8" in diameter.
3. Wood/Plastic composite post 1" minimum diameter.
4. Fiberglass T-posts and stays of at least 1" in cross-section.

For the above posts, attach wire to post by clips or by running cotter keys through holes in post. Cotter keys are preferred. Attach to stays with tight clips to hold in place.

Wood posts of black locust, red cedar, Osage orange, redwood, pressure treated pine, or other wood of equal life and strength will be used. At least one-half of the diameter of the red cedar and redwood posts shall be heartwood. Pressure treatment shall conform to Materials Specification 585. Wire shall be attached by insulators. See L - Insulation for guidance. Line posts shall be at least 4 inches in diameter.

Steel posts may be "T" posts that are a minimum of 1.25 pounds per one foot of length. Charge wire must be attached with insulators. See L - Insulation for guidance.

Landscape timbers are not acceptable anywhere in the fence as post or braces.

F. Trees as Line, Bracing, and Corner Posts

No more than 50% of post shall be trees unless in a flood plain or area shallow to rock. Live trees used for corner, bracing, and line posts shall have a diameter breast height (DBH) equal to or greater than those prescribed for normal wooden posts. Some alignment variation shall be allowed, but caution should be taken to minimize offsets and prevent excess fencing needs.

Wires or insulators will not be fastened directly to trees. When using live trees, protection will be provided between the tree and wire or insulator (CCA treated 2" x 4", fiberglass, or rigid plastic strip). Avoid using trees with a short

lifespan (i.e., elms and musclewood). Avoid using potentially high-value timber trees. Use lag bolt insulators in trees serving as end post. Do not use fast growing trees as end post.

G. Corner, End, Brace, and Pull Assemblies

(See Standard Drawing Number FEN-382-BR1 and BR2)

Braces and end assemblies are required at all corners, gates, and angles up to 150 degrees in the fence line. Tying off wires at the corner post will lessen stress on the corner post. No brace assembly is required for angles between 150 and 180 degrees however, do use a 6" diameter post as a corner post. Lean the corner post 2" or more away from the direction of pull. Five driven 6" post in the angle can be substituted for one brace assembly in the 150 degree angle.

Three or more wire electric fences require an H-brace, N-brace, or a floating angle brace assembly at all corner, gate, and end or pull assemblies. Posts will be 6-inch nominal wood or 2.5-inch nominal steel pipe (capped). Steel pipe shall be set in concrete 30 inches deep. Posts will be sufficient length to permit driving or setting the post at least 36 inches deep. Earth backfill shall be thoroughly tamped. If concrete is used, set the posts a minimum of 30 inches deep. Posts of equivalent strength may be substituted if they have suitable means of attaching wires and braces.

All wood posts will be at least 2 inches higher than the top wire of the fence to prevent splitting when attaching insulators.

All posts of other materials shall be at least 1 inch higher than the top wire of the fence.

Corner, gate, and end or pull assemblies will be an H-brace, N-brace assembly, or a floating angle brace. Posts will be 6" nominal wood or 2.5" nominal steel pipe (capped). Steel posts shall be set in 30" of concrete. Wood posts will be sufficient length for the construction of at least a 42" high fence and permit driving or setting the posts at least 36" deep. Earth backfill shall be thoroughly tamped. If concrete is used, set the posts a minimum of 30" deep.

One- and two-wire electric fence corner, gate, end, and brace post assemblies may consist of any of the following:

- Wood, steel pipe, or fiberglass posts with a minimum top diameter of 6 inches. Without any bracing, set posts 36" in ground. Install end posts with the top leaning approximately 2-5 inches opposite the direction of pull.
- Wood posts with a minimum top diameter of 6 inches, set 30 inches in the ground with appropriate

knee, floating angle, H-brace, or N-brace.

- Steel “T” posts that are a minimum of 1.25 pounds per one foot of length, set 30 inches in the ground with appropriate knee, floating angle, H-brace, or N-brace.
- Steel pipe or fiberglass posts with a minimum diameter of 2.5 inches, set 30 inches in the ground with appropriate floating angle, H-bracing, knee brace, or N-brace.
- Steel pipe, capped or fiberglass posts with a minimum diameter of 2.5 inches set in 30” of concrete.

H. Bracing

The brace member shall be the equivalent of a 4-inch diameter post or standard weight galvanized steel pipe of 2-inch diameter installed at least 3 feet aboveground or between the top two wires, whichever is higher. An 8’-10’ brace member is ideal but the brace member shall be at least 6’ long. Floating brace member will ideally be 10’ long but must be a minimum of 8’ long when the fence is on flat land or sloping downhill; for uphill slopes, it must be 10’. Do not use floating brace in high animal pressure area, e.g. adjacent to feed pad or water trough.

The brace wire shall be number 9 gauge smooth wire, or 12 1/2-gauge high tensile strength smooth wire. Twist sticks or inline strainers will be used to tighten brace wire. Twist sticks must be a minimum of 2” x 2” and remain in place.

I. Staples and Wire Fasteners

Wires will be attached to line posts by a method that allows wires to slip. If stays are used, wires will be attached to stays in a manner that prevents stay slippage along the fence. Cotter keys are preferred to clips for both post and stays.

If some wires are not electrified, use the following staples. Staples shall be of 9-gauge steel or heavier with a minimum length of 1½" for softwoods and a minimum length of 1" for close-grained hardwoods. Barbed staples shall be used for pine pressure-treated posts. Drive staple diagonally to the wood’s grain and at a slight downward angle (upward if pull is up) to avoid splitting posts and loosening of staples. Space should be left between staple and post to permit free movement of wire.

Splicing of high tensile wire will be accomplished by three crimping sleeves, “figure eight knots,” or “square knots.”

Tying of high tensile wire to end posts will be accomplished using “thread through method” or two crimping sleeves. Tension of wires will be designed to maintain the proper average height of the fence wire and tightness to provide wire contact with animals.

The tension on each wire shall be maintained according to type of grazing animal. Use of in-line strainers will be used on each wire to obtain the correct tension. Number of in-line strainers is

dependent on number of turns. Typically one in-line strainer can tension 800-1000' of straight fence. Place in-line strainers in the middle of a straight span. Tension springs are optional, but are helpful in maintaining proper tension and absorbing sudden shocks to the wire.

J. 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 transmission line and/or to protect a standard fence.

Place offset brackets no further than 60 feet apart and attach to wires of standard fence next to posts. Place offset brackets at two-thirds the shoulder height or nose height of the animals to be controlled. The offset wire shall be 6" or more away from other conductors due to induction of electricity.

K. Energizers

Electronic energizers or power fence controllers shall be installed according to the manufacturer's recommendations that 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 amps in intensity,

finished within .0003 of a second and a rate of 35-65 pulses per minute.

- High impact weather resistant cases.
- 110 volt, 220 volt, 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.
- The ideal voltage for control of all species is 4,000 volts or more. The minimum voltage for livestock control are:

Cattle and Horses - 2,000 Volts.

Sheep, Goats, and Hogs - 3,000 Volts.

Size – As a rule of thumb, the energizer should be capable of producing one joule of energy for each mile of planned fence when average energy loss to the system is expected. Each joule will typically provide enough power to fence 25 to 40 acres of pastureland.

1. Ground

Minimum grounding for all energizers except temporary fencing is three ground rods 10' apart 6' deep or equivalent. All electric

fences must be properly grounded. The energizer ground wire should be connected to a rod 1/2 inch or larger in diameter. Bury 3 feet of ground rod for each joule of energy output. Ground rods should be buried where soil remains moist for best results. Drive sufficient 6' to 8' rods into the ground at least 10' apart to provide the required amount of ground rod. Drive at a 45 degree angle or flatter if soil depth is restrictive. Connect a continuous ground wire from the energizer to all ground rods with a galvanized steel or aluminum clamp. Copper rods with copper wire may be used if the energizer terminals are stainless steel or copper. If energizer terminals are not stainless steel or copper, do not use copper ground rods due to corrosion at the connection and subsequent loss of electrical continuity. Use copper clamps with copper wire and copper rods.

The ground wire(s) of the fence may be connected to the same ground as the energizer or separate ground with the same size and depth requirement.

More ground rods may be needed for system to function properly.

Do not use the grounding system for other existing applications, such as power poles, breaker boxes, and milk barns. Separate the fence grounding system from any other grounding system by at least 25'.

2. **Lightning Protection**

Lightning can cause damage to the energizer. Most energizers are poorly protected from lightning strike. Install external lightning arrestors for added protection. Place lightning arrestor grounding rods at least 65 feet from those of the energizer.

Install an additional set of ground rods and attach to a lightning arrestor. Use at least one more ground rod on the arrestor than was used on the energizer. Attach the lightning arrestor to the wires of the fence. Install a lightning choke in the fence line immediately between the lightning arrestor and the energizer. The lightning arrestor ground must be better than the energizer ground for it to function properly, because lightning will seek the least resistant route to ground. A spark gap may be used in lieu of a lightning arrestor. A spark gap is a small gap between a hot wire and a ground wire. Set the gap slightly beyond the point

that electricity normally sparks.

3. **Surge or Spike Protector**

For protection of 120- or 240-volt energizers install a surge protector between the energizer and power supply.

L. **Insulation**

Insulation used for positively charged wire(s) must be high-density polyethylene with ultraviolet stabilizer or high-density polypropylene with ultraviolet stabilizer.

All underground wire(s) installations must be double insulated, molded, aluminum or high tensile strength steel 13 gauge or larger wire. Use the same size wire as the fence. The insulation must be high-density polyethylene with ultraviolet stabilizer or high-density polypropylene with ultraviolet stabilizer.

Insulators for steel and other conductive material posts must be high-density polyethylene with ultra-violet stabilizer, high-density polypropylene with ultra-violet stabilizer, or porcelain that withstands 10,000 volts.

Insulators for end, corner, and angle braces must be high-density polyethylenes with ultraviolet stabilizer, high-density polypropylene with ultraviolet stabilizer or porcelain that withstands 10,000 volts. Slip on insulator use is discouraged due to

the chance of them breaking down and leaking electricity. If slip on insulators are used for corners they must have reinforced steel in them.

M. **Insulated Wire**

To cross gates and areas where electrical shocks to humans and livestock should be prevented use insulated galvanized wire. For underground burial, use wire designed for burial. Install so water does not stand in the conduit pipe. Do not use insulated copper wire due to corrosion at the splice and lack of tensile strength.

N. **Gates**

(See Standard Drawing Number FEN-382-GAT.)

Electrified gates may be constructed of a single straight wire, galvanized cable, or polytape with a spring-loaded insulated handle, or an expandable, coiled, high tensile, 12 1/2-gauge wire attached to an insulated handle.

The number of wires shall be determined by the fence objective. Electric gaps will not be used to deliver electricity to the area beyond the gap. Overhead or underground transmission lines will be used to carry electricity past the gate to the remainder of the fence. When overhead transmission is used, height should be sufficient for movement of livestock and/or equipment. Placing buried wire inside plastic pipe helps to decrease the incidence of short-circuiting.

O. Floodgates

An electrified floodgate may be used instead of a non-electrified floodgate. The electrified floodgate is constructed by stretching an electrified wire or cable across the drainage above high water flow level. A second wire is used to deliver electricity to the fence on the opposite side of the stream. Attach droppers of: pipe, rods, chains, or equivalent to the electrified wire at a spacing of 6 to 10" inches. Droppers should extend to within 10 inches above the average normal water level or to the normal recommended fence height above the stream bottom. Connect the floodgate to the electric fence with double insulated cable through a cut-off switch and floodgate controller. If flooding is expected to last some time, switch the floodgate off.