

**NATURAL RESOURCES CONSERVATION SERVICE**  
**CONSERVATION PRACTICE STANDARD**

Fence

(Feet)

Code 382

**DEFINITION**

A constructed barrier to animals or people.

**PURPOSES**

This 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**

This practice may be applied on any area where management of animal or people movement is needed. Fences are not needed where natural barriers will serve the purpose.

Material used in permanent fence shall have a minimum life expectancy of 20 years.

A. Posts

All wooden posts shall consist of high quality species with a high resistance to decay such as untreated black locust, red cedar (diameter shall be at least 50% heartwood), catalpa, osage orange, iron bark eucalyptus or other wood of equal life and strength and approved by NRCS. Pressure treated posts shall have one of the following treatments or equivalent: pentachlorophenol (0.4 lbs/ft<sup>3</sup>), chromated copper arsenate (0.4 lbs/ft<sup>3</sup>) or creosote solutions (6.0-8.0 lbs/ft<sup>3</sup>). Wood posts shall be sound and free of decay with all limbs trimmed substantially flush with the body. They shall be relatively straight throughout, free from heat checks or any other damage or defects that would impair their usefulness or durability. The use of "S" irons is not permitted.

**CRITERIA**

The intended purpose of the fencing system will determine the appropriate design criteria to be used. General construction standards for fences are grouped into either permanent or temporary categories. All planned work shall comply with federal, state, and local laws and regulations.

**Permanent Fences:**

Permanent exterior fences are used to exclude livestock from all areas needing permanent protection, to establish permanent grazing system boundary areas or be used to regulate or restrict access to areas by people.

**Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service State Office, or download it from the electronic Field Office Technical Guide for your State.**

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

All steel posts shall have a minimum weight of 1.33 pounds per foot, exclusive of the anchor plate. Steel posts shall have studs or grooves that allow for a suitable means of supporting the wire. Steel posts will be "T" or "U" type and painted or galvanized. Steel posts without flanges shall not be used. Steel posts shall be alternated in the fence with wood posts at a maximum ratio of 4:1.

Fiberglass (minimum diameter of 3/4 inches for internal fence and 7/8 inches for external fence) and polyvinylchloride solid round sucker rod (minimum diameter of 5/8 inches ) used as line posts shall be alternated in the fence with wood posts at a maximum ratio of 8:1 and placed a minimum of 20 inches in the ground.

Stays used to stabilize high tensile wire between posts shall be made of fiberglass or non-conductive wood.

In place of line posts, fencing may occasionally be fastened to healthy low value trees. Trees must be properly aligned and spaced. If trees are used, the trees must be of sufficient size that swaying and other movement will not affect the efficient operation of the fence. When trees are used instead of posts, a buffer shall be installed between the wire and the tree to keep the tree from growing around the wire. A treated or rot resistant wooden board of at least 1.5 inches thickness attached securely to the tree makes a good buffer. In this case, the wire is stapled to the board rather than the tree. Spring grip clips on 3/8 or 1/2 inch diameter fiberglass rods driven into drilled holes are a good alternative and will not hamper tree harvest in the future.

Wood posts shall be driven or set in holes and backfilled with concrete, tamped earth, or tamped crushed limestone. Steel and fiberglass posts shall be driven.

Steel posts will be placed in the ground to a depth that the flange is buried a minimum of 2 inches below ground level.

Post holes shall be at least 6 inches larger than the maximum diameter or side dimension of the posts when set in concrete or tamped crushed limestone. Post holes shall be at least 4 inches

larger than the maximum diameter or side dimension of the posts when tamped with earth.

Earth and limestone backfill around posts shall be thoroughly tamped in layers not thicker than 4 inches and shall completely fill the post hole up to the ground surface. Concrete backfill around posts shall be rodded into place in layers not thicker than 12 inches and shall completely fill the post hole up to the ground surface. All backfill types shall be crowned up around the posts at the ground surface.

No stress shall be applied to posts set in concrete until at least 24 hours after the concrete has set.

#### B. Wire

The minimum total height for external fence will be 48 inches.

High Tensile Wire fence shall meet the following specifications:

Tensile Strength - 140,000 minimum psi

Galvanizing - Type III

Gauge - 12 1/2

Tension shall be maintained at a minimum of 200 pounds pressure on each wire. The appropriate springs, fasteners, clips, pin and other materials used during construction must also conform to the product qualities and assembly methods as specified by the manufacturer.

See Table 1 for recommended wire spacing and charge.

**Warning: When overstretched, wire may break and recoil. Eye and hand protection should be worn.**

Standard Woven Wire - 9 gauge or heavier for top and bottom. 12 1/2 gauge or heavier in between and 14 gauge for stays not more than 12 inches apart.

High Tensile Woven Wire - 12.5 gauge or heavier Class III galvanized high tensile for all wires with stays not more than 12 inches apart.

Barbed Wire - 12 1/2 to 15 1/2 gauges with 4 point barbs spaced not more than 10 inches apart. Barbed wire under no circumstances shall be electrified.

All wire will be galvanized. Woven and barbed wire will be selected according to information on Table 2.

#### C. Wire Attachment

Staples used to fasten fence to wooden posts will be class III galvanized, 9 gauge or heavier with a minimum length of 1 1/4 inches. Staples will be driven as nearly as possible at right angles to the grain. Fencing will be fastened to steel posts by galvanized wire clips or as according to recommendations of manufacturer. Exterior fencing should be placed on the livestock side of the post for all livestock. On curves and corners, fencing may be placed on the outside.

#### D. Brace Materials

Wood - A minimum of 4 inches diameter or 4 inches square at the small end and a minimum of 84 inches long for the horizontal brace piece.

Steel - A minimum of 2 1/2 inch diameter tubular or 2 inches x 2 inches x 3/16 inches or heavier for angular and a minimum of 84 inches long for the horizontal brace piece.

Wire for bracing shall be 1 or more strands of 9 gauge or heavier wire or 2 or more strands of 12 1/2 gauge High Tensile wire.

Corner, gate and brace/pull posts shall be eight feet long or longer with a six-inch minimum diameter. Pull, gate and corner posts will be placed a minimum 36 inches in the ground and be a minimum seven feet apart.

Use a corner post assembly for fence alignment changes of greater than 45 degrees. Sweep corners can be used for alignment changes less than 45 degrees on high tensile and barbed wire fences. Sweep corners shall have a maximum post spacing of 8 feet and consist of a minimum of three posts. Sweep corner posts shall be set with a 2 inch lean against the curve and shall have a 2 inch by 4 inch by 8 inch lug attached on the bottom of the post outside the curve in fragipan soils. A wedge shaped lug with the larger portion on top is best to ease driving posts.

External corner, gate and brace/pull posts shall be wood unless otherwise approved by the state conservation engineer. Steel and fiberglass posts can be used for end or brace posts for permanent internal fence. **Landscape timbers shall not be**

**used for posts or bracing.** Brace pins shall be class III galvanized steel with a minimum diameter of 3/8 inches. Horizontal bracing for "H" type braces shall be placed between 6 and 12 inches of the top of the post.

Braces and end assemblies shall be used at all corners, gates, and angles in the fence line unless otherwise indicated in this standard.

A single 10 foot long, 6 inch minimum diameter post may be substituted for end panel, corner, and vertical change bracing, and pull post assembly. The 10 foot long post shall extend a minimum of 5.5 feet into the ground and be backfilled with gravel or crushed limestone to the ground level. The posts may also be driven.

#### E. Energizers

Electronic energizers or power fence controllers will meet the following criteria:

High power, low impedance with a minimum 5,000 volt peak output with a short pulse that is less than 300 mAmps in intensity, finished within 300-millionths of a second (0.0003 seconds) at a rate of 35-65 pulses per minute and a high impact weather resistant case.

Be powered by a 12-volt battery powered system (capable of operating 3 weeks without recharging), solar cell or household electric current (110 or 220 volt).

The accepted figures for minimum voltage for livestock control are: cattle-1600 volts; sheep and hair goats-2000 volts; hogs, horses and meat goats-1200 volts. Higher voltage may be required for training, livestock concentrated areas and where excessive vegetation growth may occur.

Have a lightning arrestor and surge protector.

Fence chargers and other electric equipment will be used and installed consistent with manufacturer's guidelines.

All energized fences must be grounded. **All manufacturers' recommendations will be followed for grounding energizers.**

Energized ground wire must be connected to a galvanized pipe or brass or copper rod 5/8 inch or larger. Ground wire, ground rod or pipe and

connections shall be of the same material and placed below the ground surface. Ground rods shall not be placed inside buildings. The grounding system when applicable shall be heading towards the center of the energized acreage.

Do not put ground stakes near milking barns, water pipes or any other metal items leading into barns or working areas. Lightning arrestors shall be placed no closer than ten feet from the energizer.

**Additional criteria for Permanent Exterior Fence - Non-energized - Standard Type Wire**

Wooden line posts will be 84 inches long or longer with a four-inch minimum diameter. Wooden line posts will be placed on a maximum of 16.5-foot spacing and set in the ground to a minimum depth of 24 inches. Spacing will be ten to 16.5 feet for steel posts. Additional posts will be used as needed between the line posts as an added livestock barrier or for inclines or otherwise uneven ground. Total fence height shall be a minimum of 48 inches.

**Additional criteria for Permanent Exterior Fence – Energized - High Tensile**

Wooden line posts will be 84 inches long or longer with a four-inch minimum diameter. Line posts shall be spaced at a maximum spacing of 33 feet apart and set in the ground to a minimum depth of 24 inches. Additional posts will be used as needed between the line posts as an added livestock barrier or for inclines or otherwise uneven ground. Double bracing shall be used on external fence stretches over 1320 feet in length.

Line posts shall be of wooden, steel, PVC, fiberglass or other materials as recommended by the manufacturer and approved by the Natural Resources Conservation Service.

Permanent High Tensile fences will consist of at least four wires with a total height of the fence to top wire not less than 48 inches. The need for additional wires will be determined by animal size, age and the species to be held.

Wire spacing from the earth will begin at five to ten inches and continue upwards at random spacing that conforms to the animal sizes and species being held. See Table 1 for recommended wire spacing. Closer wire spacing

and adjustments to the location and number of energized wires will be needed to accommodate variable vegetation, terrain and soil conditions, and some livestock species etc. Two wires minimum will be energized; of which the 30-inch wire and the top wire shall be energized. Additional wires shall be energized as needed according to livestock species, age and use.

High tensile barb wire shall conform to all the criteria for smooth high tensile except it shall not be energized.

**Additional criteria for Permanent Exterior Fences – Non-energized High Tensile**

Fence assembly will be consistent with the recommended specifications for Permanent Exterior –Energized –High Tensile fence with the following exceptions.

Fence for large animals will consist of at least 8 wires with a minimum height of 48 inches. Wire spacing from the earth will begin at five to ten inches and continue upwards at random spacing that conforms to the animal sizes and species being held. The need for additional wires will be determined by animal size, age and the species to be held.

**Additional Criteria for Wooden Fences**

A wooden board fence shall have a minimum of 4 boards. The maximum board spacing shall be 16-inches center to center. The top edge of the uppermost board shall be at least 48 inches above the ground line for all external fences, and the top edge of the lowest board shall be no greater than 16 inches above the ground line. Each board shall be attached to each post with a minimum of two 16 d. hot dipped galvanized steel, stainless steel, copper, silicon bronze, or equivalent proprietary coated nails. For better holding power, use ring-shank, spiral, or screw-shank instead of common nails. Two 3-inch decking screws with like treatments may be used instead of nails. Unless painting is selected, lumber shall be treated with a minimum treatment of 0.4 lbs/ft<sup>3</sup> of chromated copper arsenate or equivalent treatment. (Use Category UC4A).

Posts for wood fence shall be a minimum diameter of four (4) inches and embedded a minimum of three (3) feet in the ground. The

maximum post spacing shall be eight (8) feet on center. Wood fences for cattle, bison and equine in a corral situation shall have a minimum of four (4)-2"x 6" (nominal) boards. The boards shall be placed on the livestock side in corrals and other high pressure areas. A minimum of four (4) – 1" x 6" (nominal) boards may be used in a pasture situation for cattle and equine. The boards may be placed on the non-livestock side in a pasture situation. Wood fences for small ruminants and swine shall have a minimum of four (4)-1"x 6" (nominal) boards. The spacing of the boards starting at the ground shall be capable of controlling the planned livestock.

#### **Permanent Interior Fences:**

Permanent interior fences are used for long-term subdivisions for planned grazing systems or to provide exclusion from sensitive areas.

Permanent interior fences shall conform to the specifications for permanent external fence except fence for large animals will consist of at least one wire at a height of 30 inches. The need for additional wires will be determined by animal size, age and the species to be held. See table 1 for more information.

Line posts shall be spaced at a maximum spacing of 50 feet apart except as noted below:

High tensile woven wire which will have a maximum spacing of 25 feet and high tensile wire with stays will be a maximum of 100 feet. Standard fence used for internal use shall conform to the specifications of the like external fence, i.e. standard woven wire. Additional posts will be used as needed between the line posts as an added livestock barrier or for inclines or otherwise uneven ground. High tensile internal fences with more than 3 wires or high tensile woven wire shall use double bracing with stretches that are over 1320 feet in length.

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

- Steel posts that are a minimum of 1.3 pounds per one foot of length with appropriate knee, dead-man, angle, anchor, or H brace.
- Wood posts with a minimum top diameter of 3.5 inches set 36 inches in

the ground with an appropriate knee, dead-man, angle, anchor, 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 any bracing.
- Steel pipe or fiberglass post with a minimum diameter of 2 inches, set 36 inches in the ground with appropriate angle, H bracing, knee brace, dead-man or anchor plate.

#### **Temporary Interior Fences:**

Used to subdivide land on a temporary basis within grazing areas to permit the implementation of a planned grazing system or to provide for the temporary exclusion of livestock from sensitive areas or to temporarily exclude livestock from areas needing grazing protection until seedling establishment.

Temporary fence shall consist of at least one energized wire with a total height of the fence not less than 30 inches. The need for additional wires will be determined by animal size, age and the species to be held. The additional wires may be used as a ground, if needed. Insulators and other attachments to posts must be installed as needed and in conformance with manufacturer's recommendations.

High tensile, U.V. stabilized high-density polyethylene (poly-wire, tape or rope) with a minimum of 4 strands of stainless steel wire filament, 14 gauge steel or 19 gauge stainless steel wire shall be used. Electrified netting shall be installed as needed for small livestock use and for training purposes and in conformance with manufacturer's recommendations. Low impedance energizers shall be used with all polyethylene type wires.

Reels used for polyethylene products shall be complete with carrying handle, rewind crank, ratchet lock and steel and plastic construction to allow for tension on wire and ease of attachment to conductive source.

Posts used with temporary fence shall be spaced a maximum of 50 feet apart on level terrain or as

needed on inclines or otherwise uneven terrain or as needed by livestock species or age.

Posts shall be steel, polyvinylchloride solid round sucker rod, non-breakable plastic, fiberglass or other materials as recommended by the manufacturer and approved by the Natural Resources Conservation Service.

### **Gates**

Electrified gates may be constructed of a single straight wire, poly-tape or wire or an expandable, coiled, high tensile, 12.5 gauge wire each attached to an insulated handle. The number of wires shall be determined by the fence objective. The gate shall be constructed so that it non-electrified when the gate is open. Over head or underground transmission lines will be used to carry electricity past the gate to the remainder of the fence. Galvanized or painted steel tube gates may also be used.

### **Flood Gates**

An electrified floodgate may be used in lieu of a non-electrified floodgate if desired. The electrified floodgate is constructed by stretching an electrified wire across the drainage above high water flow level. Attach droppers of the 12.5 gauge high tensile fence wire or drop chains to the electrified wire at a horizontal spacing of 6-inches, stopping above average normal water level. Connect gate to electric fence with double insulated cable through a cut-off switch and floodgate controller. If flooding is expected to last some time, switch the floodgate off.

### **CONSIDERATIONS**

Consider installing a hot wire on the livestock side of the post if the exterior fence is installed on the non-livestock side of the post.

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

Consider wildlife movement needs when locating fences.

Consider livestock management, handling, watering and feeding when locating fences.

Where applicable, clear right-of-ways should be established which would facilitate fence construction and maintenance.

The energizer should have the capability to produce 1 joule of energy for each mile of planned electrified fence wire.

Driven posts can have high tensile wire attached the same day. Set posts need to “rest” and settle in before attaching and tightening high tensile wire.

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

Fences can frequently be arranged to provide for one livestock water facility to serve two or more fields.

Type and size of livestock should be considered when choosing the appropriate type and design of fence, i.e. horses need very visible fence.

Easily repaired fences such as high tensile should be used in areas where flooding may occur or where debris may collect.

Manufacturer’s guidelines should be followed during installation of each type of fence to assure that all components are assembled properly.

Safety guidelines for each type of fence should be strictly adhered to particularly if the fence is to be constructed to restrict human access.

Fences constructed in fragile soils and uneven landscapes may require additional bracing.

Fence posts may need to be set deeper in soils subject to serious frost heave.

A continuous vertical 1” x 4” face board can be used at each line post to cover and help to secure the horizontal boards (rails) to the line posts on wooden board fences. They should be attached with four 4-inch long hot dipped galvanized steel, stainless steel, copper, silicon bronze, or equivalent proprietary coated nails or decking screws. This extra board extends the life of the board fence by providing some extra protection for the ends of the boards.

The Natural Resources Conservation Service recommends the use of new technology with concurrence of the state conservation engineer.

## PLANS AND SPECIFICATIONS

Plans and specifications are to be prepared for site-specific job. Plans shall include a map indicating location of fence and gates as appropriate, drawing of planned fence type, purpose, estimate of materials needed, specifications and operation and maintenance. These plans and specifications shall be consistent with this standard and shall describe the requirement for applying the practice to achieve its intended purpose.

## OPERATION AND MAINTENANCE

Regular inspection of fences shall be 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.

Fence lines and adjacent areas shall not be burned.

Fence repairs shall be made with materials that equal or exceed the quality of the original materials.

## REFERENCES:

National Standard Material Specifications – Part 642 – National Engineering Handbook - Material Specification 585 – Wood Preservatives and Treatment. 2001

National Standard Material Specifications – Part 642 – National Engineering Handbook - Material Specification 591 – Field Fencing Material. 2001

Premier Fence Systems, A Guide to Fencing that Works. 2004

USDA Forest Service. Fences. Technology and Development Program. USDI Bureau of Land Management.

Structures and Environmental Handbook, MWPS – 1, Eleventh Edition, Iowa State University 1983

American Society for Testing and Materials, Standard D 1760-96, Pressure Treatment of Timber Products, 1996

Indiana Fence Law; Indiana Code, Article 10 of Title 32 (IC 32-10-9-2)

Table 1. Recommended High Tensile Wire Spacing and Charge (+/-)

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

\* External Fences must be 48 inches in total height

Table 2. Recommended Standard Fence Heights and Wire Spacing

| ANIMAL TYPE                                  | WIRE TYPE  | WIRE SPACING  |
|--|--|---|
| Cattle, Horses,<br>Sheep, Swine and<br>Goats | Woven wire with 1 or 2<br>barbed wires on top or 1<br>barbed wire on top and<br>1 on bottom. | On ground or slightly higher for larger<br>animals. |
| Cattle and Horses                            | 4 wire barbed  | 10, 22, 38, 46+                                     |
| Cattle and Horses                            | 5 wire barbed  | 10, 20, 30, 40, 48                                  |

\* External Fences must be 48 inches in total height