

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

382A – FENCE – BARBED, SMOOTH, OR WOVEN WIRE

I. SCOPE

Locate fences to help facilitate management of livestock or different land uses and special management areas such as riparian areas, critical eroding areas, pasture types, etc.

For domestic livestock, install fences in areas that will address resource concerns, improve livestock distribution, and improve livestock handling, feeding, watering and movement of the type of livestock managed.

For horses, consider avoiding the use of barbed wire and steel T-Posts when possible in order to minimize potential injury, especially when areas of confinement are small.

When installing fences in areas of heavy wildlife movement / traffic (such as riparian areas) consideration should be given to wire types and spacing. Spacing of top and bottom wires should be adequate for the movement of the types of wildlife managed for. Where deer range, the height of fence should be less than 48 inches, space the top two wires 10 inches apart to reduce the hazard of catching deer in the fence. Where barbed wire fence construction is done, choose smooth wire as the top and bottom wire to reduce potential for harm to wildlife.

When installing interior fences to facilitate livestock movement, temporary fences may be considered in order to minimize costs and allow for flexibility in the system. Locations should allow for the shortest and straightest distances.

Prior to construction of fence, a utility check sheet must be completed to make sure all underground utilities are avoided. The producer/contractor must call 811 for DigAlert information.

Work shall consist of furnishing materials and installing either barbed, smooth, or woven wire, or combinations thereof at the location as shown on the plan map or as staked in the field.

II. FENCE TYPES

A. *Permanent fence* types are designed to be in place for a period of many years with minimal maintenance requirements. Therefore, components are designed for a life span of 20 years.

B. *Temporary, or moveable fences*, are designed to be in place for short periods of time. Temporary fences are best used as division fences for controlled or targeted grazing and fencing of areas where livestock exclusion is needed for periods of 60 days or less.

C. Standard Post and Wire Fences are the most common fence type used for controlling all types of livestock. They are suitable as permanent fences in areas that receive moderate to heavy pressure from livestock. They are typically barbed wire or double strand smooth wire.

D. Both High Tensile and non-High Tensile; Woven, Net and Mesh Wire Fences are best suited in areas where tight control is necessary such as with sheep, goats, horses or hogs.

III. MATERIALS & INSTALLATION SPECIFICATIONS

A. WIRE

All wire will be of new galvanized material and in accordance with criteria outlined in Table 1 which follows ASTM - A 116 (woven wire), and/or ASTM-121 (barbed wire) standards.

Galvanization is critical to rust protection of wire and different classes of galvanization provide different levels of protection. Wire with Class I and Class III galvanization meets the minimum level of treatment required to protect the wire from rust for the expected life span. Wires designated as regular, commercial and utility grade does not offer the level of treatment to prevent rust.

Most wire manufacturers include wire specifications on fence tags.

WIRE TYPE	MINIMUM WIRE SIZE	MINIMUM PROTECTIVE COATING	STRAND-BREAKING STRENGTHS
Standard Double Strand Barbed Wire	12-1/2 gauge with 14 gauge or heavier two- point barbs spaced not more than 5 inches apart.	Class I galvanized per ASTM-121	850 pounds or 60,000 psi
High-Tensile Double Strand Barbed Wire	15-1/2 gauge	Class III galvanized per ASTM-854	1,400 pounds or 135,000 psi
Standard Smooth Double Strand Wire	12-1/2 gauge	Class I galvanized per ASTM-121	950 pounds or 70,000 psi
High-Tensile Single Strand Smooth	12-1/2 gauge	Class III galvanized per ASTM-854	1,400 pounds or 135,000 psi
Woven Wire, Style 4 – Farm Fence	Top and bottom wires, 11 gauge, intermediate and stay wires 14-1/2 gauge	Class II zinc coating or equivalent 0.5 oz. per sq. ft. or wire surface.	950 lbs. minimum

1. Wire Installation

Fence wire will be stretched to sufficient tension prior to being fastened to posts. Temperature variations must be considered (wire will tighten in cold weather and expand in hot weather).

Wherever possible, wire will be attached to fence post on side receiving most pressure.

2. Wire Attachments

The following criteria will be followed for attaching wires to all posts:

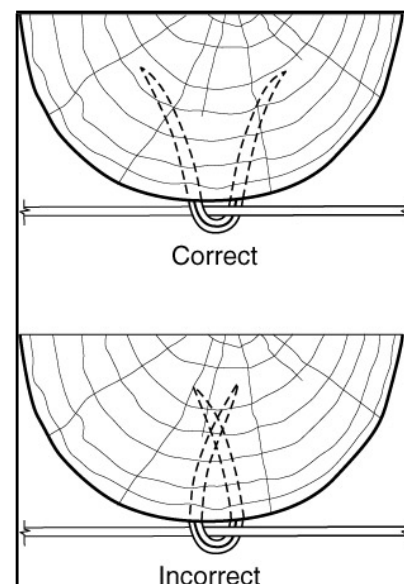
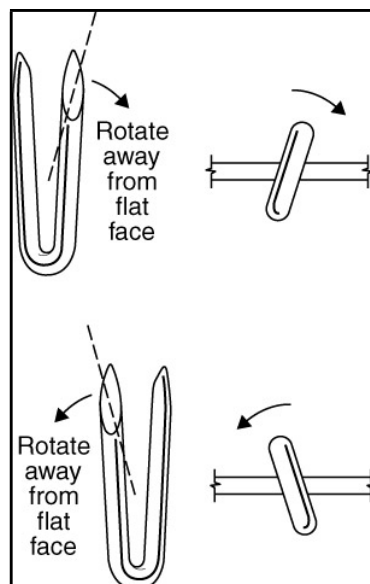
a) Wire clips

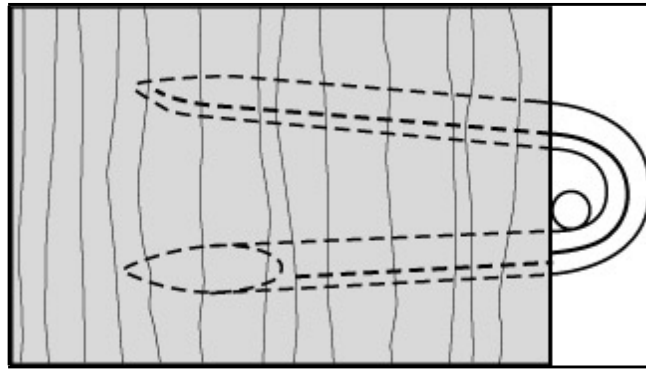
- Wire clips should be 12 – 12 ½ gauge galvanized.
- Wire clips or drilled holes could also be used for fiberglass posts.
- Wire clips or fasteners must be galvanized and similar to strength of fence wire.

b) Staples

9-gauge steel staples with a minimum length of 1½ inches for soft woods (pine) and 1 inch for hardwoods (cedar, oak, juniper, black locust and Osage orange).

- Drive staples diagonally to the wood grain at a slight downward angle (upward if pull is up) to avoid splitting the post.
- Space will be left between post and staple to allow free movement of wire and to avoid damage to zinc coating.





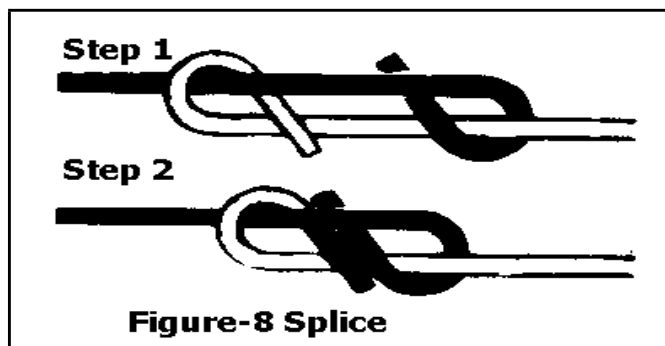
**** See figures above to view the proper use of staples for fence construction.**

c) Wire Splices

1. Standard Wire - Western Union splices, as shown below, shall have a minimum of 8 wraps on each side of center, tightly wound and closely spaced.



2. Standard and High Tensile Wire - Compression fittings or splice sleeves will have a tensile strength not less than 80% of the wire. Ends of wire will be overlapped at least 2 inches with sleeves crimped and installed according to manufactures specifications. Two 3/8 in. sleeves or one 3/4 in. sleeve will be installed at each splice.
3. Standard wire may also have “loop” splices where the wire has a minimum of 8 wraps on each side. (Western union is the preferred method, followed by compression fittings, but “loop” splicing is acceptable).
4. High Tensile Wire – “The Figure 8”, as shown below, can be used by overlapping wires 2 inches, looping each wire over and back through, then pulling together. As fence is stretched, the splice will tighten.



B. POSTS

Type, height, size, and spacing of posts will be used that best provides the needs for the types of fences required and is best suited for the topography of the landscape.

1. Post Materials

a) *Wood Post*

In order for wooden posts to be used, the following criteria must be met:

- Must be sound and free from decay
- Minimum lengths will allow for required buried depth and fence height plus at least 2 inches of post above top wire for wire fences (to the top board of board fences).

b) *Steel pipe posts*

In order for steel pipe posts to be used, the following criteria must be met:

- Will be of good quality.
- Will have the top permanently capped to prevent rainfall from entering the post.
- Minimum lengths will allow for required buried depth and fence height plus at least 1 inch of post above top wire for wire fences.

c) *Steel “T” or “U Section” posts*

In order for Steel “T” or “U Section” posts to be used, the following criteria must be met:

- Shall be of high carbon steel weighing are 1.33 lbs/ft.
- Will have an anchor plate and be studded, embossed, or punched for wire attachment.
- Will be new, galvanized, enameled and baked, or painted with weather resistant steel paint and components will be repainted if rusting occurs.
- Minimum lengths will allow for minimum setting depth and fence height plus at least 2 inches of post above top wire.

TABLE 2. Line Post Requirements				
Wood posts do not need to be new materials (Railroad Ties and Power Poles are adequate); however, all posts shall meet the minimum criteria for durability and protective coating. Wood posts need to be sound and free from decay, with all limbs trimmed substantially flush with the body. Post shall be sufficient length to meet buried depth, fence height requirement plus 2 inches. Lengths listed below are based on a 42-inch top wire height.				
LINE POST TYPE	MINIMUM DIAMETER	MINIMUM SETTING DEPTHS	MINIMUM LENGTHS	MINIMUM PROTECTIVE COATING
Wood-juniper, cedar	4-1/2 inches	24 inches	6 feet	None
Wood other than above	4-1/2 inches	24 inches	6 feet	Complete penetration of the sapwood with approved treatment materials. Pressure- treated, entire length of post. See note below.

LINE POST TYPE	MINIMUM DIAMETER	MINIMUM DEPTHS	MINIMUM LENGTHS	MINIMUM PROTECTIVE COATING
Standard "T" or "U" section steel rolled with high carbon steel and studded, embossed, or punched for wire attachment with anchor plate.	1.33 pounds per foot of length, exclusive of anchor plates	16" – Bury the spade + 1 knob	5.0 feet	Hot-dip galvanized, or one or more coats of high-grade, weather-resistant steel paint, or enamel-applied and baked.
Steel, round	2-3/8 inches outside diameter (OD), 3.65 lb./ft. or equivalent	3 ft. – set in concrete entire depth.	7 feet	Schedule 40 pipe. Wrap wire or place a metal stay on wires next to post to prevent vertical wire movement.
Live trees	6 inches at top wire	Wire not wrapped or stapled directly to tree. A wood slat is nailed to the side of the tree and the wires stapled to the slat.		

C. BRACE ASSEMBLIES

Braces determine the structural soundness and longevity of any fence line. Corners are braces that are located where there are changes in fence direction due to slope and alignment changes in the fence line. If any brace fails, there is a loss of wire tension and fence effectiveness. Design and spacing are determined from factors such as number of wires used, type of wire, soil type, terrain and animals to be restrained.

Fence braces fail because of structural failure, soil movement or failure or corner or end post pullout. Structural failure of an end brace is usually due to improper design, poorly selected materials, or over-stressed members. By carefully designing fence braces and properly proportioning and sizing the members, structural failures can be all but eliminated. Fence braces also fail when the soil is too weak to support the load, which allows the fence brace to move through the soil. Soil failures can usually be eliminated by using larger posts or by applying plates. Corner post pullouts, when braces lift out of the ground, can be eliminated by using longer fence braces and placing cleats on the post.

Bracing of anchor (pull) posts is required at all corners, gates and ends of the fence line. They are also needed at slope and alignment changes of the fence lines. See figures for selection criteria and design specifications of single and double brace assemblies.

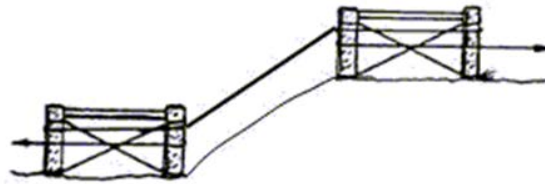
1. In-line Pull (H-Brace) Post

In-Line Pull Post assemblies are located in straight sections at lengths of 1320 feet (length of a spool of wire) or where there are sudden changes in elevation, such as the bottom and top of steep slopes. Any of these types can be used:

- Single Post Pull Assembly
- H-Brace Pull Assembly
- Three-Post Welded Pull Assembly.

a) Wood - On single H-Braces, a minimum of 4 inch top diameter of treated timber or durable wood listed above for upright post and a 4 inch diameter for the horizontal cross post.

b) Steel- Minimum 2-3/8 inches outside diameter (OD) metal pipe or equivalent. Steel cross- post must be a minimum of 2-3/8 inches OD.



Braces on the top and bottom of steep slopes.

2. Corner Gate and End/Gate Posts

a) Corner braces are required at all points where the fence alignment has a change of 20 degrees or more and the pull is from two directions, and/or when the topography change is greater than eight (8) percent.

b) End braces are required where fence ends and on both sides of gate openings.

- **Wood** - (Pressure treated or durable wood) shall have minimum top diameter of 6 inches, 8 ft. in length, and be set firmly 3 ft. in the ground. Cross post will have a minimum 4 inch top diameter.
- **Steel** - Minimum 2-3/8 inch steel pipe or equivalent, 8 ft. in length, set 3 ft. in ground. Steel cross-posts must be a minimum 2-3/8 inch diameter.

Braces where angle of the fence changes more than 20 degrees can be an H-Brace or a Steel Welded Single Post End/Angle (Diagonal) Brace.

Allow newly-installed braces and assemblies to settle and/or pack dirt sufficiently around all post; do not over-tighten wires.

D. GATES

1. Wire gates shall be made of the same materials of the same kind, grade and size specified for the field fence and stays will not exceed a 4-foot spacing.

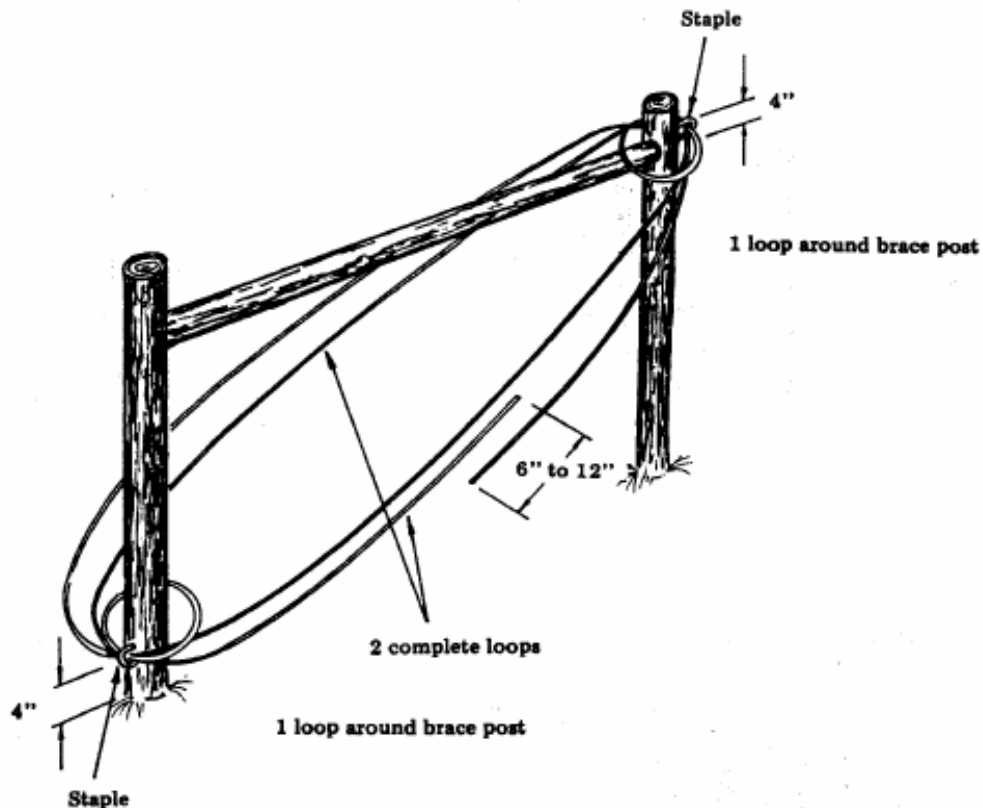
2. Gates constructed of wood, panels, aluminum or steel will have galvanized or painted hinges and be attached directly to a braced end / gate post.

E. ANCHOR POST

1. Attaching wire to Anchor / Pull Posts - For standard wire fences, wires will be attached to anchor (pull) posts by two complete wraps around post, stapled (wood posts) or wired (steel posts) and ends tightly twisted around stretched wire at least six times.

For woven or mesh wire, determine amount of wire needed to fully wrap around post twice then remove enough vertical stays to provide the length needed. The wire ends are then attached as described above.

The figure below shows the proper way of attaching wire to anchor or pull posts if a dead

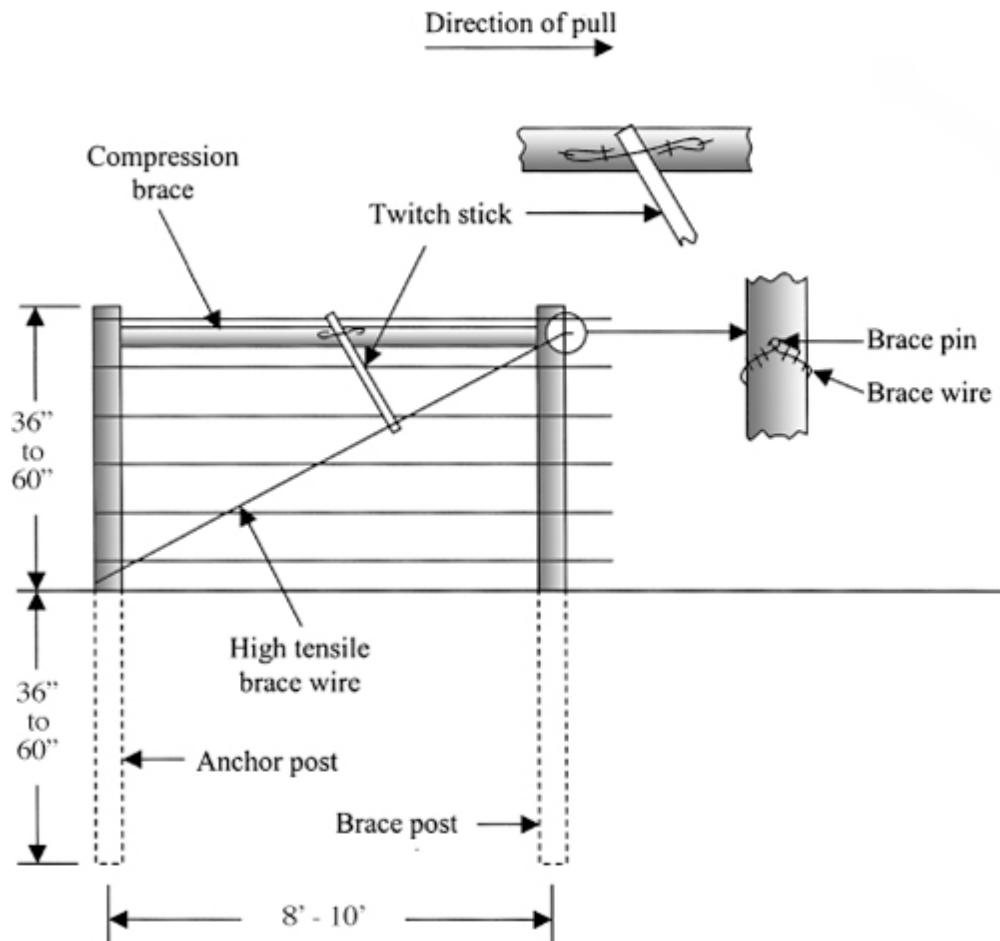


2. Setting Posts

- a) When backfilled with dirt, posts will be centered in a hole at least 6 inches larger in diameter than the diameter of the post and tamped in 4 to 6 inch lifts up to ground level.
- b) When backfilled with concrete, posts will be centered in a hole that is a minimum of 12 inches in diameter. The hole will be completely filled and crowned (mounded) at post base to prevent water from ponding around post at ground level.
- c) All dug post will be set at a depth of 3 feet.

3. Horizontal H-Brace Assembly

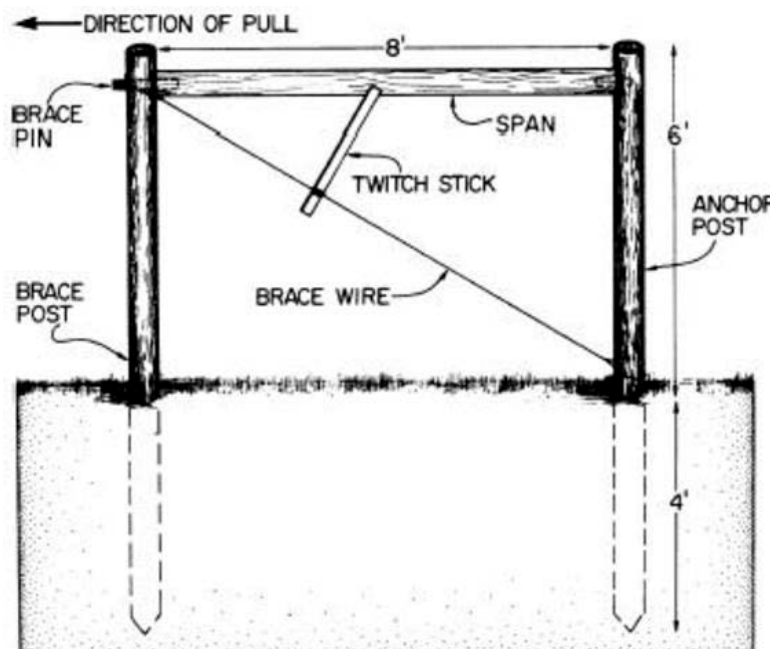
a) Horizontal Braces (H Brace) are the most commonly used design in the construction of post braces. An example of an H Brace is shown below:



- b) Placement of the Horizontal brace should be a minimum of $\frac{2}{3}$ height of the top wire height and no higher than 8 inches from the top of the post.
- c) Diagonal braces will be attached to brace post a minimum of 6 feet from anchor post and set into concrete as specified for steel pipe posts or attached to a steel reinforced concrete block.
- d) For slip braces, the steel reinforced concrete block must equal or exceed 225 square inches of surface area (Cinder pads are unacceptable).
- e) The slip brace must be at least $3\frac{1}{2}$ inches width.
- f) Wood posts used for horizontal braces will be straight and free of splintering. The brace post and anchor posts should be notched to achieve a secure fit and the horizontal brace should be attached using screws, nails, or steel dowel pin (drilled to fit, and at least 2 inches into each post).
- g) Steel and angle iron members will be installed into a $\frac{3}{4}$ - 1 inch notch in brace posts.
- h) All steel assemblies will be welded and painted for rust protection.

4. Tension / Brace (Guy) Wires (where applicable)

- a) Two complete loops of 9-gauge smooth wire, 12½ gauge double strand barbed or smooth wire or 12½ gauge high tensile smooth wire.
- b) Wire will be twisted or strained to provide necessary rigidity with a twist rod that should be 18-24 inches long and will remain in place approximately midway along brace wire.
- c) For horizontal braces, brace wire will be double wrapped and stapled to brace post at a height 4-6 inches above brace member and anchor (pull) post at a point 4 inches above the ground level.
- d) If a deadman is used, the tension wire extending to the deadman must be one continuous loop.
- e) An illustration of a tension wire being used for the H Brace is shown below:



F. STAYS

1. When line post spacing exceeds the maximum without stays, stays will be included and spaced at equal distances between posts with spacing not to exceed the maximum specified in Table 6.
2. Length of stays will be fence height plus 2 inches and installed so that stays swing free of the ground and allow fence to move when touched by animal.
3. Stays will be constructed of durable materials designed for this purpose.

TABLE 3. Brace Member (Compression) Requirements for Barbed and Smooth Wire Fence

BRACE MEMBER TYPE	MINIMUM DIAMETER/WEIGHT	MINIMUM LENGTH	OTHER
Wood, horizontal	3.5 inches	6 feet	Juniper, cedar, no treatment needed. All others pressure-treated, entire length of post.
Wood, diagonal	3.5 inches	8 feet	Juniper, cedar, no treatment needed. All others pressure-treated, entire length of post.
Steel, round, horizontal, pipe or tubular steel	2 inches OD, 2.25 lb./ft. or equivalent	6 feet	None
Steel, round, diagonal, pipe or tubular steel	2 inches OD, 2.25 lb./ft. or equivalent	8 feet	None
Steel, angle iron, diagonal (when used with and all metal brace system)	2 inches x 2 inches x 0.25-inch	8 feet	None

Table 4. Brace Post Requirements for Barbed and Smooth Wire Fence

Posts need not be new materials, (Railroad Ties and Power Poles are adequate); however, all posts shall meet the minimum criteria for durability and protective coating and be sound and free from decay, with all limbs trimmed substantially flush with the body. Lengths listed below are based on a 42-inch top wire height. Steel pipe needs to be free from corrosion and pitting.

BRACE POST TYPE	MINIMUM DIAMETER/WEIGHT	MINIMUM SETTING DEPTHS	MINIMUM LENGTH	OTHER
Wood-juniper, cedar, osage orange, black locust, redwood, oak or pine (See other)	5 inches	3 feet or 1/3 of post length	7 feet	If pine is used it must be pressure treated the entire length of the post. (See Note Below*)
Steel, round	2-3/8 inches outside diameter (OD), 3.65 lb./ft. or equivalent	3 feet – set in concrete entire depth. No concrete needed if welded to compression brace.	7 feet	Schedule 40 pipe will meet these requirements. Place a metal stay on wires, next to the pipe post so wire cannot be moved vertically.
Live trees	6 inches at top wire	Wire not wrapped or stapled directly to tree. A wood slat is nailed to the side of the tree and the wires stapled to the slat.		

*Wood should be treated with Chromated Copper Arsenate (CCA) or other EPA approved wood preservative. CCA treated wood posts should not be used where treated wood may come into contact with water sources (wetlands, streams, high water tables, etc.). Other chemically-treated and pressure-treated wood posts may be used in these areas.

Rock cribs can be used in rocky areas for corner bracing where soil does not permit post holes to be dug.



FENCE TYPE	LINE POST SPACING (MAXIMUM INTERVAL)
3-Wire Fence	13-16.5 feet (1 rod) without stays 15-20 feet with one stay mid-way between posts
4-Wire Fence or more	15-feet without stays 20-feet with one stay set mid-way between line posts 25-feet with two stays set at equal intervals between posts
3-Wire or 4-Wire Suspension Fence	80 to 100 feet (not to exceed 100 feet). Stays shall be spaced not to exceed 16.5 feet (1 rod) in the line.
Heavy Snow Country and Let-Down Fences	16.5 feet between wooden posts – wood/fiberglass stays at approximately 4-foot intervals.

STAY TYPE	MINIMUM DIAMETER/WEIGHT	MINIMUM LENGTH
Wood - Preferred in high snow areas	1.5 inches diameter	Fence wire height + 2 inches
Wire – Not to be used in snow areas	9.5 gauge twisted, manufactured for this purpose; galvanized-zinc coated	4 inches + distance between bottom and top wire
Fiberglass	Especially fabricated for this purpose	Fence wire height + 2 inches

Table 7. Fence Height and Spacing Requirements	
INTENDED USE	FENCE HEIGHT & WIRE SPACING
Domestic livestock control with wildlife consideration.	Minimum height of 42 inches (+ or - 2 inches) for the top wire. Wire spacing of the top two line wires shall be a minimum of 10 inches apart at the post location. Bottom wire will be a minimum of 14 inches from the ground ; 16 inches for antelope (see below for additional considerations for wildlife).
Domestic livestock control with wildlife consideration where the top wire exceeds 44 inches. Fence height shall not exceed 48 inches.	If wire height exceeds 44 inches, the distance between the top wire and the second wire will be at least 12” and provisions must be made at identified crossings for wildlife movement; both over and under the fence. These areas will not exceed 1/4-mile apart and there must be a minimum of one per fence. The fence in these designated crossing locations will not exceed 42 inches at the top wire and must include a minimum of one of the alternatives listed below to allow for wildlife movement (*see Wildlife Alternatives below)

***Wildlife Alternatives.** (1. Smooth wire on top and/or bottom, top wire tied down between two posts, bottom wire tied up between two posts, 2. PVC on top wire for entire length between two posts; raise bottom wire in that stretch, lower top wire in that stretch, 3. Wood rail at top wire between two posts maximum 38 inches high (38-inch elk jump), 4. Extra stays so top and second wire will not cross, etc.).

Sheep fences should have gates no taller than 36 inches so wildlife can jump over or any other means to allow control of the sheep while allowing movement across fences. Leave gates open when sheep are not present to accommodate all wildlife movement.

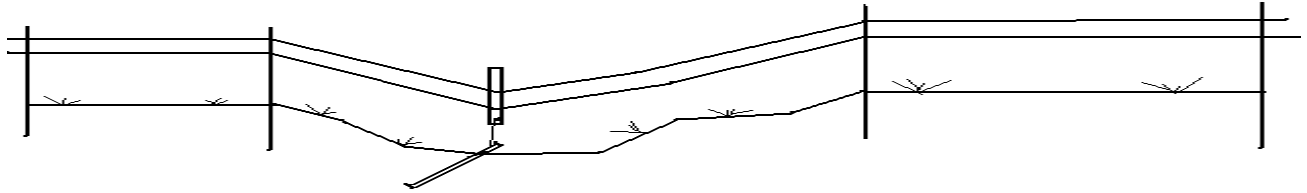
IV. CLEARING THE FENCE LINES

Establish fence boundaries on a map or aerial photograph prior to clearing the fence line. Locate underground utilities prior to clearing the fence line. Once the utilities have been located, remove brush, loose rocks, trees, and tall grass from the fence line. Fence construction time is considerably reduced when the fence line is well cleared ahead of time. Fence appearance is also improved.

V. SPECIAL CONSIDERATIONS

Crossing Streams or Draws

When the fence crosses landscape depressions, draws, or swales, and the bottom line wire is more than 20 inches above the ground at the low spot, the use of a deadman may be necessary to maintain fence height. When crossing the streams or very deep draws, the fence may be dead-ended on each side of the crossing by use of line braces. The section across the stream may be removable, a breakaway type, or swinging picket-type fence.



This illustration shows the use of a deadman when crossing a draw.



Deadman used for change in topography and a break-away fence crossing a draw

VI. INSTALLATION

The installation of the fence shall conform to the figures and to the drawings. All posts shall be placed to the required depth and shall be firmly embedded so that there is less than 1 inch of horizontal movement at the top of post when a horizontal force of 80 lbs. is applied.

The completed job shall be workmanlike and present a good appearance. The installer and other persons will conduct all work in accordance with proper safety procedures.

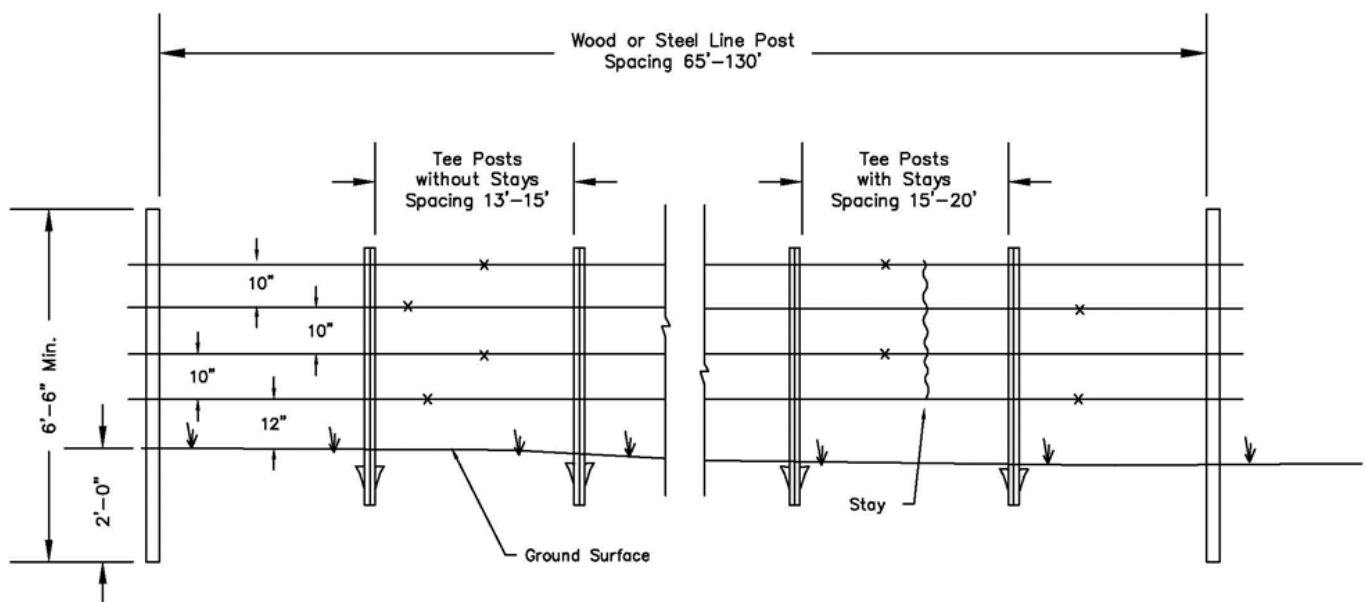
VII. BASIS OF ACCEPTANCE

After the fence has been installed, a site inspection will be made to determine if the materials and placement adhered to the specification. A practice certification form will be completed by the planner.

VIII. MAINTENANCE

A properly maintained fence is an asset to your property. This practice will require you to perform periodic maintenance. Some items to be observed and corrected are:

- Tension of wire, broken wires.
- Post alignment, post stability.
- Broken or bent stays.



STANDARD 4 WIRE FENCE

Stays only needed if line posts are more than 15' apart

Wildlife option: smooth bottom wire

FIGURE 1

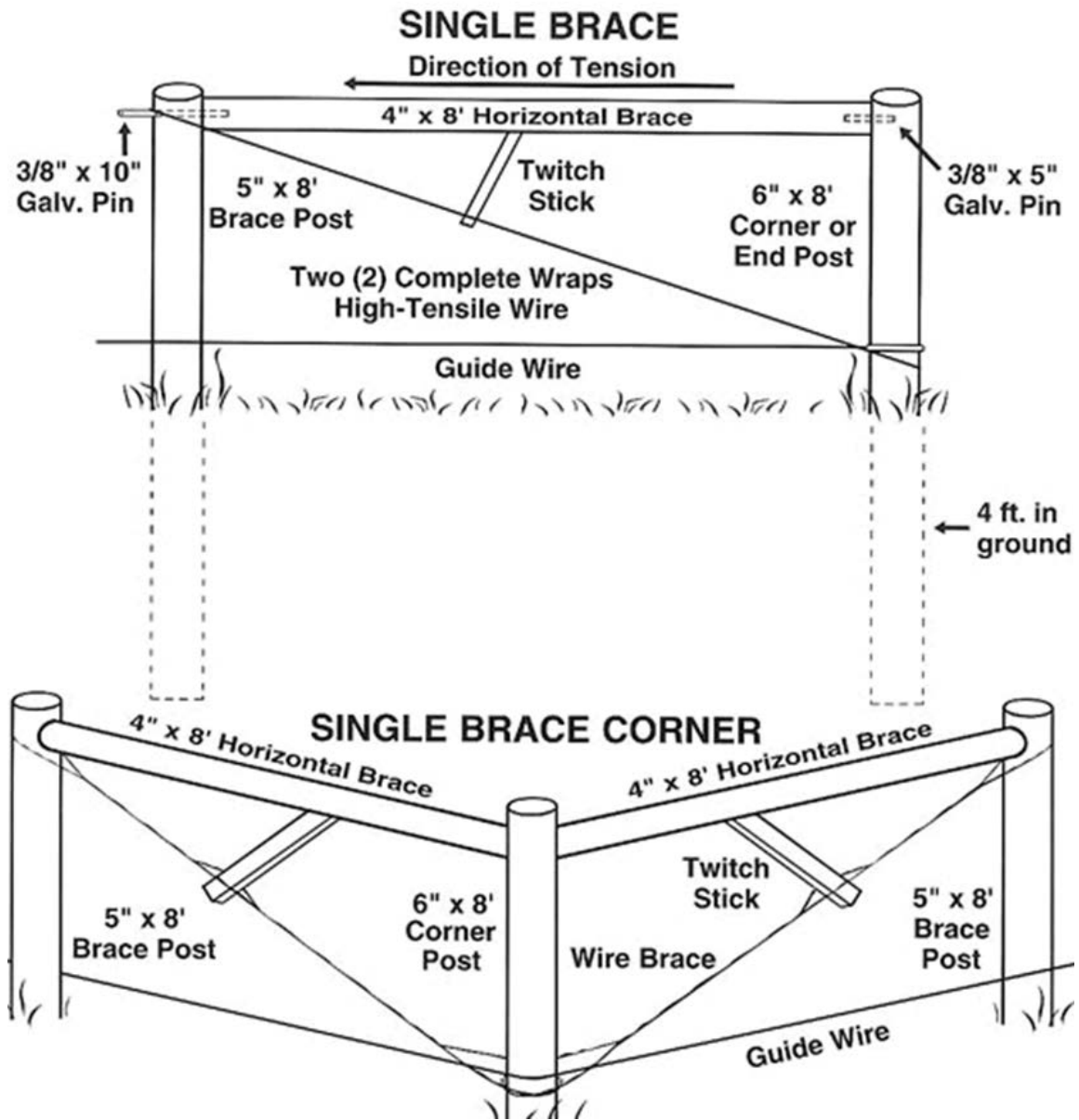
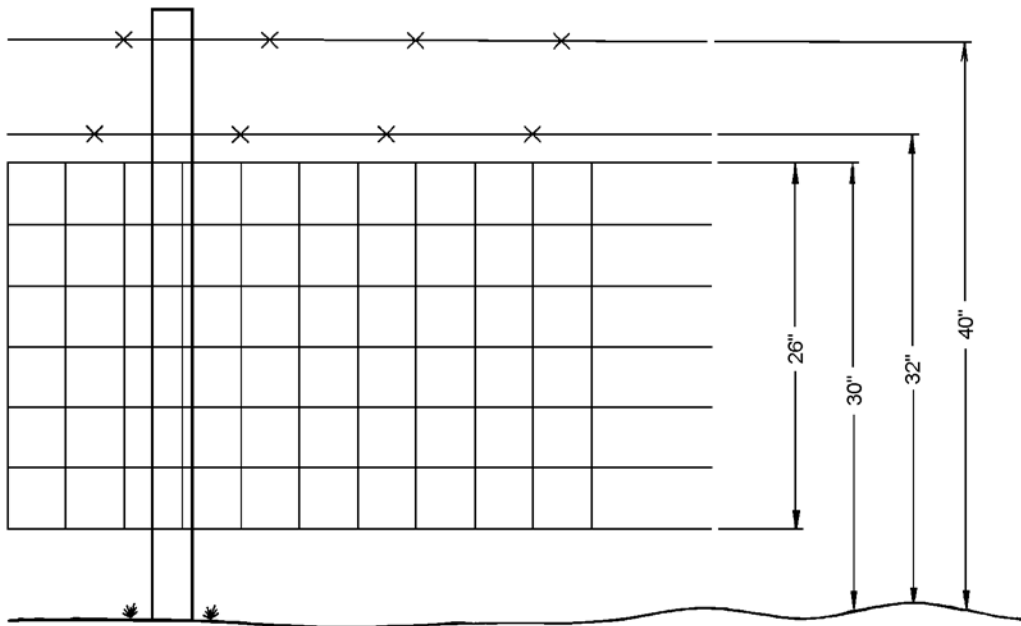
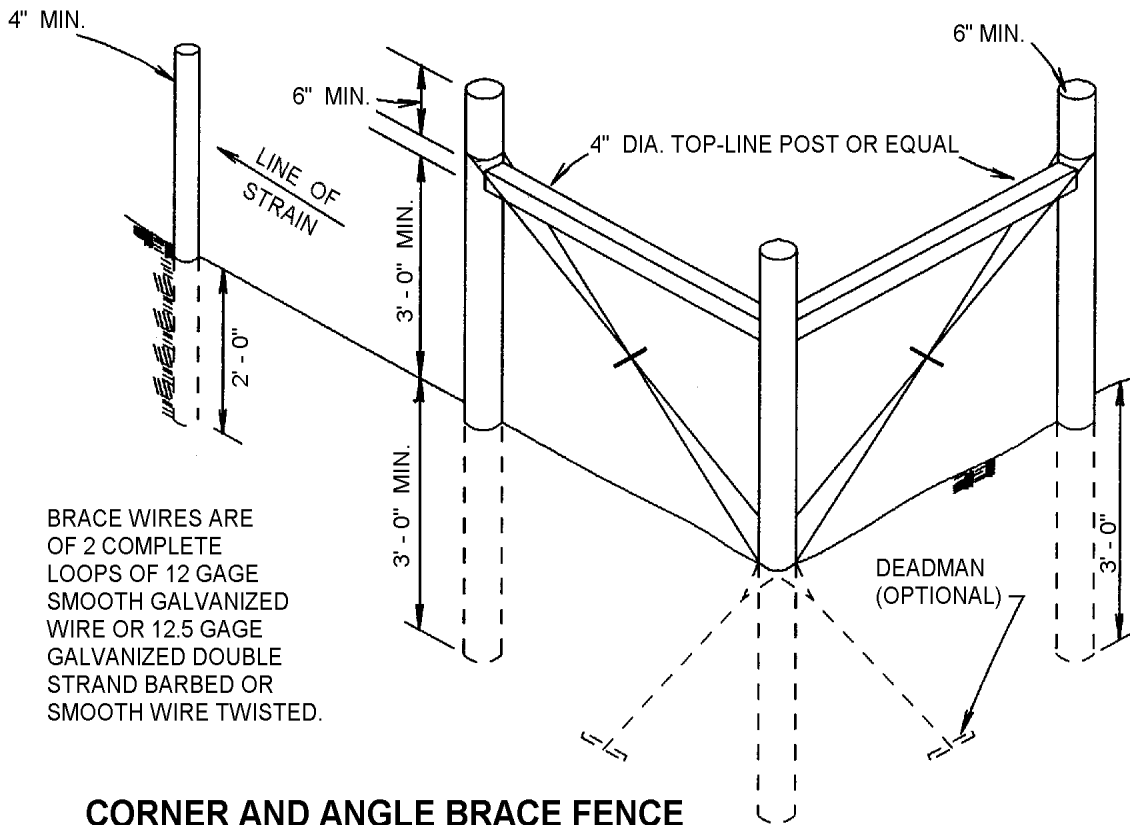


FIGURE 2



WOVEN WIRE WITH 2 STRANDS BARBED WIRE

FIGURE 3.



BRACE WIRES ARE OF 2 COMPLETE LOOPS OF 12 GAGE SMOOTH GALVANIZED WIRE OR 12.5 GAGE GALVANIZED DOUBLE STRAND BARBED OR SMOOTH WIRE TWISTED.

CORNER AND ANGLE BRACE FENCE

FIGURE 4.

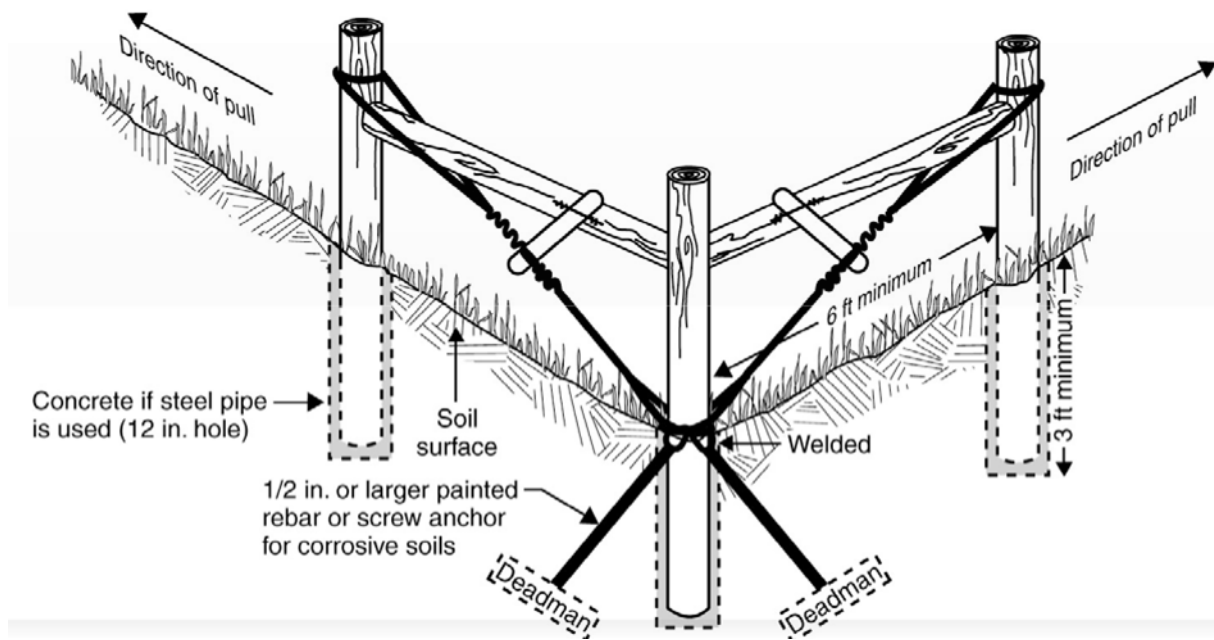
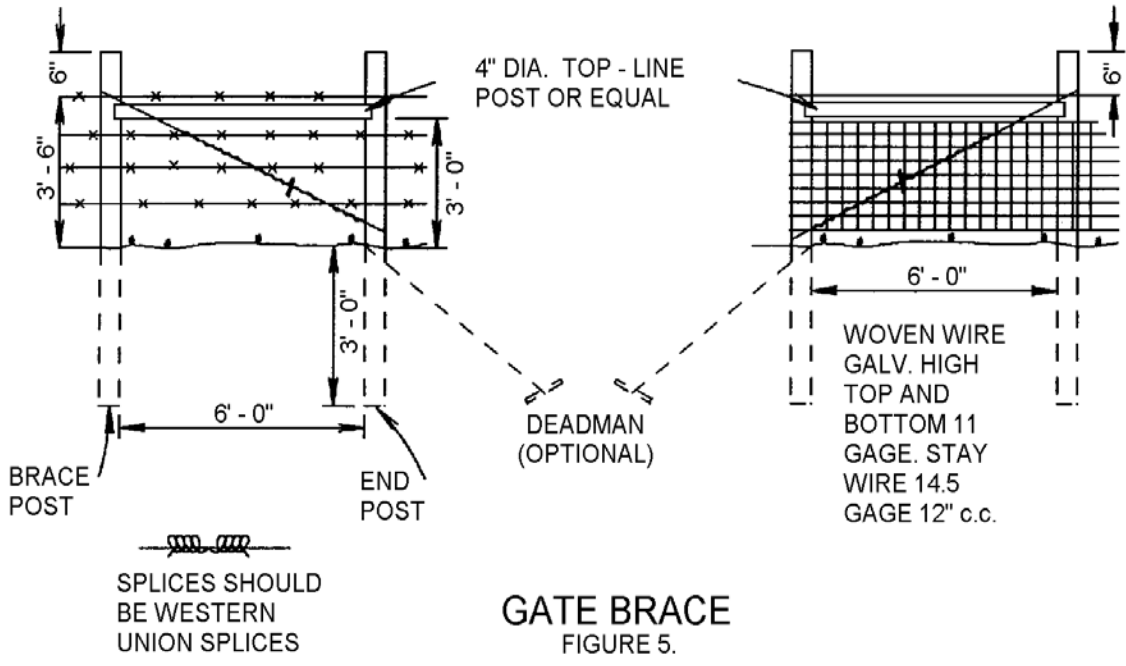
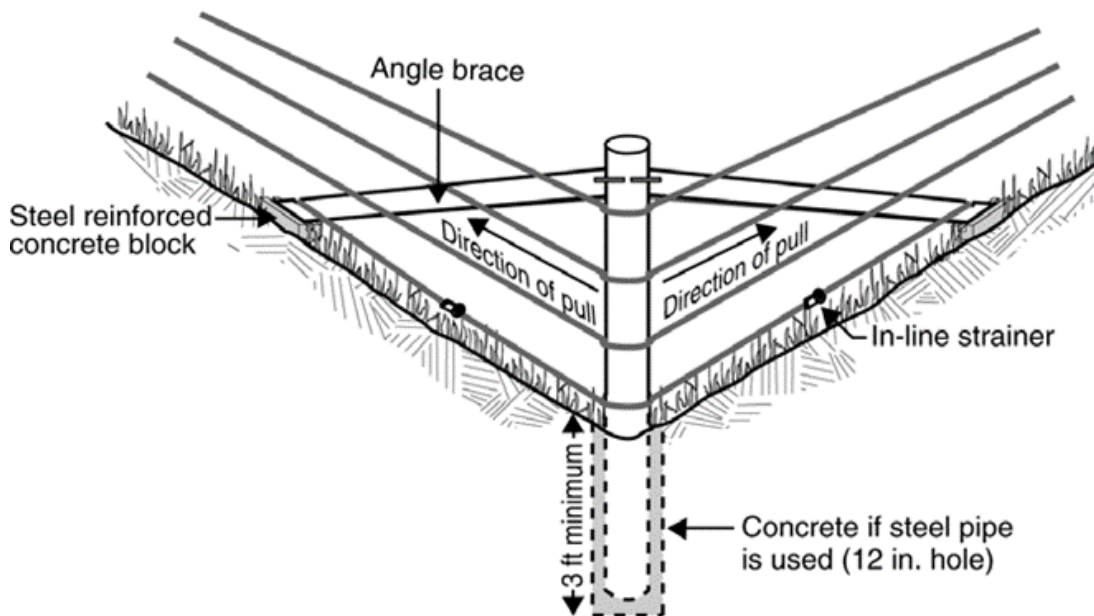


FIGURE 6 – CORNER BRACE ASSEMBLY

FIGURE 7 – Single Post Corner or Angle Brace Assembly



Pull Assembly

