

**NATURAL RESOURCES CONSERVATION SERVICE
CONSTRUCTION SPECIFICATION**

**FENCE
(Electric Fence)**

SCOPE

The work shall consist of constructing the fence, including any associated gates, water gaps, electrical system and other related items as required by the construction plans or job sheets.

LOCATION

The location of the fence shall be as shown on the Fence Job Sheet (JS382e) or identified on a project map, and as staked in the field.

SITE PREPARATION

All trees, stumps, brush and debris shall be removed from the fence construction site and disposed of so that they will not interfere with construction or proper functioning of the fence. Removed material shall not be deposited or buried in a draw.

Remove and properly discard all broken fencing material and hardware. All necessary precautions should be taken to ensure the safety of construction and maintenance crews.

MATERIALS**Fence Wire (Energized) and Fasteners**

Wire shall be 12½ gauge, single strand, minimum tensile strength of 140,000 PSI, and 1,078 lbs. minimum breaking strength. All wire shall have, as a minimum, Class III galvanization.

All fasteners for insulators, etc. will be Class III galvanized or stainless steel.

Wire Insulation

All underground wire installations must be double-insulated, Class III galvanized, Hi-Tensile strength steel 12½ gauge or larger wire. 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 ultraviolet stabilizer, high-density polypropylene with ultraviolet stabilizer, or porcelain that withstands a minimum of 12,000 volts or more without arcing.

Insulators for end, corner, and angle braces must be high-density polyethylene with ultraviolet stabilizer, high-density polypropylene with ultra-violet stabilizer, or porcelain that withstands a minimum of 12,000 volts or more without arcing. Do not use insulated galvanized wire or reinforced tubing for attaching fence wires around post of brace assemblies.

Red insulators should not be used due to their attractiveness by hummingbirds.

Posts and Stays

Posts and stays shall conform to size and material specifications in Table A, except as noted below.

Use of landscape timbers is prohibited in any part of a fence.

Reinforced concrete or metal posts of equivalent strength to wood posts specified for corner, gate, end or pull assemblies, and brace posts may be substituted if a suitable means of attaching wires and braces to the posts is available.

Six (6) foot, or longer, fiberglass posts may be used in exterior fences; however, if the depth of placement is less than the depth required in Table A, every sixth post must be wood and the wood posts must meet size and depth placement specifications for exterior fences.

Manufactured fiberglass brace assemblies that contain fiberglass posts (minimum of 2 inches outside diameter and 1.5 inches inside diameter) and are attached to screw-in anchors in the ground are acceptable if installed according to manufacturer's recommendations, and if the fiberglass component is guaranteed to last for 20 years without flaking, peeling, rotting, abnormally

discoloring, splintering or deteriorating from sunlight and weather.

Live trees shall be allowed for bracing or line posts only when application of standard wooden posts or steel posts is impractical because of restrictive soil depths due to parent material (rock, shale, etc.) and cannot be set or driven to the minimum depths required by the standard and specification. At no time shall live trees constitute more than 10 percent of the line posts used.

Live trees used for bracing and line posts shall have a diameter breast height (DBH) equal to or greater than those prescribed for normal wooden posts.

The top of all wooden posts shall be 2 to 4 inches above the top wire of the fence to prevent splitting when attaching insulators.

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

CONSTRUCTION

Wire Placement

Fence height shall be defined as the average height from ground to top of wire at each fence post. Fence height of exterior/property line fences shall be at least 54 inches, unless a lower height is allowed by law and is shown on the Fence Job Sheet (JS-382e). In no case shall the height of the exterior/property line fences be lower than 48 inches.

Fence height of interior fences shall be at least 2/3 of the shoulder height of the grazing animals.

Wire shall be attached to line posts by a method that allows the wire to slip. Attach wire to fiberglass posts by loose clips or by running through holes in post. For wood or steel posts, attach wire to posts by insulators. Attach to stays with tight clips to hold stays in place.

Wires shall be placed on the side of the post located closest to the livestock. Wires shall be placed on the outside of corner posts and where placing the wires on the outside of the post(s) in a curve in the fence is required for structural stability.

All sections of fence must be started and ended at all corners, ends, braces, and pull assemblies. For dug corners/ends only one

(1) corner may be pulled around using Hi-Tensile single strand wire. For driven corners/ends less than 500' from end to end, a maximum of four (4) driven corners may be pulled around using Hi-Tensile single strand wire. Wire tighteners/strainers will be placed in the middle of the pull.

Splicing of Hi-Tensile wire will be accomplished by using a lap splice with 3 crimping sleeves or equivalent, "figure eight knot," "square knot," "Western-Union splice" or other acceptable tying methods. Tying of Hi-Tensile wire to end post will be accomplished using "thread through method" or an eye splice with 2 crimping sleeves with appropriate insulators as needed. (Reference standard drawing: Methods of Tying Hi-Tensile Strength Wire).

Positive charged wires must be insulated when coming into contact with conductive material (i.e. posts, corners, trees, etc.).

When using live trees as posts, protection will be provided between the tree and wire or insulators by:

1) using strips of treated wood, red cedar, Osage orange, black locust, fiberglass or rigid plastic. Strips should be at least 3½ inches wide and 6 inches in length and placed 3 inches above top and 3 inches below bottom of wire to prevent splitting or cracking; or

2) using a 3/8 inch by 8 inch eye or "J" screw may be fastened directly to the tree to the depth of the threads and then an end or corner insulator assembly attached to the eye or "J" screw.

Wire Tension

In-line strainers/wire tighteners will be installed on each wire to obtain/maintain the correct tension. In-line strainers/wire tighteners will be installed in the center of wire pull sections when wire pulls are greater than 600 foot in length.

The tension on each wire shall be maintained according to type of grazing animal or season. A tension spring will be used on at least one wire strand as a guide in maintaining proper tension. Tension of wires will be approximately 200 – 250 pounds.

Where electrified exterior/property line fences come into proximity of trees/woods, all wire

strands shall be installed with tension springs. Interior fences with 4 wires or greater that are located in proximity of trees/woods should have springs installed on the top two wire.

Use of tools specifically designed for handling and constructing Hi-Tensile fence is recommended for safety and ease of installation.

Number and Spacing of Wires

The number of wires shall be as shown on the Fence Job Sheet (JS-382e).

Exterior/property line fences shall be constructed of at least five wires. Interior cross fences shall be constructed of one or more wires, with the interior fence height being at least 2/3 of the shoulder height of the grazing animals.

Table C suggests wire spacings and electrical polarity for different kinds and classes of grazing animals. When multiple wire systems are used, spacing of wires should be designed to ensure head electrical contact when an animal attempts to place head between the wires.

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

One- and two-wire electric fences may be used for interior uses such as streamside fencing and subdividing pastures, but may not be used for property line or roadside fencing.

Post Placement

In undulating terrain, space posts and stays so fence height is maintained. Posts in dips shall be constructed so that they will not pull out of the soil. Two-inch or smaller posts will be anchored or wooden posts set to sufficient depth to resist pull out.

Set or drive posts to depth as specified on plans or as outlined for the type of post in Table A.

Backfill around posts shall consist of earth or Illinois Department of Transportation Gradation No. CA-6 coarse aggregate. The backfill shall be placed in layers no thicker than 4 inches; each layer shall be thoroughly tamped, and

shall completely fill the post hole up to the ground surface on set posts.

Spacing of line posts and stays for permanent electric fence depends on terrain and number of wires. Maximum spacings are as follows (Refer to Table D):

- One-wire fences have line posts spaced up to 90 feet apart with no stays.
- Two- and three-wire fences have line posts spaced up to 50 feet with no stays or up to 100 feet with stays placed every 50 feet.
- Four-wire fences have line posts spaced up to 30 feet with no stays or up to 90 feet with stays placed every 30 feet.
- Five-wire and above fences have line posts spaced up to 30 feet apart.

Corners and Braces

Bracing is required at all corner, gate, pull, and end assemblies in a fence. The horizontal brace member shall (as a minimum) be the equivalent of a 4-inch diameter post or standard weight (schedule 40) galvanized steel pipe of at least 2 3/8-inch outside diameter installed in the upper 1/3 of the posts and below the top wire. Steel pipe may be primed and painted as an alternative to galvanizing. The horizontal brace member length shall be between 8 foot and 2.5 times the height of the top fence wire. As a minimum, 3/8-inch diameter, Class I, Class II or Class III galvanized pins will be used to hold horizontal brace in place. A tension member (brace wire) composed of 2 complete loops of Class III galvanized 9 gauge smooth wire or Class III galvanized 12½ gauge Hi-Tensile strength smooth wire may be used. "H" Braces, Double "H" Braces, or Angle Braces shall be used in standard fences. Refer to applicable IL NRCS Fence standard drawings for specifications on corners, angles, or brace assemblies.

End bracing will be installed at locations where the fence ends and on both sides of gate openings when gate is located inline.

Changes in fence directions greater than 20 degrees, but less than 60 degrees require change of direction bracing as shown in standard drawings.

Changes in fence directions from 60 to 90 degrees require a standard corner brace assembly.

Driven series of single posts should be used on a maximum of 10-foot centers when rounding a long, gradual fence curve greater than 20 degrees. Driven single posts must have a minimum diameter of 6 inches and be driven at least 4 ft. into the ground with a 4" lean toward the outside of the curve.

Double "H" assemblies are required for all fences that have greater than 6 strands of Hi-Tensile wire or 8-foot high game fences.

On sandy loams and coarser textured soils, or sites with restricted soil depth of less than 36 inches, a "deadman", a screw-in anchor applied against the direction of pull, or a double "H" assembly is required.

For double post pull assemblies with brace (H assembly), wire must be tied off at pull assembly to the post opposite the direction of pull. (Refer to standard pull assembly drawing.)

Dug brace assemblies that are supporting gates must have an additional brace wire to support the gate, resulting in brace wires making an "X".

Pull assemblies shall be spaced at intervals not to exceed 1,320 feet (80 rods). Tie off all wires at pull assemblies and start new wires for the next section.

Single driven 7-inch minimal diameter post may be substituted for end panel, corner, and vertical change bracing, and pull post assemblies. The posts shall be driven a minimum of 5 feet into the ground.

Three wire Hi-Tensile fence corner, gate, end, and brace post assemblies may use a single 6 in. X 8 ft. post driven 48 inches into the ground with properly tightened wires.

Corner, gate, end, and brace post assemblies for 1- and 2-wire fences may use the options listed in Table A.

Electrical Grounding System

All electric fences must be grounded. The two type of systems are listed below.

Earth-Return System – An energizer grounding system is used that relies on livestock's contact with the earth for a ground and the resulting shock.

Wire-Return System – An energizer ground is used and at least one non-energized fence

wire is connected to the non-energized side of the energizer, ensuring that a circuit is completed when an animal comes in contact with an energized wire and a grounded wire.

Non-electrified fence wires need to be attached to a ground rod at intervals between 1,300 to 1,500 feet, or according to manufacturer's recommendations.

Install at least one ground rod at all breaks in the fence such as gates, gaps, and flood control sections. Keep ground rods at least 25 feet from water lines, well casings, or other grounding systems. Do not use the grounding system for other existing applications. Do not connect the energizer into any existing ground system.

For best results, ground rods (galvanized pipe or rod ½ inch or larger in diameter) should be buried where soil remains moist. Drive sufficient 6- to 8-foot rods into the ground at least 10 feet apart and 6 to 8 feet deep to provide the required amount of grounding. Connect a continuous ground wire (12½ gauge, Class III galvanization) from the energizer to each pipe or rod with a galvanized steel or bronze clamp.

Copper clad ground rods with copper wire may be used if the energizer terminals are stainless steel. If energizer terminals are not stainless steel, do not use copper due to corrosion at the connections and subsequent loss of electrical continuity. Use a copper clamp only with copper wire and copper clad ground rod.

Energizer

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

- High voltage, low impedance that produces at least 5,000-volt peak output and a short pulse that is less than 300 mAmps in intensity, finished within 0.0003 of a second and a rate of 35 - 65 pulses per minute.
- High impact, weather resistant case.
- Solid state circuitry. Snap in service modules provides for fast field repair.
- Safety pace fuse, to prevent over-pulsing.
- 110-volt or 220-volt mains.
- 12-volt battery powered system capable of charging fence adequately for three weeks before replacing or re-charging battery.

- On fences electrified by battery-powered energizers requiring more energy than can be supplied by a dry-cell battery, a properly sized solar battery charger or solar array will be required.

All energizers must be properly grounded. Normally, three ground rods at the energizer are a minimum. Follow energizer manufacturer's recommendations for minimum grounding requirements. More ground rods may be needed for system to function properly.

All energizers require an external lightning arrestor. Attach lightning arrestor to the fence wires. Install an induction loop type lightning choke in the fence line immediately between the energizer and lightning arrestor/fence. Install more ground rods for the lighting arrestor than for the energizer/charger. Lightning arrestor ground rods must be placed at least 50 feet from the energizer ground rods. (Refer to IL NRCS fence standard drawings for lightning protection and grounding.)

Surge/Spike Protection

For protection of 120- or 240-volt energizers, a voltage surge/spike protector shall be installed between the energizer and power supply. Also, ground rod(s) should be installed at electric company's transformer pole (primary ground) and ground rod(s) installed at the electrical circuit breaker box (secondary ground), if they do not exist. **Check with local power supply company to ensure applicability and installation.**

Power Supply Cable

To cross gates and areas where electrical shocks to humans and livestock should be prevented (e.g. working facilities), use 12½ gauge double insulated Class III galvanized wire (insulation rated at 20,000 volts minimum). For underground burial, use 12½ gauge double insulated Class III galvanized wire designed for burial (insulation rated at 20,000 volts minimum). Place buried wire inside plastic pipe to decrease incidence of grounding. When overhead transmission is used, height should be sufficient so as not to impede livestock movement. Wire for overhead transmission does not require insulation.

Buried wire from energizer to fence connection must be insulated and placed in plastic pipe to

decrease incidence of grounding. Insulation must be rated at 20,000 volts minimum.

Do not use household insulated copper wire due to low voltage ratings.

Wire connections will be made with crimping sleeves, wire crimping taps, split bolt, tap line, or flexible spring connector.

Gates and Water Gaps

On hinged gates, set hinge pins to hold gate in place so gate cannot be lifted off pins.

Electrified gates may be constructed of a single straight wire with a spring loaded insulated handle, or an expandable, coiled, Hi-Tensile, 12½ gauge wire attached to an insulated handle. The number of wires shall be determined by the fence objective and be at least equal to the number of wire strands in the fence. The gate shall be constructed to be non-electrified when open. Over head or underground transmission lines will carry electricity past the gate to the remainder of the fence.

Fencing across areas of concentrated flow should include water gaps or flood gates. For areas with very little water and only occasional flooding, a breakaway fence or water gap will be sufficient. Areas with regular flooding will require floating gates or panels, or water gates. Refer to applicable IL NRCS Fence standard drawings for water gaps and flood gates.

For depressions less than 16 feet wide, install fence across the depression with no braces.

For depressions over 16 feet wide, construct a fence that will breakaway only in the depression and leave the rest of the fence undamaged. Construct brace assemblies on each side of the depression. Construct a fence in the depression with single end posts 6 inches from the brace assemblies, which allows the depression fence to breakaway without damaging the main fence. Attach breakaway fence section to the main fence with light gauge wire. Refer to applicable IL NRCS Fence standard drawings for more details about fencing across depressions.

If the depression has regular flooding, use a swinging or floating panel. The panel must be free to swing when water comes through. Construct horizontal cross braces on the down-stream side of the vertical panel(s) in

order to provide for a smooth edge for debris to slide by on the upstream side. Using only wire panels will result in debris catching on the panel and clogging the panel, resulting in failure. Refer to applicable IL NRCS Fence standard drawings for more details about flood gates or picket fences across a stream.

An electrified floodgate may be used in lieu of a non-electrified gate if desired. The electrified flood gate is constructed by stretching an electrified wire across the drainage above high water flow level. Attach droppers of 12½ gauge Hi-Tensile fence wire or drop chains to the electrified wire at a horizontal spacing of 6-inches, stopping above average normal water level. Use crimping sleeves or spacers to ensure drops stay in position. Connect gate to

electric fence with double-insulated cable through a cut-off switch and floodgate controller. Secure drops with crimp sleeves to hold in place. Refer to applicable IL NRCS Fence standard drawings for more details about electric flood gate.

UTILITIES

The landowner and/or contractor shall be responsible for locating all buried utilities in the project area, including drainage tile and other structural measures.

Prior to all digging and soil disturbance landowner and/or contractor will call Julie.

TABLE A: Acceptable post materials and installation depths for electrified fence.

Function	Material Type	Min. Dia. in Inches	Notes
<p>Line Posts and Stays</p> <p>(Posts must be set or driven at least 24 inches in the ground, except 18 inches for 1 and 2 wire fence posts in soil which is not sandy loam or coarse textured.)</p>	Australian ironwood (eucalyptus)	2	
	Fiberglass reinforced solid round rod	2/3	With UV inhibitors
	70% polypropylene/30% wood	1 1/8	With UV inhibitors, color pigments
	Fiberglass reinforced plastic T-post	1" cross-section minimum	With UV inhibitors
	Black locust, red cedar or redwood ¹	3	At least one half of the diameter of the red cedar or redwood post shall be heartwood.
	Osage orange	2½	
	Pressure-treated pine or other wood of equal life and strength. ¹	3	Pressure treatment shall be according to Table B.
	Standard "T", "Y", or "U" shaped steel posts (hot dip galvanized, painted with high grade weather resistant steel paint, or enameled and baked).	*	* Weight must be at least 1.33 pounds per foot of length with the weight of the anchor plate. Posts must be new. Posts must be set solidly in the ground so that the top of the anchor plate is below the ground surface.
<p>Posts for 3 to 6 wire corners, gates, end or pull assemblies, and brace post assemblies</p>	<p>Wood posts, including black locust, red cedar, redwood, osage-orange, or pressure-treated pine or other wood of equal life and strength.¹</p>	5 (3 wires) 6 (4 – 6 wires)	Posts for "H" assemblies must be driven or set at least 36 inches deep or below the frost line.
		6 (3 wires)	Single post driven 4 foot into the ground.
		7 (4 - 6 wires)	Single post driven 5 foot into the ground.
<p>Posts for 4+ wire fence corner, gate, end, and brace post assemblies</p>	<p>Manufactured fiberglass brace assemblies that contain fiberglass posts (minimum of 2 inches outside diameter and 1.5 inches inside diameter) and attached to screw in anchors with appropriate angle bracing.</p>	2	Must be installed per manufacturer's recommendations, fiberglass component guaranteed to last for 20 years without flaking, peeling, rotting, abnormally discoloring, splintering, or deteriorating from sunlight and weather.
<p>Posts for 3 wire fence corner, gate, end, and brace post assemblies</p>	<p>Manufactured fiberglass brace assemblies that contain fiberglass posts (minimum of 2 inches outside diameter and 1.5 inches inside diameter or 2 inch diameter) and attached to screw in anchors with appropriate angle bracing.</p>	2	Must be installed per manufacturer's recommendations, fiberglass component guaranteed to last for 20 years without flaking, peeling, rotting, abnormally discoloring, splintering, or deteriorating from sunlight and weather.
<p>Posts for 1 and 2 wire corners, gates, end or pull assemblies, and brace post assemblies</p>	<p>Standard "T", "Y", or "U" shaped steel posts (hot dip galvanized, painted with high-grade weather resistant steel paint, or enameled and baked) with appropriate knee, deadman, angle, or "H" brace.</p>	*	* Weight must be at least 1.33 pounds per foot of length with the weight of the anchor plate. Posts must be new. Posts must be set solidly in the ground so that the top of the anchor plate is below the ground surface.
	<p>Wood posts, including black locust, red cedar, redwood, osage orange, or pressure-treated pine or other wood of equal life and strength, with appropriate knee, deadman, angle, or "H" brace.¹</p>	3½	Posts must be set at least 36 inches in the ground.
	<p>Wood posts, including black locust, red cedar, redwood, osage orange, or pressure treated pine or other wood of equal life and strength, without any bracing.¹</p>	5	Posts must be set to a depth at least equal to the height of the post above the ground.
		4	Driven to a depth of 48 inches
	<p>Steel pipe without any bracing.</p>	2¾	Posts must be set to a depth at least equal to the height of the post above the ground.
<p>Manufactured fiberglass brace assemblies that contain fiberglass posts (minimum of 2 inches outside diameter and 1.5 inches inside diameter or 7/8 inch diameter) and attached to screw-in anchors with appropriate angle bracing.</p>	2	Must be installed per manufacturer's recommendations, fiberglass component guaranteed to last for 20 years without flaking, peeling, rotting, abnormally discoloring, splintering, or deteriorating from sunlight and weather.	

¹At least one half of the diameter of the red cedar or redwood post shall be heartwood. Pressure treatment shall be according to Table B

TABLE B: Allowable pressure treatment for wood posts. Pressure treatment shall conform to American Wood Preservers Association (AWPA) Standard U1, Use Category 4 (UC4) or higher.

Treatment Type	Pressure Treatment Level
Pentachlorophenol (PCP)	UC4 = 0.4 lbs/ft ³
Creosote and creosote solutions	UC4 = 6.0 – 8.0 lbs/ft ³
Chromated Copper Arsenate (CCA)	UC4 = 0.4 lbs/ft ³
Alkaline Copper Quat (ACQ)	0.4 lbs/ft ³
Micronized Copper Quaternary (MCQ)	UC4 = 0.34 lbs/ft ³
Micronized Copper Azole (MCA)	UC4 = 0.15 lbs/ft ³

UC4 = A – Ground contact or fresh water.
 B – Ground contact, fresh water or important construction components.
 C – Ground contact, fresh water or critical structural components.

TABLE C: Suggested number of wires, animals, fence height, wire spacings and wire charge.

Wires	Animal	Fence Height in Inches*	Spacing from Ground in Inches
1	Cattle Hogs	26 to 32 12	26 to 32+ 12+
2	Cattle Cattle, Sheep, Goats Sheep Hogs	24 to 36 20 to 30 18 to 20 18	18 to 24+/-, 24 to 36+ 8 to 10+, 20 to 30+ 8 to 10+, 18 to 20- 6+, 18+
3	Cattle w/calves, 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 Cattle Sheep, Goat	30 to 35 40 30 to 38	5 to 7-, 12 to 15+, 18 to 24-, 30 to 35+ 8+/-, 18+, 28+/-, 40+ 6 to 16+/-, 12 to 22+, 18 to 30+/-, 30 to 38+
5	Cattle Horses Sheep, Goats	50* 54 48*	10+, 20+/-, 30+, 40+/-, 50+ 12+, 22-, 32+, 42-, 52 to 54+ 6 to 7+, 11 to 13-, 18 to 21+, 26 to 30-, 35 to 40+
6	Sheep, Goats	48*	5 (neutral), 10 to 11+, 15 to 17-, 21 to 24+, 28 to 32-, 36 to 46+
7	Sheep, Goats (predator)	54"	6+, 12-, 18+, 26-, 34+, 44-, 54+

+ = positive charged wire, - = ground wire, and +/- = positive or ground wire

* exterior/property line fences = 54 inches, unless a lower height is allowed by law and as shown on the Fence Job Sheet (JS-382e).

TABLE D: Spacing of fence posts and stays relative to the number of line wires

Electric Fences, Erected in Straight Lines Over Level Terrain			
Number of line wires	Maximum Spacing of Primary Line Posts		Maximum Stay Spacing
	Without Stays	With Stays	
1	90'	-	-
2	50'	100'	50'
3	50'	100'	50'
4	30'	90'	30'
5	30'	-	-
6	30'	-	-