

**NATURAL RESOURCES CONSERVATION SERVICE
CONSTRUCTION SPECIFICATION**

**FENCE
(Feet)**

CODE 382

PERMANENT ELECTRIC WIRE FENCE (PEWF)

Permanent electric wire fence (PEWF) shall consist of high tensile smooth wire. All or part of the wires shall be electrified. One to 4 wires of 14 or 16 gauge high tensile smooth wire may be used for interior fences. The runs of 14 and 16 gauge wire should be less than 3 miles for cattle and horses and no more than a mile for goats and sheep. Boundary, exclusion, and arterial leadout fences shall be a minimum of 12.5 gauge high tensile smooth wire.

Permanent electric wire fence is suitable for all animals.

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

1. Materials.

a. Wire.

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

Gauge – 12.5

Tensile Strength – 170,000 psi (minimum)

Galvanizing – Class 3

Breaking Strength – 1,300 lbs. (minimum)

Gauge---14

Tensile Strength – 200,000 psi. (minimum)

Galvanizing – Class 3

Breaking Strength – 955 lbs (minimum)

Gauge – 16

Tensile Strength – 200,000 psi (minimum)

Galvanizing – Class 3

Breaking Strength – 585 lbs (minimum)

b. Insulators and/or Fasteners.

(1) Staples, nails, or screws to hold insulators shall be of 9 gauge class 3 galvanized steel or heavier with a minimum length of 1¾ inches for softwoods and a minimum length of 1 inch for close-grained hardwoods.

(2) Insulators shall be high density polyethylene or polypropylene with ultra-violet stabilizer or porcelain.

2. Posts.

a. Wood.

All wooden posts and brace members (except red cedar, osage orange, or black locust) shall be treated with a minimum of 0.40 lbs/cubic foot of chromated copper arsenate (CCA) type A,

B, or C or ammoniated copper quat (ACQ) preservative by a method to ensure that complete penetration of the sapwood is obtained or have a 20-year warranty. All bark shall be removed from the red cedar, osage orange, and black locust. At least half the diameter of red cedar shall be heartwood. Quality of treated wood shall provide sufficient strength and last for the expected life of the fence.

All corner, end and gate brace assembly posts shall be wooden with a minimum top diameter of 6 inches. Assembly posts shall be a minimum of 8.5 feet long for single H-brace assemblies and 7.5 feet long for double H-brace assemblies.

Bend assembly post shall have a minimum top diameter of 5 inches and will be a minimum of 7.5 feet long.

Wooden line posts shall have a minimum 4 inch diameter (3-inch for osage orange). Wood line posts shall be a minimum length of 7 feet.

b. Plastic.

Plastic line posts shall be at least 4 inches in diameter, able to accept and hold staples, and be durable for the life of the fence. Plastic line posts shall be a minimum length of 7 feet.

c. Steel.

Steel line posts shall have the standard "T" section, nominal dimensions of 1 3/8" x 1 3/8" x 1/8" with anchor plate. The posts shall weigh at least 1.25 pounds per foot of length and be painted with a weather resistant paint. The posts shall be studded to aid in wire attachment. Steel line posts shall be a minimum length of 6 feet.

d. Fiberglass.

Fiberglass T-post shall be of at least 1 inch in cross-section. Attach wire to post by loose clips or by running through holes in the post. Attach to stays with tight clips to hold in place.

Fiberglass, rigid plastic, and polyvinylchloride solid round sucker rod shall be of at least 5/8 inch in diameter.

e. Australian ironwood (eucalyptus) shall be of at least 2 inches in width.

f. Stays/Battens.

Stays shall be at least 3/8 inch in diameter steel, fiberglass, rigid plastic, or eucalyptus.

g. Other.

Other materials may be used for line and assembly posts if they are of equal or greater strength and quality of above. They must be approved by the engineer.

3. Construction.

a. Post Installation and Spacing.

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. Wire or insulators will not be fastened directly to trees. A board or boards will be placed on the tree to keep the wire from contacting the bark. Wire shall not be

wrapped around the tree. A CCA treated 2" x 6", fiberglass strip, plastic strip, or an untreated red or white oak board with a minimum size of 1" x 4" must be securely fastened to the tree with at least three 40 lb. pole barn nails. The board must be long enough to accommodate the wire. The fence will be fastened to the board with staples.

b. Corner, End, and Gate Brace Assemblies for five and more wire fences.

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

- (1) If the posts are to be set or driven to 4 feet below the ground line, a single H-brace assembly shall be used.
- (2) If the posts are to be set or driven to 3 feet below the ground line, a double H-brace assembly shall be used.

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

All brace members shall be wood and the horizontal cross member centerline shall be 4 to 9 inches below the top of post. Other brace material of equal strength may be used with the approval of the fence designer.

The horizontal cross member shall be a minimum of 4 inches in diameter and a minimum of 7 feet in length. A tension wire composed of 2 complete loops of number 9 gauge smooth wire, of 12.5 gauge high tensile smooth wire shall be used. One end of the tension wire shall be at the height of the horizontal cross brace member and the other end of the tension wire shall be 4 inches above the ground line on the other post.

A corner assembly or a bend assembly shall be used when the horizontal alignment changes more than 15 degrees and a pull assembly when the vertical alignment changes more than 15 degrees. A bend assembly will be used only when it will not affect the integrity of the fence. Post spacing for a bend assembly can be determined by placing 3 stakes, each spaced 14 feet apart along the fence line. A string is then stretched between the first and third stake. A measurement is then taken from the second stake and the string. The spacing of the posts for a bend assembly is determined as follows:

0 to 4 inches	14 feet
5 to 7 inches	12 feet
8 to 10 inches	10 feet
11 to 15 inches	8 feet
16 or more inches	6 feet

These bend assembly posts will be wood and set with a 6-inch lean from vertical to the outside of the curve and set or driven 36 inches deep.

c. Line Post.

Wooden and plastic line posts shall be set or driven 34 inches below ground line. If soil depth is less than 28 inches, use standard "T" section posts.

Steel line posts shall be set or driven 21 inches below ground line.

If posts are not driven, the backfill around the post shall be thoroughly compacted.

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

d. Number of Wires and 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. When multiple wire systems are used, spacing of wires should be designed to ensure facial shock when animal attempts to place head between wires.

TABLE 1. Recommended Wire Spacing and Charge (+/-)

WIRES	ANIMAL TYPE	FENCE HEIGHT (INCHES)	SPACING FROM GROUND (INCHES)
1	Cattle Hogs	26 to 32 12	26 to 32+ 12+
2	Cattle Cattle, Sheep & Goats Hogs	24 to 36 20 to 30 18	18 to 24+/-, 24 to 36+ 8 to 10+, 20 to 30+ 6+, 18+
3	Cattle w/calves and Division Fences Sheep, Goats Cattle, Horses Hogs	34 to 44 32 46 18	11 to 18+/-, 23 to 30-, 34 to 44+ 10+, 20+/-, 32+ 20+, 34+/-, 46+ 6+, 12+, 18+
4	Cattle Sheep, Goat	40 30 to 38	8+/-, 18+, 28+/-, 40+ 6 to 16+/-, 12 to 22+, 18 to 30+/-, 30 to 38+
5	Cattle, Horses, Sheep, Goat	48 to 50	10+, 20+/-, 30+, 40+/-, 50+
6-8	Deer, Predator Control	52 to 62	4-6+, 6-8-, 12+, 18-, 24+, 30+/-, 40+/-, 52+

e. Fastening.

The top wire shall be at least 2 inches below top of wooden post and 1 inch below the top of steel post.

Tension – Approximately 100 pounds on each wire.

Tension will be applied with an in-line stretcher on each strand.

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 pressure treated posts.

Wire shall be spliced by means of a figure 8 knot, reef knot or by suitable splice sleeves applied with a tool designed for the purpose. All wraps at the ends of knots shall be tightly wound and closely spaced.

In instances where ground moisture is high, an all positive charged fence will normally suffice.

f. Interior Fences.

For 1 to 3 wire electric fences, corner, gate, end, and brace post assemblies may consist of the following:

Steel "T" posts that are a minimum of 1.25 pound per one foot of length with appropriate knee, deadman, angle, anchor, or H-brace.

Wood posts with a minimum top diameter of 4 inches set 36 inches in the ground with appropriate knee, deadman, angle, anchor, or H-brace.

Wood, steel pipe, or fiberglass posts with a minimum top diameter of 5 inches, set to a depth equal to or greater than the height of the post above the ground without any bracing.

Steel pipe or fiberglass posts with a minimum diameter of 2 inches, set 36 inches in the ground with appropriate angle, H-bracing, knee brace, deadman or anchor plate.

Steel pipe or fiberglass posts with a minimum diameter of 2 inches if set in concrete to a depth of 24 inches.

Steel pipe or fiberglass posts with a minimum diameter of 1 inch with appropriate angle bracing and sufficient ground anchoring to maintain wire tension to remain firmly anchored and stay erect.

Four wire electric fences shall use a single H-brace assembly for corner, end, and brace assembly. Assembly post shall be a minimum of 7 feet long. Posts will be 5-inch nominal wood. Posts must be set or driven a minimum of 36 inches below the ground line.

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.

h. Line Post.

(1) Post Length.

Wood posts shall be long enough to be set at least 30 inches in the ground. Steel posts shall be driven 21 inches below ground line. Fiberglass, ironwood, rigid plastic, and polyvinylchloride will be driven at least 16 inches below ground line. 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.

(2) Spacing.

Spacing of line posts and stays depends on the livestock species, terrain and number of wires. Maximum spacings are as follows. One and two wire fences may have line posts spaced up to 100 feet apart with no stays required. Line posts may be spaced 150 feet apart with stays or light posts at 50-foot spacings between the posts. Three or more wire fences may have line posts spaced up to 50 feet with no stays or up to 150 feet with stays every 50 feet. In undulating terrain, space posts and stays so that fence height is maintained. Posts in dips shall be installed so that they will not pull out of the soil. Two-inch or smaller posts will be anchored or wooden posts (3 inch) set to sufficient depth to resist pull out.

(3) Offset Brackets.

Offset brackets made of galvanized high tensile spring wire with an insulator of high density polyethylene containing an 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 post. If control of animals is desired, place offset

brackets at 2/3 the shoulder height of the animals to be controlled. Ensure that no wires of the old fence come in contact with the electric fence wire, as a short will occur.

4. Energizers.

a. Power Source.

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, finished within .0003 of a second and a rate of 35-65 pulses per minute.
- High impact weather resistant cases.
- 110 volt, 220 volt, or 12-volt battery powered capable of operating 3 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 accepted figures for minimum voltage for livestock control are: cattle-1600v; sheep and hair goats-2000v; hogs, horses, and meat goats-1200v.
- Safety fuse fused to prevent over pulsing.

b. Size.

Rule of thumb, the energizer should be capable of producing 1 joule of energy for each mile of planned fence when average energy loss to the system is expected. (Joules are units of electrical energy. One joule does about 0.74 ft-lb. of work. Watts x seconds = joules.)

5. Ground.

All electric fences must be properly grounded. The energizer ground wire should be connected to a galvanized pipe or rod ½ 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 feet rods into the ground at least 10 feet apart to provide the required amount of ground rod. Connect a continuous ground wire from the energizer to each rod or pipe 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. Follow the manufacturer's recommendations for the number of ground rods.

Do not use the grounding system for other existing applications, such as power poles, breaker boxes, and milk barns. At least 25 feet should separate the fence grounding system from any other grounding system.

6. Lightning Protection.

Lightning can cause damage to the energizer. Most energizers are poorly protected from lightning strike. External lightning arrestors and an induction loop (lightning choke) should be installed for added protection. Lightning arrestor grounding rods should be placed 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 1 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.

7. Spike Protector.

A voltage spike protector is recommended for use with 120 and 140-volt energizers. Also, a ground rod should be installed at 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. Additionally, a surge protector should be installed between the energizer and power supply.

8. Insulation and Insulated Cable.

Insulation used for positively charged wire(s) must be high-density polyethylene containing an ultra-violet stabilizer or high-density polypropylene containing an ultra-violet stabilizer.

All underground wire(s) installations must be double insulated; molded; aluminum or high tensile strength steel, 14 gauge or larger wire. The insulation must be high density polyethylene polypropylene containing an ultra-violet stabilizer.

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. Placing buried cable inside plastic pipe helps to decrease the incidence of short-circuiting. When overhead transmission is used, height should be sufficient so as not to impede the movement of livestock or equipment. Do not use insulated copper wire due to corrosion at the splice and lack of tensile strength.

9. Gates.

a. Electrified Gates.

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 ½ 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.

b. 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 ½ 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 to last some time, switch the floodgate off.

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