

**NATURAL RESOURCES CONSERVATION SERVICE
CONSTRUCTION SPECIFICATION**

IA-92. FENCES

1. SCOPE

The work shall consist of furnishing and installing fences, including gates and fittings.

2. STANDARD FENCE

Barbed wire fences shall have a minimum of 4 wires for farm borders. A minimum of three wires shall be used for interior fencing, cross fencing, or excluding livestock from special areas such as wildlife area, forested tracts or other special use areas. Wires shall be spaced approximately an equal distance apart. The top wire shall be at least 42 inches high and 2 inches below the top on wood posts and 1 inch below the top on steel posts. The bottom wire shall be 18 inches or less above the ground level. Wire shall be spaced no more than 12 inches apart.

Each barbed wire shall consist of 2 twisted strands of either 12 ½ gauge wire or 15 ½ gauge high tensile strength wire. The barbs shall be either 2-point barbs on approximately 4 inch centers or 4-point barbs on approximately 5 inch centers. Wire shall be stretched and attached after the posts are properly set and backfilled. Attach wire to the side of the post closest to the livestock, except on corners and curves where the wire should be placed on the outside of the corner or curve.

Top and bottom strands of **woven wire** shall be a minimum of 12 ½ gauge. Wire for intermediate strands shall be 14 1/3 gauge or heavier. Fences with woven wire 32 inches or less in height shall have at least 2 barbed wires above the woven wire spaced 8 to 12 inches apart. Fences constructed with woven wire higher than 32 inches shall have at least 1 barbed wire 8 to 12 inches above the woven wire. The base of the woven wire shall be placed near the ground surface. The top wire shall be at least 42 inches above the ground level and 2 inches below the top of wood posts and 1 inch below the top of steel posts. All wire shall be galvanized. . Wire shall be stretched and attached after the posts are properly set and backfilled. Attach wire to the side of the post closest to the livestock, except on corners and curves where the wire should be placed on the outside of the corner or curve.

Staples shall be 9 gauge steel or heavier with a minimum length of 1 ½ inches for soft woods and a minimum length of 1 inch for close grained hardwoods. Drive staples diagonal to the grain of the wood and at a slight downward angle. Space should be left between the staple and the post to permit free movement of the wire. Wires may be attached to steel posts by use of manufacturer's clips or by 14 gauge galvanized wire twisted at least two turns.

All wooden **posts** (except red cedar, Osage orange, or black locust) shall be treated with pentachlorophenol, creosote, or chromated copper arsenate (CCA) by a method that ensures complete penetration of the sapwood. At least half of the diameter of red cedar shall be heartwood. Quality of treated wood shall provide sufficient strength and quality to last for the expected life of the fence.

All corner posts, gate posts, end posts, pull posts and brace posts normally shall be wood with sufficient length for the construction of at least a 42 inch high fence and permit setting the post at least 36 inches deep. Earth backfill shall be thoroughly tamped. On areas where soil depth is restricted to less than 36 inches, additional anchors or deadman applied against the direction of pull may be needed. Wood posts shall have a minimum top diameter of 5 inches. A 2-½ inch steel pipe with appropriate bracing or set in concrete of sufficient depth also may be used. Reinforced concrete or metal posts of equivalent strength may be substituted if they have suitable means of attaching wires and braces.

The maximum spacing of line posts shall be one rod (16.5 feet). Wood line posts shall have a 3 inch top (2 ½ inch for osage orange). Wood line posts shall have a minimum length of 6 ½ feet and shall be set or driven to a minimum depth of 24 inches where conditions permit. When posts are set, earth backfill shall be thoroughly tamped. Steel line posts shall weigh not less than 1.33 pounds per foot and shall have a steel anchor plate securely fastened to the plate. The posts shall be “T”, “U”, or “Y” shaped and have corrugations, knobs, studs, or grooves suitable for fastening fencing to the posts. Steel posts shall be rolled from high carbon steel and shall have a protective coating; either galvanized by the hot dip process, painted with one or more coats of high grade weather resistant paint for steel, or enameled and baked. Steel line posts shall be at least 6 feet in length and shall be set in the ground a minimum of 20 inches. Steel posts shall be used as line posts at least once every 6 rods (99 feet) to act as a ground for lightning protection.

End **bracing** will be installed at locations where the fence ends and on both sides of gate openings. Corner bracing should be installed where fence alignment changes 15 degrees or more. Bracing is required at all corner, gate, pull and end assemblies in a fence. The brace member shall be the equivalent of a wood post with at least a 3 ½ inch diameter at the top or standard weight 2 inch diameter galvanized steel pipe. The brace shall be at least 3 feet above the ground and at least 8 inches below the top of the post. The brace member shall be 6 to 8 feet in length. A brace wire consisting of 2 complete loops of 9 gauge smooth wire, 2 loops of barbed wire or a single loop of 12 ½ gauge high tensile strength wire shall be installed. “H” braces or angle braces as shown in figure 3 will be used in standard fences.

Pull post assemblies consisting of three posts with braces shall be installed in straight reaches of fence at intervals 660 feet (40 rods), at any point where the vertical angle described by two adjacent reaches of wire is upward and exceeds 10 percent and at the beginning and end of each curve.

For a **narrow ditch or draw crossing** with slopes steeper than 8 feet horizontal to 1 foot vertical, the fence shall be anchored with a concrete anchor weighing at least 150 pounds and buried with at least 18 inches of cover or a commercial screw-in type metal anchor 5 inches in diameter and not less than 48” long to position the fence to the contour of the ditch or draw.

Wire **gates** shall be made of the same materials as used for the fence. Panel gates shall be equivalent in quality to the fencing material and shall be fitted with at least two hinges and a latch or galvanized chain for fastening.

3. CHAIN LINK FENCE

Chain link fence, fabric, posts, top rails, braces, gates and accessories shall conform to the requirements of ASTM Specifications types, classes and materials listed below. The fence shall be constructed in a workmanlike manner.

Fabric shall be ASTM A 392, 2-inch mesh, 9 gauge galvanized steel wire. Zinc coating shall be Class 2. Fabric shall be 60 inches in height. Fabric shall not be stretched until at least 4 days after the posts are set in concrete backfill or grouted in concrete walls. A stretcher bar of the same length as the fabric width shall secure each end of each run of fabric. The bar and fabric shall be stretched taut and secured to the end post by tension bands equally spaced not more than 15 inches apart. The fabric shall be attached to all braces; the top rail, all line posts and the tension wire by wire ties or clips at intervals not exceeding two feet.

Posts and fence framework shall conform to the requirements of ASTM F 1043 Group 1A, for Heavy Industrial Fence. Coatings shall be type A galvanized coating both internal and external surfaces. Steel pipe for posts shall conform to the requirements of ASTM F1043 and F 1083. The minimum diameter of end, corner, and pull posts shall be 2 3/8 inches. Line posts shall be at least 1.9 inches in diameter. Gate posts shall have a minimum diameter of 2 7/8 inches. The maximum spacing of line posts shall be ten feet. Post holes shall be at least 6 inches in diameter and 18 inches deep for line posts and 24 inches for corner, end, pull and gate posts. All posts shall be set in concrete backfill. Concrete shall completely fill the annular space around the posts and shall be neatly finished to slope up to the post approximately 1 1/2 inches above the ground surface. Pull posts shall be located in long straight runs of fence at intervals of 500 feet or less. Posts set in concrete walls shall be grouted into preformed holes at least 12 inches in depth. Where posts are installed in highly corrosive soils such as disturbed mine spoil, the posts shall be vinyl coated in addition to the above requirements and set in concrete poured inside a 6 inch clay tile or plastic tubing at least 24 inches long.

When used, **braces and top rails** shall be installed horizontally at the height shown on the drawings or recommended by the manufacturer. See previous paragraph for specifications. Braces and top rails shall be attached to the posts by suitable fittings, as recommended by the manufacturer. When the brace has been placed, a 6 gauge double truss galvanized steel wire with adjustable tightened and fittings shall be attached to the corner post just below the brace and to the brace post approximately 4 inches above ground level. A similar truss wire shall be attached to brace post just below the brace and to the corner post approximately 4 inches above ground level. A 7 gauge galvanized steel tension wire, tightened by mechanical means, shall be placed approximately 4 inches from the ground level. A similar tension wire shall be placed at the top of the fence if a top rail is not used.

Gates, gateposts and gate accessories shall conform to the requirements of ASTM F 900. Coating shall be the same as the adjoining fence and framework.

4. HIGH TENSILE WIRE (HTW) FENCE

HTW fence shall have a minimum of eight smooth strands of galvanized 12 1/2 gauge **wire** with not less than 0.8 ounce of zinc per square foot of wire surface and a tensile strength of 200,000 pounds per square inch. Each strand of wire shall be strung to a tension of not less than 250 pounds. The top wire shall be 48 to 54 inches above the ground surface. The bottom wire shall not be more than 6 inches above the ground surface. The wire shall be fastened on a direct line splice with enough nicopress sleeves that the accumulated strength of the sleeves exceeds the tensile strength of the wire. End wrap splices shall be fastened with two nicopress sleeves. Splices may also be made with other products used as directed by the manufacturer.

Posts shall be the same size and material as posts for standard fences. Line posts shall be spaced not more than 30 feet apart with spacer made of wood or fiberglass spaced at not more than 15 feet from either post. Corners, pull assemblies, ends and gates shall have a double assembly consisting of three driven posts with horizontal braces. Each assembly shall be further braced with a double wrap of high tensile wire (see attachment A).

5. PERMANENT HTW ELECTRIC FENCE

Permanent HTW electric fences are constructed with the intent of being in place for years. It is the equivalent of any non-electric permanent fence. Electric fences provide psychological deterrent rather than a physical barrier to livestock and wildlife. To be effective, a shock of at least 1,000 volts must be delivered to cattle, 2,000 volts to sheep and 2,500-3,000 volts to deer, dogs, and coyotes.

Wire shall be a single strand of 12 ½ gauge or larger with a minimum tensile strength of 110,000 pounds per square inch. The wire shall galvanized (Type III) or aluminum or copperclad. Barbed wire should not be used on electric fences because of safety hazard. Wire will be attached to the posts by a method that allows them to slip. Wires will be attached to stays in a manner that prevents stay slippage along the fence. The tension of each wire shall be sufficient to maintain the wires at the appropriate height. Suggested wire heights and spacing are shown by intended use in the following table.

Fence Description	Number of Wires	Wire Height (In.)
<u>Internal/Cross Fence</u>		
Cow /calf & stocker	1 wire	30 to 34
Hogs	1 wire	12
Cow /calf & stocker	2 wire	22;32
Sheep and cattle	3 wire	10; 20; 32
Sheep and cattle	4 wire	10; 20;32;46
<u>Perimeter Fence</u>		
Cattle, horses, sheep (Non-predator)	5 wire	10; 20; 30; 40; 50
Sheep, goats (Predator)	8 wire	4; 8; 12; 18; 24; 30; 40; 52

Electronic energizers of power fence controllers shall be installed according to manufacturer's recommendations. The energizers shall be high power, low impedance with 5,000 volt peak output and a pulse that is less than 300 mAmps in intensity, finished within 0.0003 of a second and at a rate of 35-65 pulses per minute. Energizers shall be provided with high impact, weather resistant cases. Circuitry shall be solid state. Service modules shall be snap-in for fast field repair. A safety fuse to prevent overpulsing shall be provided. The system shall be 110 volt, 220 volt or 12-volt battery powered. The battery-powered system shall be capable of working for at least 3 weeks without replacing the battery. If the length of the fence requires more than 4 joules (watts times seconds equals joules), a solar charger will be needed for 12 volt systems. The energizer shall be capable of producing one joule for each mile of planned fence when average energy loss is expected.

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. Ground rods should be driven into the ground at least 10 feet apart when multiple rods are necessary to provide the required length of ground rod. Normally individual ground rods will be driven no more than 6 to 8 feet into the ground. Connect a continuous ground wire from the energizer to each ground rod with aluminum or galvanized steel clamp. 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. Copper rods with copper wire may be used if energizer terminals are stainless steel or copper. 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 to a separate ground with the same size and depth requirements. More ground rods may be needed for the system to function properly. 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.

Lightening can cause damage to the energizer. Most energizers are poorly protected from damage caused by lightning. External **lightning arrestors** and an induction loop (lightening choke) should be installed for added protection. Lightning arrestor grounding rods should be placed at least 65 feet from those of the energizer (See attachment B).

Install an additional set of ground rods and attach to a lightning arrestor. The lightning arrestor ground must be better than the energizer ground for it to function properly, because lightning will seek the path of least resistance to ground. 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.

For protection of energizers, it is recommended that for 120 or 240-volt energizers that a voltage **spike protector** be used. 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.

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

Braces and end assemblies are required at all corners, gates and angles in the fence line (See attachment A for criteria on corners, angles, and brace assemblies.)

For 1 and 2 wire fences, corner, gate, end and brace assemblies use one of the following:

- Steel "T" post that are a minimum of 1.25 pounds per foot of length, with appropriate knee, deadman, angle or H-brace.
- Wood posts with a minimum top diameter of 3.5 inches set two feet in the ground with appropriate knee, deadman, angle, or H-brace.
- Wood, steel pipe or fiberglass post 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 bracing.
- Steel pipe or fiberglass posts with a minimum diameter of 2 inches, set 2 feet in the ground with appropriate knee, angle, or H-brace, deadman or anchor plate.
- Steel pipe or fiberglass posts with a minimum diameter of 2 inches and set in concrete to a depth of 2 feet.

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

For 3 or more wire power fences; corner, gate, end and brace assemblies will be either a floating angle brace or H-brace assembly. Posts will be 4-inch nominal wood, 2-inch nominal steel pipe (capped), 2-inch fiberglass or steel "T" posts with appropriate appurtenances for corner and end bracing. Posts must be set a minimum of 2 feet in the ground.

All wood posts shall be at least 2 inches higher than the top wire of the fence. Posts of any other material shall be at least 1 inch higher than the top wire of the fence.

Line post and stays will be either:

- Australian ironwood (eucalyptus) at least 2 inches in diameter; fiberglass, rigid plastic and PVC solid round sucker rod of at least 5/8 inch diameter, or fiberglass "T" post and stays of at least 1 inch in cross-section. Attach wire to the post with loose wire clips or run the wire through holes in the post. Attach the wire to stays with tight clips.
- Wood posts at least 3 inches in diameter of black locust, red cedar, Osage orange, redwood, pressure treated pine or any other wood of equal life and strength may be used. At least one half of the diameter of the red cedar and redwood post shall be heartwood. Pressure treated posts shall be treated with pentachlorophenol, creosote, or chromated copper arsenate (CCA) by a method which ensures the complete penetration of the sapwood. Insulators shall attach wire.
- Steel "U" or "T" posts that are a minimum of 1.25 pounds per foot of length. Wire shall be attached with insulators.

Posts for one or two wire fences shall be long enough to be set at least 18 inches in the ground, except that in soils which are sandy loam or coarser in texture, the posts shall be set at least 24 inches into the ground. Posts for 3 or more wire fences shall be set at least 24 inches into the ground. Posts in dips shall be constructed so that they do not pull out of the soil. Posts 2 inch or smaller shall be anchored. Wood posts shall be set to a depth sufficient to resist pull out.

Wood posts shall be at least 2 inches higher than the top wire on the fence. All other posts shall be at least 1 inch higher than the top wire of the fence.

Spacing of the line posts and stays depends on the terrain and the number of wires.

Maximum spacing is as follows

- One or two wire fences may have line posts spaced up to 100 feet apart with no stays. Line posts may be spaced 150 feet apart with stays every 50 feet between the posts
- For three and four wire fences, the line posts may be spaced every 50 feet with no stays or every 150 feet with stays at spacing of not more than every 50 feet.
- Fences with more than 4 wires shall have posts and stays spaced every 30 feet, with posts not further apart than every 90 feet.
- In undulating terrain, space posts and stays as needed to maintain the fence height.

Insulators for conductive material posts, end, corner and angle braces shall be high-density polyethylene with ultra-violet stabilizer, high density propylene with ultra-violet stabilizer, or porcelain. All insulators shall be capable of withstanding 10,000 volts or more of current leakage. Red insulators attract hummingbirds and should not be used.

Electrified **gates** may be constructed of a single straight wire, galvanized cable, or polytape with a insulated spring loaded 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 objective of the fence. 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.

Use insulated galvanized wire for crossing gates and areas where electrical shocks to livestock and humans is undesirable. All underground wires must be insulated for a minimum of 15,000 volts. Insulated underground wire should be specifically designed for high voltage electric fence. The insulation shall be high-density polyethylene with ultra-violet stabilizer or high-density polypropylene with ultra-violet stabilizer. Placing buried wire inside plastic pipe helps to decrease the likelihood of short-circuiting. Overhead transmission lines shall be at a height where the lines do not impeded movement of livestock or equipment.

An electrified **floodgate** may be used in lieu of a non-electrified gate if desired. The electrified floodgate should be constructed by stretching an electrified wire across the drainage above the high water 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 for sheep and 12 inches for cattle. The droppers shall be extended to approximately 6 inches above normal water level. Connect gate to electric fence with a double insulated cable through a cutoff switch and flood control gate controller. If flooding is expected to last for an extended period of time, switch the floodgate off. (See attachment C).

Other materials of equivalent strength, durability and design may be used.

6. TEMPORARY ELECTRIC FENCE

Temporary electric fencing is constructed with the intent of being left in place for only a short period of time. The fence is not intended as a substitute or equivalent of permanent fence. The temporary fence requires materials, design and construction that will accomplish the intended purpose and last for the planned time period with no more maintenance than is desired.

Many companies market portable fence systems that use materials such as polyethylene wire and tape with steel or aluminum wire woven into them, aluminum wire, plastic and fiberglass posts, reels to roll up wire, and battery operated energizers that are high voltage and low impedance (see previous section on energizers). A minimum of six strands of steel or aluminum wire should be woven into the polywire or polytape. Temporary fences may be attached to permanent fences to subdivide pasture. Follow manufacturer's directions for construction, use and operation of temporary electric fences

7. SPECIAL SPECIFICATIONS