NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

FENCE
(Feet)
(382)

DEFINITION

A constructed barrier to animals or people.

PURPOSE

The fence practice is applied to facilitate the application of conservation practices by providing a means to control movement of animals and people.

CONDITIONS WHERE PRACTICE APPLIES

Fence (382) practice may be applied on any area where animal or people movement is needed. Fences are not needed where natural barriers will serve the purpose.

CRITERIA

General Criteria Applicable For All Purposes

Fencing materials shall be of a high quality and durability. The type and design of fence installed will meet the intended management objectives and topographic challenges of the site.

Fences shall be positioned to facilitate management requirements.

Standard or conventional (barbed or smooth wire), suspension, woven wire, or electric fences shall consist of acceptable fencing designs to control the animal(s) or people of concern and meet the intended life of the practice.

All permanent fences are to be constructed with the intent of being left in place for at least 20 years. Therefore, the criterion for all permanent fences requires material, design, and construction that shall have a minimum life expectancy of 20 years with minimal maintenance.

Height, number, and spacing of wires will be installed to facilitate control and management of the animals(s) and people of concern.

Height, size, spacing and type of posts will be used that best provide the needs for the type of fence required and are best suited for the topography of the landscape.

Joining of wires will be by way of approved splices such as “Western-Union Splice”, figure eight knot, square knot, or crimping sleeves.

All wires will be attached to the side of the post closest to the livestock. Single strand Hi-Tensile wire fence may be placed on the outside of corner post assemblies when pulled around a corner. Wire (barbed, woven, or Hi-Tensile) may be placed on the side of the posts opposite the livestock when a fence curves and placing the wires on the outside of the curve is required.

Landscape timbers are not allowed in any part of a fence.

Notching posts to retain wires or braces are not allowed in any part of a fence.

Barbed wire is not to be electrified or insulated for electrification.

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

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

Fence location is the responsibility of the landowner/user. Legal surveys may be needed for proper fence location.

Fence design and installation shall follow all federal state and local laws and regulations.

CONSIDERATIONS

The fence design and location should consider topography, soil properties, safety and management of livestock, development of potential grazing systems, human access, landscape aesthetics, erosion problems, moisture conditions, flooding potential, stream crossings, and durability of materials.

Consider installing fences in locations that will facilitate maintenance avoiding irregular terrain and/or water crossings.

Fences across gullies, canyons, or streams may require special bracing, designs, or approaches.

Consider wildlife movement needs when locating and constructing fences. Strands of wire spaced too close together at the top of a fence have entangled deer.

Consider livestock management, handling, location and adequacy of watering facilities, and feeding when locating fences.

Where applicable, rights-of-way will be cleared to facilitate fence construction and maintenance.

When using gates of substantial weight consider supporting free end of gates, when open or closed, to relieve constant pressure applied to post on hinged end of gate.

Consider soil erosion potential when planning and constructing a fence on steep slopes.

When using electric fences, training areas should be used to condition livestock to fences. Select a well-fenced area and construct an electric fence across, or around, the area to allow animals to come in contact with the electric fence. Normally, a minimum of 12 hours of exposure to the electric fence is required. Most animals will be trained fully in 48 hours. When animals are approaching the fence with caution, they are trained.

When using electric fence with sheep or goats, sheep or goats must be clean shorn prior to being introduced to the fence.

Check with respective companies prior to erecting electrified wires or ground wires near overhead power lines, telephone wires, or radio antennas. If electrified fences must cross power lines, etc. cross lines at as close to perpendicular as possible and keep top fence wire below 6 feet. Ground rods may be needed at each side of crossing for safety in case of downed power lines.

Contact JULIE prior to any digging.

Consider safety recommendations and cautions from suppliers, distributors, manufacturers, installers, dealers, power companies, electricians, and the like, when constructing fences.

PLANS AND SPECIFICATIONS

Plans and specifications are to be prepared for specific field sites based on Illinois' Fence Standard and **appropriate state or local statutes or laws**.

Plans and specifications for installing fences shall be in keeping with Illinois Fence standard and shall describe the requirements for applying the practice to achieve all of the intended purposes.

NOTE: Materials and workmanship of fence applications must be in accordance with and equal or exceed in size, strength, durability, and lifespan the standard and specifications included in the Fence Conservation Practice.

Variations from materials and construction may be approved by the State Resource Conservationist, if sufficient documentation is provided which proves that the variations will result in an installation that will meet or exceed that which is described in the fence standard and specification.

I. SPECIFICATIONS RELATIVE TO ALL FENCES

A. Posts

1. Treatment

All wooden posts except red cedar, Osage orange, black locust or redwood shall be pressure treated according to the Use Category (UC) with:

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)	0.0.4 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.

Certification labels may be required.

Pressure treatment shall conform to American Wood Preservers Association (AWPA) standards. Quality of treated wood shall provide sufficient strength and last for the expected fence life (20 years).

At least half the diameter of red cedar and redwood shall be heartwood.

2. Live trees as line and bracing posts

Live trees shall be allowed 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.

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.

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.

When using live trees protection will be provided between the tree and wire or insulators. (Use 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 placed 3 inches above top and 3 inches below bottom of wire to prevent splitting or cracking). 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.

At no time shall live trees constitute more than 10 percent of the line posts used.

3. Corner, Gate, End or Pull Assembly, and Brace Posts

All corner, gate, end or pull assemblies, and brace posts shall normally be wood with sufficient length for the construction of at least a 54-inch exterior/property line fence and permit setting the post at least 36 inches deep or below the frost line. Earth backfill or Ca6 "roadpack" shall be thoroughly tamped.

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

Posts shall have a minimum diameter of 6 inches. Reinforced concrete or metal posts of equivalent strength may be substituted if they have suitable means of attaching wires and braces.

Double “H” assemblies are required for all 8 foot fences and fences that exceed 6 single strands of wire.

Eight foot fences require 6 inch diameter posts for corner, gate, end, or pull assembly, and brace posts.

See Table 2 (IL-800, IL-801, IL-803, IL-804, IL-805, IL-806, IL-808, IL-809, and IL-810) for specifications on corners, angles, or brace assemblies.

4. Line Posts

Wooden line posts shall have a minimum 3-inch top commercial size (2 1/2-inch for Osage-Orange).

Wood posts must have a minimum length to ensure for the construction of the designed fence height with the posts set or driven to a minimum depth of 24 inches. When set, earth back fills or Ca6 "roadpack" shall be thoroughly tamped.

Use standard "T", “Y”, or "U" shaped steel posts, weighing not less than 1.33 pounds per foot of length less the weight of the anchor plate, in lieu of wooden line posts. Steel posts shall have a protective coating; either galvanized by the hot dip process, painted with one or more coats of high-grade weather resistant steel paint, or enameled and baked. Steel posts shall be studded, embossed, or punched to aid in the attachment of wire. Steel posts must have a length sufficient to:

- provide for the construction of at least a 54-inch-high exterior/property line fence;
- be set solidly in the ground so that the top of the anchor plate is below the ground surface.

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. Two-inch or smaller posts will be anchored or wooden posts set to sufficient depth to resist pull out.

Refer to Section IV. PERMANENT ELECTRIC FENCES (HI-TENSILE WIRE) for additional line post options for electric fences.

5. Driven Posts Substituted for Assemblies

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

B. Bracing

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 special bracing as shown in standard drawing IL-820 or individual bracing as shown in standard drawing IL-821.

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 driven at least 4 feet in ground with a 4” lean toward the outside of the curve.

Bracing is required at all corner, gate, pull, and end assembles in a fence. The 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 diameter installed in the upper 1/3 of the posts and below the top wire. The horizontal brace member length shall be between 8 foot and 2.5 times the height of the top fence wire. At least 3/8-inch diameter, class III galvanized pins will be used to hold brace in place. A tension member composed of 2 complete loops of Class III galvanized 9 gauge smooth wire or Class III galvanized 12 1/2-gauge Hi-Tensile strength smooth wire may

be used. “H”-Braces, Double “H” Braces, or Angle Braces will be used in standard fences (See Table 2, IL-800, IL-801, IL-803, IL-804, IL-805, IL-806, IL-808, IL-809, IL-810, and IL-819).

All bracing for game fences (8 foot high) will be double “H” assemblies. The horizontal brace member will be a minimum of 10 feet in length. Refer to standard drawing IL-808.

C. Pull Assemblies

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 IL-811A H-Brace Pull Assembly). Brace wire tension members must be installed in both directions forming an “X” and adhere to specifications under **B. Bracing**.

Pull Assemblies will be spaced at intervals not to exceed 1,320 feet (80 rods) for barbed wire and Hi-Tensile electric fences and 660 feet (40 rods) for woven wire in straight sections of fence (See Table 2, IL-811A H-Brace Pull Assembly or IL-811B Single Post Pull Assembly)

Driven Single posts must have a minimum diameter of 7 inches and driven 5 feet in the ground; and will be used at the same spacing as above.

D. Water Gaps/Flood Gates

Most water gaps or flood gates are designed to be self-cleaning. Sometimes the cleaning action is not totally complete and the gate is blocked partially open. Livestock are then able to get through the opening. Check gaps/gates after heavy rains.

There are two basic types:

- Areas with very little water and only occasional flooding, a breakaway fence or water gap will be sufficient. Refer to IL standard drawing IL-823

- Area with regular flooding, floating gates or panels, or water gates, would be best. Refer to IL standard drawing IL-822

For depressions less than 16 feet wide, 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 will allow the depression fence to breakaway without damaging the main fence. Attach the breakaway fence section to the main fence with light gauge wire. Refer to IL standard drawing IL-824

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 the 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 IL standard drawings IL-822, and IL-825

II. STANDARD FENCES (NON-ELECTRIFIED)

A. Barbed Wire

Barbed wire fences shall be either four (4) or five (5) wires for exterior fences. A minimum of three wires shall be used for interior fencing, cross fencing, or excluding livestock from special areas such as wildlife areas, forested tracts or other special use areas. The height of interior barbed wire fences shall be at least 42 inches. Exterior/property line fences shall be 54 inches high.

Wires shall be spaced approximately equal distance apart. The top wire shall be 2 – 4 inches below the top of post. The bottom wire shall be 12 to 18 inches above the ground level. Wires shall be spaced no more than 12 inches apart.

Each line wire will consist of 2 twisted strands of 12-1/2-gauge wire or Hi Tensile strength wire of 15-1/2 gauge. The barbs shall be either 2-point barbs on approximately 4-inch centers, or 4-point barbs on approximately 5-inch centers. 4-point barbs provide more deterrent to grazing animals.

DO NOT ELECTRIFY BARBED WIRE

B. Woven Wire

Top and bottom strands of standard or Hi-Tensile woven wire shall be 12 1/2 gauge or heavier, and 14 1/2 gauge wire, or heavier, for intermediate strands.

Exterior/property line fences constructed with woven wire equal to or less than 32 inches in height shall have at least 2 barbed or smooth wires above the woven wire, spaced evenly (10 to 12 inches) between the top of the woven wire and the top fence wire. For interior fences the top fence wire will be a minimum of 42 inches from the ground. Exterior/property line fences shall be 54 inches high. Single smooth wire will be 11 gauge, or 12 1/2 gauge if Hi Tensile.

Top fence wires will be 2 to 4 inches below the top of the posts.

Fences constructed with woven wire greater than 32 inches in height shall have at least 1 barbed or smooth wire above the woven wire spaced at 8 to 12 inches above the top woven wire.

The base of the woven wire shall be placed within 2 inches of the ground surface.

All wires shall have Class III galvanization. The wire specifications for the barbed wire shall be the same as for a barbed wire fence.

C. Staples and Wire Fasteners (Barbed Wire or Woven Wire)

Staples shall be of 9-gauge Class III galvanized steel or heavier with a minimum length of 1 1/2 inches for softwoods and a minimum length of 1 inch for close-grained hardwoods. Drive staples diagonally to the wood's grain and at a slight downward angle, (upward if pull is up) to avoid splitting post and loosening of staples. Space should be left between staple and post to permit free movement of wire.

Wires may be attached to steel posts by use of manufacturer's clips or by two turns of 14-gauge Class III galvanized wire.

D. Line Post Spacing (Barbed Wire or Woven Wire

Standard barbed wire fences shall have a maximum post spacing of 20 feet unless stays are used between posts and then shall not exceed 30 feet. The maximum spacing of wire stays shall be 15 feet.

Standard Woven wire fences shall have a maximum post spacing of 15 feet. Hi-Tensile woven wire posts shall have a maximum spacing of 20 feet and be either wood or steel.

III. SUSPENSION FENCES (NON-ELECTRIFIED)

Fence construction, dimensions, and quality of materials used shall be in accordance with the requirements set forth in specifications for standard fences except as noted in the following:

Suspension fences shall be constructed in straight-line sections and properly braced at each point of directional change.

Line posts shall be spaced not more than 100 feet apart.

Wire stays shall be spaced a maximum of 15 feet apart between posts in the line fence. All stays shall swing free of the ground to permit the fence to sway when contacted by animals.

Fences shall have a minimum of four barbed wires spaced approximately an equal distance apart. Steel staples 1 1/2 to 2 inches long, driven diagonally to within about one-half inch of the post to allow for free movement of wire or special manufactured fasteners for suspension fences shall be used. Wire clips that allow free sliding of wire shall be used for attaching line wire to steel posts.

To allow for maximum sway of the fence, tension on line wires shall permit about a 3-inch sag in 100-foot span of fence in warm weather.

Bracing is required at all corner, gate, end, and pull assemblies. In straight continuous sections of a suspension fence, 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.

All corner, gate, end, pull, and brace posts shall be at least 8 feet in length and have a minimal diameter of 6 inches. Posts must be set in the ground at least 36 inches or below the frost line.

Specifications for barbed wire will be the same as found under Section II. STANDARD FENCES (NON-ELECTRIFIED).

IV. PERMANENT ELECTRIC FENCES (HI TENSILE WIRE)

A. Wire (Energized)

Wire shall be 12 1/2 gauge, single strand, minimum tensile strength of 140,000 PSI, and 1078 lbs. minimum breaking strength. All wire will have, as a minimum, Class III galvanization.

Wires will be attached to line post by a method that allows them to slip. If stays are used, wires will be attached to prevent stay slippage along the fence.

Wires will be placed on the side of the post closest to the livestock, except when single Hi-Tensile wire strands are being pulled around a corner. Only one (1) corner may be pulled around using Hi-Tensile single strand wire.

Splicing of Hi-Tensile wire will be accomplished by using a lap splice with 3 crimping sleeves, "figure eight knots", "square knots", or other acceptable tying methods. (See Table 2, IL-814 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.).

Tying of Hi Tensile wire to end post will be accomplished using "thread through method" or an eye splice with 2 crimping sleeves. (See Table 2, IL-814 Methods of Tying Hi Tensile Strength Wire).

Tension of wires will be approximately 200 – 250 pounds.

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 pulls 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.

Where electrified exterior/property line fences come into proximity of trees/woods all wire strands shall be installed with tension springs.

Interior fences that are in proximity of trees/woods will benefit with installation of springs on the top two strands of wire.

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

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

Exterior/property line fences must be constructed of at least five wires, the total height to the top wire must be at least 54 inches. Interior cross fences will be constructed of one or more wires, with the fence height being 2/3 of the shoulder height of the grazing animal.

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.

TABLE 1: 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 to30-, 35 to 40+
6	Sheep, Goats	48	5 (neutral), 10 to 11+, 15 to 17-, 21 to 24+, 28 to 32-, 36 to 46+

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

* exterior/property line fences = 54 inches

C. Line Post and Offset Brackets.

1. Line post and stays will be either:

- Australian ironwood (eucalyptus), 2 inches in diameter. Attach wire to post by loose clips or running through holes in post. Attach to stays with tight clips to hold in place.

- Fiberglass reinforced solid round sucker rod of at least ¾ inch in diameter. Attach wire to post with loose wire clips or by running through holes in post. Attach to stays with tight clips to hold in place.

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

- Wood post of black locust, red cedar, Osage-Orange, redwood, pressure treated pine or 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 treatment shall conform to American Wood Preservers Standards, see **I. SPECIFICATIONS RELATIVE TO ALL FENCES, A. Posts, 1. Treatment**. Wire shall be attached by insulators, **see G. Insulation**, for guidance. Wooden line posts shall have a minimum 3-inch top commercial size (2 1/2-inch for Osage-Orange).

- Charge wire must be attached with insulators **see G. Insulation**, for guidance. Increased maintenance will be needed with steel posts to ensure functionality of fence insulators.

Posts for 1 and 2 wire fences shall be long enough to be set at least 18 inches in the ground and extend 2 to 4 inches above the height of the fence. On sandy loam and more coarse textured soils the post shall be at least 24 inches in the ground. Post for 3 or more wire fences shall be set at least 24 inches into the ground.

Six (6) foot, or longer, Fiberglass posts may be used in exterior fences; however, every sixth post must be wood and the wood posts must meet size and depth placement specifications for exterior fences. If fence is 54 inches in height the 6 foot fiberglass posts will be 16 inches in the ground.

Spacing of line post and stays depends on terrain and number of wires. Maximum spacings are as follows:

- One and two wire fences may have line posts spaced up to 90 feet apart with no stays required.
- Three and four wire fences may have line posts spaced up to 30 feet with no stays or up to 90 feet with stays every 30 feet.
- Five wire and above fences can have line posts spaced up to 30 feet apart.

2. Offset Brackets

Offset brackets made of galvanized Hi Tensile spring wire with insulator of high density polyethylene with ultraviolet stabilizer or porcelain can be attached to standard barbed wire fence or woven wire fence to provide transmission line and/or to electrify a standard fence. Place Offset Brackets no further than 70 feet apart and attach to post or 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 grounding will occur.

D. Corners and Braces

Braces and end assemblies are required at all corners, gates and angles in the fence line. Single post corner, angle or end brace assemblies, "H" Brace assemblies, or equivalent strength brace will be used. Double “H” assemblies are required for fences that have greater than 6 strands of Hi-Tensile wire, restricted soil depth, sandy loam or coarser textured soils, or 8 foot high game fences. See Table 2 (IL-800, IL-801, IL-803, IL-804, IL-805, IL-806, IL-808, IL-

809, and IL-810) for specifications on corners, angles, or brace assemblies.

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 in the ground are acceptable if installed according to the manufacturer's recommendations, and the fiberglass component is guaranteed to last for 20 years without flaking, peeling, rotting, abnormally discoloring, splintering or deteriorating from sunlight and weather. Exterior/property line fences must be 54 inches in height.

For 3 wire Hi-Tensile fence corner, gate, end, and brace post assemblies may use a single 5 inch X 8 feet post driven 48 inches into the ground with properly tightened wires.

For 1 and 2-wire fence corner, gate, end, and brace post assemblies may use the following:

- Steel "T", "Y", or "U" post that are new, painted or galvanized and a minimum of 1.33 pound per foot of length, less the plate, with appropriate knee, deadman, angle, or H-brace.
- Wood posts with a minimum diameter of 3.5 inches set 24 inches in the ground with appropriate knee, deadman, angle, or H-brace.
- Wood post with a minimum diameter of 5-inches, steel pipe, or fiberglass, set to a depth equal to, or greater than, the height of the post above the ground without any bracing.
- Fiberglass posts with a minimum diameter of 2-inches, set 2 feet in the ground with appropriate angle or H-bracing.

All wood post tops will be 2 – 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.

E. Fence Ground

All electric fences may be grounded by using the same ground as the energizer or a separate grounding system.

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

Wire-Return System – 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 an interval between 1300 to 1500 feet, or according to manufacturer's recommendations.

Install at least one ground rod at all breaks in the fence such as gates, gaps, flood control sections, etc.

F. Energizers

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

- High voltage, low impedance that can produce 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, 220-volt, or 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.

1. Energizer Ground

All energizers must be properly grounded.

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 (12.5 gauge, Class III galvanization) from the energizer to each pipe or rod (galvanized pipe or rod ½ inch or larger in diameter) with a galvanized steel clamp.

Use copper clamp only with copper wire and copper clad ground rod. 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.

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

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.

2. Lightning

Lightning can cause damage to the energizer. Most energizers are poorly protected from lightning strike. External lightning arrestors are required and should be installed in conjunction with an induction loop type lightning choke for added protection. Lightning arrestor ground rods must be placed at least 50 feet from the energizer ground rods. (See Table 2, IL-812 Electric Fence and IL-813 Energizer to Electric Fence Connection and Grounding).

Install more ground rods for the lighting arrestor than for the energizer/charger and attach to the arrestor. Attach the lightning arrestor to the wires of the fence. Install an induction loop type lightning choke in the fence line immediately between the energizer and lightning arrestor/fence (Refer to IL-812).

3. Surge/Spike Protector

For protection of 120 or 240-volt energizers, a voltage surge/spike protector will be used. A surge/spike protector must 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).**

G. Insulation

All underground wire(s) installations must be double insulated, molded, aluminum or Hi-Tensile strength steel 12 1/2 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 10,000 volts or more without arcing.

Insulators for end, corner, and angle braces must be high-density polyethylene with ultra-violet stabilizer, high-density polypropylene with ultra-violet stabilizer, or porcelain that withstands 10,000 volts or more without

arcing. Do not use insulated tubing for attaching around post of brace assemblies.

Red insulators should not be used due to their attracting hummingbirds.

H. Insulated Cable

To cross gates and areas where electrical shocks to humans and livestock should be prevented (e.g. working facilities); use insulated galvanized wire (12.5 gauge). For underground burial, use wire designed for burial (12.5 gauge). Placing buried cable inside plastic pipe helps to decrease the incidence of grounding. When overhead transmission is used height should be sufficient so as not to impede the movement of livestock. Cable for overhead transmission does not need to be insulated.

Buried wire from energizer to fence connection must be insulated and placed in plastic pipe to assist in decreasing incidence of grounding. Insulation must be rated at 20,000 volts minimum.

Do not use insulated copper wire.

I. Connectors

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

J. Gates

Electrified gates may be constructed of a single straight wire with a spring loaded insulated handle, or an expandable, coiled, Hi Tensile, 12 1/2 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 the gate is non-electrified when open. Over head or underground transmission lines will be used to carry electricity past the gate to the remainder of the fence.

K. Flood Gates

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 12 1/2 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. If flooding is expected to last some time, switch the floodgate off. Secure drops with crimp sleeves to hold in place. (See Table 2, IL-802 - Electric Flood Gate).

IV. TEMPORARY ELECTRIC FENCE

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

The number of wires and spacing will be designed to accomplish the desired result of the fence. (See permanent fence guidance for number of wires and spacing). Temporary plastic net fence is available for animals such as sheep, goats, hogs, and crowding areas.

Many companies provide portable fence systems that use such materials as polyethylene wire and tape with steel or aluminum wire woven into them, aluminum wire, plastic and fiberglass post, reels to roll up wire, and portable battery operated energizers that are high voltage, low impedance that can produce sufficient voltage to turn livestock. Temporary fences may be attached to permanent fences to further subdivide pastures. Follow manufacturer's directions for construction, use, and operation.

OPERATION AND MAINTENANCE

Regular inspection of fences is a part of an on-going management program. Inspection

of fences after storm events is needed to facilitate the function of the intended use of the fence.

Maintenance and repairs will be performed as needed to facilitate the intended operation of the installed fence

Voltage of Electric fences will be checked on a regular basis to ensure at least 3000 peak volts at the farthest distance from the charger. If voltage is not sufficient, determine the cause and correct. During dry weather, ground rods may need water applied to soil around them. Maintain between 200 to 250 lbs. tension on Hi-Tensile fence wires. Clear brush from fence lines to reduce voltage loss. Remove fallen limbs. Overhanging trees and limbs should be trimmed or removed as needed to prevent their falling onto the fence.

Electrified floodgates must be maintained and kept clear of debris. During extended flooding periods, switch floodgate(s) off.

DOCUMENTATION

The following items shall be considered when designing fences. Those items marked with an asterisk (*) shall be recorded as minimum documentation requirements. The use of computer programs are considered adequate documentation if the programs contain information as outlined in the plan and the following:

- *Location of fences marked on the conservation plan's Plan Map (or have individual maps)
- *Acres to be treated
- *Fence components that include items identified on Job Sheets 382e and 382ne, as applicable.
- *Quality of materials used (treatment, protection, etc.)
- *Operation and planned maintenance.
- Refer to Fence Statement of Work.

REFERENCES

USDI Bureau of Land Management and USDA Forest Service. 1988. Fences. Missoula Technology and Development Center, Missoula, MT. 210 pp.

High-Tensile Wire Fencing. 1987. Northeast Regional Agricultural Engineering Service, Ithica, NY. A. Selders and J. McAninch

ASTM: A 854/A 854M - 98, Standard Specification for Metallic-Coated Steel Smooth High-Tensile Fence and Trellis Wire.

How to Build Fences with Max-Ten 200 High-Tensile Fence Wire, United States Steel Corporation, 1980.

Fence Systems for Grazing Management, James R. Gerrish.

B.C. Agricultural Fencing Handbook, British Columbia, Ministry of Agriculture, Food and Fisheries, August 2002

Fencing Guidelines for Wildlife, Habitat Extension Bulletin No. 53, November 2004, Rory Karhu, Wyoming Game and Fish Department.

IL Fence Act s 765 ILCS 130/1-21

Many fencing companies also have reference material available for use. When looking at their recommendations, keep in mind that they are in the business to sell a product.

Table 2	
Drawing No.	**Description**
IL-800	Single Post Corner or Angle Brace Assembly
IL-801	Single Post End Grace (Slip Brace) Assembly
IL-802	Electric Flood Gate
IL-803	Steel, Welded, Single Post End Brace (Concrete or Driven)
IL-804	Deadmaned 3-Post Corner
IL-805	5 Post, H-Brace Corner, Without Deadman
IL-806	Wooden 3 Post double “H” Brace End Assembly without Deadman
IL-807	Deer Management Fence
IL-808	End Brace Assembly Deer Management Fence
IL-809	Welded Steel 3 Post Diagonal End Brace Assembly
IL-810	2 Post Brace with Deadman
IL-811A	H-Brace Pull Assembly
IL-811B	Single Post Pull Assembly
IL-812	Electric Fence
IL-813A	Energizer to Electric Fence Connection and Grounding (Wire Return System)
IL-813B	Energizer to Electric Fence Connection and Grounding (Earth Return System)
IL-814	Methods of Tying High Tensile Strength Wire
IL-815	Electrical connection Through Fence Opening
IL-816	Setting Fence Post on Uneven Terrain
IL-817	Streambank Watering Ramp Fencing
IL-818	Lakeshore Watering Ramp Fencing
IL-819	Attachment of Horizontal Brace Member (Pin and Brace Wire)
IL-820	Change of Direction Bracing - For Fence Changes of 15 - 60 Degrees
IL-821	Individual Bracing Alternative for Fence Changes of 15 - 60 Degrees
IL-822	Flood Gates
IL-823	Water Gaps
IL-824	Fence Crossing Depression
IL-825	Picket Fence Across Streams