

**NATURAL RESOURCES CONSERVATION SERVICE  
PACIFIC ISLANDS AREA**

**CONSERVATION PRACTICE SPECIFICATION**

**FENCE (382)**

**INTRODUCTION**

This document provides the materials and construction specifications for building a fence with an intended lifespan of 20 years under normal conditions.

- *Note: This intended lifespan may not be realized in locations where the fence might be subject to salt spray, vog, lava, fire, or other environmental factors that encourage accelerated corrosion or other damage to fencing materials.*

This document includes diagrams and installation methods that follow industry standards. Other installation methods **may** be approved at the discretion of the State Range Management Specialist if they have been demonstrated to meet the 20 year lifespan of the practice under the planned conditions of use and in a similar environmental setting. Deviations from the installation methods in this document **must be approved prior to purchase of materials and commencement of construction** in a written variance signed by the NRCS Pacific Islands Area (PIA) State Range Management Specialist.

**PLANNING FENCES**

All planned fences will be included in the conservation plan, which must also include the following documentation:

1. The cooperator's goals and objectives for the fence.
2. A Resource inventory, including:
  - A Conservation Plan Map showing all existing and planned fences.
  - A Water Distribution Map showing watering locations.
  - A fence construction/specification job sheet (Attachment A), which must be completed with the cooperator. One copy of this job sheet will be given to the cooperator and one copy will be placed in the conservation plan/contract file.
3. A maintenance plan to ensure the integrity of the fence for its intended lifespan.

Before new fences are built, existing fences are replaced, or more cross fences are considered, careful planning must take place. The first consideration is having a well-built, properly functioning permanent boundary fence. This will ensure proper confinement of livestock on the ranch premises and exclude neighboring livestock. Without a properly-functioning boundary fence, cross-fences are useless. Existing fencing materials from non-functional fences may not be reused when building replacement fences. Fence construction requiring the removal of existing fencing materials should provide for proper disposal to prevent harm to animals, people and equipment.

It is also imperative to select the proper type of fence that will adequately contain the livestock. For example, a four-strand barbed wire fence is effective for controlling cattle, but not sheep or goats. These animals require a woven wire fence, which when properly constructed, is also effective at controlling cattle. It is the responsibility of the conservationist to work with the cooperator to determine the proper type of fence needed to meet the cooperator's goals and objectives.

In the NRCS Pacific Islands Area, Fence (382) a facilitative practice and all contracts on grazing land (including Range and Pasture) containing fences require the planning of Prescribed Grazing (528) as a contracted management practice. See the Prescribed Grazing (528) practice standard and specification for details on planning fences and grazing management.

### **OPERATION AND MAINTENANCE**

Regular inspection of fences shall be part of an ongoing maintenance program. Inspection of fences after storm and other disturbance events is necessary to ensure the continued proper function of the fence. Maintenance will be performed in a timely manner as needed.

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

Maintenance activities include:

- Repair or replacement of loose or broken material, gates and other forms of ingress/egress.
- Removal of trees/limbs.
- Replacement of water gaps as necessary.
- Repair of eroded areas as necessary.
- Repair or replacement of markers or other safety and control features as required.

### **FENCE TYPES**

**Temporary or Moveable Fences** are designed to be kept in place for short periods of time. These fences are best used as interior division fences for controlled grazing of livestock. *Temporary Fencing is not eligible for NRCS financial assistance in the PIA.*

**Permanent Fences** are designed to remain in place with minimal maintenance requirements. Permanent fences are used for interior cross-fencing, exterior boundary fencing, livestock and/or feral ungulate exclusion, and for cordoning off areas that have specific land uses or are environmentally-sensitive. All fences built with financial assistance from NRCS must be designed and installed as permanent fences.

- *Note: Fence designs following the specifications in this document are intended for cross-fencing purposes only, and are not to be used for boundary or perimeter fences. If you have any questions regarding boundary fencing, contact the PIA State Range Management Specialist.*
- *Note: Exterior boundary fences and feral ungulate exclusion fences are not eligible for NRCS financial assistance in the PIA in all but a very few select instances. These types of fences are not covered by this practice specification. Please contact the State Range Management Specialist for assistance with these types of fences.*

There are many types of fences used in the PIA. This practice specification will provide typical designs for the three most popular types of permanent cross-fences used in the PIA to support NRCS conservation measures: the barbed wire fence, the woven wire fence, and the electric fence.

The designs provided for each of these fences are backed with specifications for materials and construction that must be met or exceeded for the fence to qualify as meeting NRCS specifications.

Fences built with financial assistance from NRCS in the PIA are only eligible for certification and payment if each of the minimum specifications provided below for a given fence design are met or exceeded.

**Barbed Wire Fences** – This type of fence is appropriate for cattle, horses, and carabao. The PIA typical barbed wire fence (Figure 1) will have a *minimum* height of 44 inches and at least four strands of either malleable or high tensile barbed wire. There is no specific spacing requirement between the four courses of wire, however wires below the top wire shall be spaced in a manner that is sufficient to control the livestock and prevent them from passing through the fence. Please refer to the specifications below for details regarding materials and installation specifications.

**Woven Wire Fences** - This type of fence is appropriate for sheep, goats, cattle, horses, and a variety of other domestic livestock, especially mixed herds. The PIA typical woven wire fence (Figure 2) will have a *minimum* height of 44 inches. It must consist of *at least* one course of woven wire that is at least 39 inches in height and must be topped with no less than one strand of either malleable or high tensile barbed wire (or double-stranded smooth wire, if fence is being built in Hawaiian hoary bat habitat). The course of barbed wire must be placed within 5 inches above the top of the woven wire.

One or multiple strands of barbed wire may be placed along the bottom of the woven wire to prevent feral dogs, pigs, and other predators or unwanted ungulates from digging under the fence. Where predator and feral ungulates exclusion is not a concern, the woven wire may be installed up to 4 inches above ground-level to slow corrosion in an effort to prolong the life of the bottom wire. Please refer to the specifications below for details regarding materials and installation specifications.

**Permanent Electric Fences** - This type of fence is appropriate for cattle, horses, sheep and goats. The PIA typical electric fence (Figure 7) will have a *minimum* height of 36 inches and two to five strands of high tensile wire. Please refer to the specifications below for details regarding materials and installation specifications.

The number of electric fence wires will depend on the class of livestock the producer is managing. Cross fences shall be constructed in a manner which result in the top wire being 2/3 of the shoulder height of the grazing animal (see following table for wire quantity and spacing guidelines).

Livestock Type	Min Number of Wires	Suggested Wire Spacing Inches from Ground				
		Wire 1	Wire 2	Wire 3	Wire 4	Wire 5
Cattle/Horses	2	24	36			
Sheep/Goat	5	6	12	20	28	36

When more than one class of livestock are being managed, design the fence for the class which is the most difficult to control. Electric fences shall also be designed to insure facial shock when animal attempts to place head between wires. In instances where ground moisture is high an all positive charged fence will normally suffice. If experience shows that the soil on site will dry to the point of not causing a shock to the animal, then a combination of positive (+) and negative (-) wires shall be used. Please refer to the following table as well as the specifications below for details regarding materials and installation specifications.

## **POST SPECIFICATIONS FOR ALL FENCES (NON-ELECTRIC & ELECTRIC)**

### **A. POST MATERIALS**

- Wood
  - Commercially-produced wooden fence posts must be new material, sound, free from decay and sufficiently pressure treated with pentachlorophenol, creosote, or chromated copper arsenate (CCA) to meet the following specifications:
    - Pentachlorophenol: retention of 0.3 lb. /cu ft.
    - Creosote coal tar: retention of 6.0 lb. /cu ft.
    - Chromated Copper Arsenate: retention of 0.4 lb./cu ft
  - The use of landscaping timbers in any part of the fence is prohibited.
  - Tying or affixing any part of a fence to a living or dead tree is prohibited.
  - Kiawe posts are approved for use.
  - Ohia, koa and eucalyptus posts may be used, as long as the following conditions are met:
    - Cut surfaces must be hand-painted with wood preservative to prevent rot.
    - All bark must be removed from posts.
  - Wooden Line posts must have a minimum diameter of 4 inches (exception: 2 inches for electric fences).
  - Wooden anchor/pull, brace, and gate posts must have a minimum diameter of 6 inches (exception: 4 inches for electric fences).
  - Must be of sufficient length to allow for the required buried depth of:
    - 36 inches plus at least 2 inches of post above the top wire for anchor/pull, brace and corner posts.
    - 24 inches (exception: 18 inches for electric fences) plus at least 2 inches of post above the top wire for line posts.
- Steel Pipe
  - Must be of good quality and free of excessive rust, pitting, or other damage.
  - Must be galvanized or painted to provide protection from rust.
  - Must have the tops permanently capped or filled to prevent rainfall from entering the post.
  - Steel pipe Line posts must have a minimum nominal diameter of 2 inches or 2 3/8 inches OD (exception: 1 inch nominal or 1 3/8 inches OD for electric fences).
  - Steel pipe anchor/pull, brace, and gate posts and horizontal compression members must have a minimum nominal diameter of 2 inches (2 3/8 OD).
  - Must be at least schedule 40, 3.65 lb./ ft. for 2 inch nominal diameter (2 3/8 OD).
  - Must be of sufficient length to allow for the required buried depth of:
    - 36 inches plus at least 2 inches of post above the top wire for anchor/pull, brace and corner posts.
    - 24 inches (exception: 18 inches for electric fences) plus at least 2 inches of post above the top wire for line posts.
- Steel “T” or “U” Posts
  - Must be new or unused.
  - Must be galvanized or coated with baked enamel.
  - Must be made from high carbon steel weighing not less than 1.33 lbs. per linear foot.
  - Must be of sufficient length to allow for the required buried depth of 18 inches plus at least 2 inches of post above the top wire.

- Must have an anchor plate and be studded, embossed, or punched for wire attachment.
- Concrete Line Posts
  - Concrete must conform to NRCS-PI Specification 103 – Concrete.
  - Concrete strength must be at least 3,000 PSI at 28 days.
  - Acceptable minimum dimensions include:
    - 6 inches round.
    - 5 inches x 5 inches square.
    - 6 inches x 4 inches rectangle.
    - Must be of sufficient length to allow for the required buried depth of 24 inches (exception: 18 inches for electric fences) plus at least 2 inches of post above the top wire.
  - Reinforcing steel:
    - Shall be at least grade 40 deformed #4 bar, centered in the middle of the post.
    - Must be covered by at least 3 inches of concrete on both ends of the post
  - Wire fastener appurtenances may be incorporated into the post (i.e. indentations, grooves, etc.) or nail holes may be drilled into the post while concrete is “green.”
- Composite or Fiberglass / Insultimber Posts (electric fences only)
  - Must be at least 1inch diameter.
  - Must be of sufficient length to allow for the required buried depth of 18 inches plus at least 2 inches of post above the top wire.

#### **B. POST INSTALLATION: LINE POSTS**

- For non-electric fences wooden or steel pipe line posts are required at bends or turns less than 20 degrees, as well as at high and low spots to ensure the fence follows the terrain and remains at the appropriate height.
- For non-electric fences line posts must be spaced no farther than:
  - 14 feet for all woven wire fences.
  - 14 feet for barbed wire fences when no stays are used.
  - 20 feet for barbed wire fences when one stay is used.
  - 30 feet for barbed wire fences when two stays are used.
  - Spacing may need to be narrower depending on terrain and pressure from livestock.
- For permanent electric fences line posts must be spaced no farther than 50 feet apart.
- Line posts will be set in as straight a line as possible between corners and turns.
- Spacing may need to be narrower depending on terrain and pressure from livestock.
- Fence stays will be constructed of durable materials designed specifically for this purpose.
  - All stays must be the height of the fence plus 2 inches.
  - All stays will be installed so that they swing free of the ground and allow the fence to move when touched by an animal.

#### **C. POST INSTALLATION: BRACE POST ASSEMBLIES**

- Refer to the following diagrams for H brace, double H brace (pull) or angle brace assemblies:
  - Figures 3-6 for non-electric fences.
  - Figures 8-11 for electric fences.
- Brace post assemblies determine the structural soundness and longevity of any fence. Brace failure leads to a loss of wire tension and fence effectiveness. Brace assemblies fail as a result of structural failure, soil movement, or end-post pullout. Structural failure of an end brace is usually the result of improper design, substandard materials, or over-stressed

- members. Nearly all structural failures can be eliminated by carefully designing brace assemblies and ensuring quality materials are used to properly construct them.
- Brace assemblies must be located:
    - At terminal points (where the fence ends).
    - Where the pull of the fence is from two different directions.
    - At gate openings.
    - Where there are sudden and significant changes in fence direction or alignment or terrain, such as the tops and bottoms of steep slopes.
  - Spacing between any type of brace assembly will be no more than 4,000 feet (electric fences), 1,320 feet (barbed or smooth wire fences) or 660 feet (woven wire fences) in straight pulls on flat topography. At corners, points of significant changes in slope, and bends or turns, spacing shall be shorter.
  - Avoid setting all types of brace assemblies in low areas or gullies where the tension of the fence will cause them to pull out. If this is unavoidable, set the posts in concrete to prevent lifting out of the ground.
    - When backfilled with concrete, brace posts must be centered in a hole that is a minimum of 12 inches in diameter. The hole must be completely filled and the concrete crowned or mounded at the base of the post to prevent water from ponding around the post at ground level.
  - Anchor/pull and brace posts must be of sufficient length to allow for the required buried depth of 36 inches plus at least 2 inches of post above the top wire.
    - For example, if the top wire is set at 44 inches, minimum post length is 82 inches.
  - Horizontal compression members (i.e. horizontal brace) must be placed inside and between the upright posts, 8-12 inches from the top of anchor/pull, brace or corner posts.
  - Changes in fence alignment (bends or turns) require additional bracing to prevent pullouts and fence failure.
    - Fence bends or turns of less than 20 degrees must be supported by:
      - One 6 inch (exception: 4 inch for electric fences) diameter wood post or one 2 inch nominal diameter (2 3/8 inch OD) steel pipe post with a buried depth of 36 inches.
    - Fence bends or turns between 20 and 60 degrees must be supported by:
      - A single H-brace or single angle brace, set to the interior of the fence to bisect the interior angle.
    - Fence bends or turns greater than 60 degrees must be supported by:
      - A double H brace or double angle brace set to either side of the anchor/pull post that follows the alignment of the fence.
  - Criteria for Wooden Brace Assemblies:
    - Wooden compression members must be at least 8 feet in length --OR-- at least 6 feet if pull lengths do not exceed:
      - 1,320 feet for barbed or smooth wire fences.
      - 660 feet for woven wire fences.
      - Any pull length for electric fences.
    - Minimum wooden angle brace post length shall be eight (8) feet for fence heights up to 48 inches or nine (9) feet for fence heights of 49-54 inches.
    - Angle brace assemblies shall not be used for fences exceeding 54 inches in height.

- Wooden compression members and angle brace posts shall be:
  - At least 4 inches in diameter.
  - Straight and free of splintering.
- Wooden compression members and angle brace posts will be attached using:
  - At least a 3/8 inch steel dowel pin, drilled 2 inches into each post and 2 inches into the compression member, *OR*
  - At least a 3/8 inch steel dowel pin, drilled 2 inches into the anchor post and 2 inches into the compression member and at least a 3/8 inch steel dowel pin or lag screw, drilled through the brace post and at least 2 inches into the compression member, *OR*
  - Notched and nailed.
- Tension wires for wooden brace assemblies
  - Two complete loops for:
    - 9 gauge single-strand smooth malleable wire.
    - 12.5 gauge double-stranded barbed or smooth malleable wire (exception: only smooth wire for electric fences).
  - One complete loop for:
    - 12.5 gauge single-strand barbed or smooth high tensile wire.
  - Anchor/pull posts and angle brace posts will be notched to accept the tension wire 4 to 6 inches above ground level – staple wire to post.
  - Brace posts will be notched to accept the tension wire 4 to 6 inches above horizontal compression member – staple wire to post.
  - Wire will be twisted (malleable) or strained (high tensile) to provide necessary rigidity to ensure brace assembly integrity.
- Criteria for steel pipe brace assemblies:
  - Steel pipe compression members must be:
    - At least 8 feet in length --*OR*-- at least 6 feet if pull lengths do not exceed:
      - 1,320 feet for barbed or smooth wire fences.
      - 660 feet for woven wire fences.
      - Any pull length for electric fences.
  - Minimum steel pipe angle brace post length shall be eight (8) feet for fence heights up to 48 inches or nine (9) feet for fence heights of 49-54 inches.
  - Angle brace assemblies shall not be used for fences exceeding 54 inches in height.
  - Steel pipe compression members and angle brace posts shall be:
    - At least 2 inches in nominal diameter (2 3/8 OD).
    - Schedule 40 (3.65 lbs./ ft.) rating.
  - Steel pipe compression members & angle brace posts shall be notched to ensure a smooth, secure fit & must be attached by welding a bead completely around the post joints.
  - All steel pipes must be galvanized or painted with baked enamel for rust protection.
  - Tension wires are required for steel pipe angle braces but not steel pipe H braces.
- Additional criteria for wooden or steel pipe angle brace assemblies:
  - The top of angle brace posts shall be attached 8-12 inches from the top of anchor/pull or corner posts as detailed above for wooden and steel pipe posts.
  - The base of angle brace posts shall be placed on a flat stone or concrete block at least 96 square inches in surface area (e.g. 8" x 12") to prevent contact with & settlement into the soil.
  - The tension wire shall extend from the base of the angle brace post to the base of the anchor/pull post 4 to 6 inches above ground level.

## **ADDITIONAL SPECIFICATIONS FOR NON-ELECTRIC FENCE MATERIALS**

### **I. WIRE:**

#### **A. BARBED WIRE**

- All barbed wire will be of new galvanized material and consist of two strands twisted together and must conform to ASTM-A121 standards.
- Malleable barbed wire must:
  - Be at least 12.5 gauge (diameter of 0.099 inches, +/- 0.005 in).
  - Meet one of the following galvanization classes:
    - Class III (0.80 oz./sq. ft of Zinc).
    - ZA galvanization [0.60 oz./sq. ft of zinc-5 % aluminum-mischmetal alloy (Zn-5AL-MM)].
- High Tensile barbed wire must:
  - Be at least 15.5 gauge (diameter of 0.067 inches, +/- 0.005 in).
  - Meet one of the following galvanization classes:
    - Class III (0.65 oz./sq. ft of Zinc).
    - ZA galvanization [0.60 oz./sq. ft of zinc-5 % aluminum-mischmetal alloy (Zn-5AL-MM)].
- The breaking strength of all types of stranded barbed wire shall not be less than 950 lb.
- All barbed wire must have barbs of at least 14 gauge, spaced on no more than 5 inches apart.
- The use of double-strand barbless/smooth wire is sometimes required as a top wire on fences when working in endangered species (e.g. Hawaiian Hoary Bat) habitat or around high-value animals such as horses or alpaca. Double-strand malleable and high tensile barbless/smooth wire must conform to the same diameter and galvanization specifications as their barbed counterparts.

#### **B. WOVEN WIRE**

- All woven wire must be of new galvanized material and conform to ASTM-A116 standards.
- All woven wire must be at least 39 inches in height.
- All woven wire must have a stay wire spacing of 12 inches or less.
- Malleable woven wire must:
  - Have at least 11 gauge (diameter of 0.120 inches, +/- 0.005 in) top and bottom strands.
  - Have at least 14.5 gauge (diameter of 0.076 inches, +/- 0.005 in) intermediate line and stay wires.
  - Meet one of the following galvanization classes:
    - Class III.
    - ZA galvanization [zinc-5 % aluminum-mischmetal alloy (Zn-5AL-MM)].
- High Tensile woven wire must:
  - Have at least 12.5 gauge (diameter of 0.099 inches, +/- 0.005 in) top and bottom strands.
  - Have at least 14.5 gauge (diameter of 0.076 inches, +/- 0.005 in) intermediate line and stay wires.
  - Meet one of the following galvanization classes:
    - Class III.
    - ZA galvanization [zinc-5 % aluminum-mischmetal alloy (Zn-5AL-MM)].

## II. WIRE ATTACHMENT HARDWARE & INSTALLATION

### A. WIRE CLIPS

- Wire clips and fasteners must be equal to or greater than the strength of the fence wire.
- Wire clips and fasteners must meet or exceed the following galvanization classes:
  - Class III.
  - ZA galvanization [zinc-5 % aluminum-mischmetal alloy (Zn-5AL-MM)].

### B. STAPLES

- Materials
  - Must be 9 gauge steel.
  - Must meet or exceed the following galvanization classes:
    - Class III.
    - ZA galvanization [zinc-5 % aluminum-mischmetal alloy (Zn-5AL-MM)].
  - Must be at least 1 inch long for use in hardwood posts (such as ohia or kiawe).
  - Must be at least 1.5 inches long for use in soft wood posts (such as pine or fir).
- Installation
  - Drive staples diagonally to the wood grain to avoid splitting the post.
  - Rotate staples away from the staple slash cut to ensure the staple legs flare outward. This will make the staple more resistant to pulling out of the post.
  - Leave enough space between the post and the inside of the staple to allow free movement of the wire and to avoid damaging the wire's coating. Never drive the staple flush against the post.
  - For rises in the fence, drive staples at a downward angle.
  - For minor dips in the fence, drive staples at an upward angle.

### C. WIRE SPLICES

- Malleable wire may be spliced by using the method described in Figure 13a:
  - "Western Union" splice.
- High-tensile wires may be spliced by using any of the methods described in Figure 13b:
  - "Figure 8" knots.
  - Nicopress sleeves.
  - Wire link joiners.

## ADDITIONAL SPECIFICATIONS FOR ELECTRIC FENCE MATERIALS

### I. ENERGIZERS & COMPONENTS (refer to Figure 12 for a diagram and details)

#### A. ENERGIZERS

- The energizer is the heart of the electric fence system. Energizers may be solar, 12 Volt DC (Battery powered), or 110 or 220 AC powered and
  - All 110 and 220 V AC energizers must have a surge protector to protect the energizer from power surges from the energizer plug.
- All energizers must be installed according to the manufacturer's recommendations and must meet or exceed the following minimum criteria:
  - Low or Ultra Low Impedance.
  - Capable of producing a minimum of 5,000 volts output with all livestock containment fences charged under the maximum anticipated load.
  - Energizer shall produce 35 to 65 pulses per minute.
  - Energizers must be grounded and protected from lightning according to manufacturer's recommendations if they differ from these specifications.

- The intensity of each pulse shall not exceed 300 milliamps (mAmps).
- Equipped with a safety pace fuse to prevent over-pulsing.
- Solid state circuitry and high-impact weather-resistant case.
- Sufficient power rating to provide the minimum required shock for the type(s) of livestock contained for the size of the pastures served by the electric fence.
  - *Must follow manufacturer's recommendations.*
- Do not connect the earth ground terminal on the energizer to any other ground except for the energizer grounding rod system.
- Install energizers in locations that are out of the reach of children and in locations free from risk of mechanical damage and flammable materials.
- Never connect more than one energizer to the same electric fence. Maintain a minimum spacing of 6 feet between wires connected to different energizers.

#### B. GROUNDING RODS

- A minimum of three (3) grounding rods shall be installed near the energizer and spaced at ten (10) foot intervals for energizers with an output of six (6) joules or less.
- Energizers that produce greater than six (6) joules must have at least three additional feet of ground rod installed for each additional joule of output.
  - Grounding rods must be galvanized steel rods that are:
    - At least 5/8 inch in diameter.
    - Buried at least four (4) feet per rod.
  - Wire clamps must be made from galvanized steel.
  - Connecting wire must be a continuous strand of 12.5 gauge or larger, high-tensile steel.
  - Keep the tops of the grounding rods, clamps, and connecting wire above the ground surface – do not bury.
  - Do not mix dissimilar metals to prevent electrolysis (i.e. do not use copper components).

#### C. LIGHTNING ARRESTORS AND CHOKES

- The lightning protection grounding system must be more efficient than the grounding system for the energizer. Use at least one more grounding rod for the lightning protection grounding system than the energizer grounding system:
  - A minimum of four (4) grounding rods shall be installed at least 65 feet away from the energizer grounding system and spaced at ten (10) foot intervals for energizers with an output of six (6) joules or less.
  - Energizers that produce greater than six (6) joules must have at least three additional feet of ground rod installed for each additional joule of output, plus one additional grounding rod for lightning protection.
  - Grounding rods must be galvanized steel rods that are:
    - At least 5/8 inch in diameter.
    - Buried at least four (4) feet per rod.
  - Carefully locate the lightning protection grounding system away from sites where people or livestock congregate or where equipment, fuel or flammable materials are stored.
- Follow any additional manufacturer's recommendations for lightning protection.

## II. WIRE & COMPONENTS

### A. WIRE

- Electrified barbed wire is dangerous and will not be planned by NRCS-PIA conservationists under any circumstances. Fences that contain electrified barbed wire or combinations of electrified smooth wire placed adjacent to non-electrified barbed wire are ineligible for certification and payment under NRCS financial assistance programs.
- All electric fence wire must meet or exceed the following minimum specifications:
  - Must be no less than 12.5 gauge.
  - Must be High-tensile steel and conform to ASTM A-854 standards.
  - Must have a minimum breaking strength of 170,000 psi.
  - Must meet one of the following galvanization classes:
    - Class III (0.80 oz./sq ft of zinc).
    - ZA galvanization 0.60 oz./sq ft of zinc-5 % aluminum-mischmetal alloy (Zn-5AL-MM)].
  - Must be new material.

### B. HOT (+) WIRE PLACEMENT

- The top wire shall always be energized, or “hot” (+), regardless of the number of wires used for the fence.
- For locations that receive more than 35 inches of rainfall annually or where adequate grounding is easily achieved:
  - The bottom wire may either be hot (+) or grounded (-).
  - Additional wires may be all hot (+) or alternate between hot (+) and ground (-), starting with the hot (+) top wire.
    - For locations that receive 35 inches of rainfall or less annually or where adequate grounding is difficult to achieve:
  - The bottom (second) wire must be grounded (-).
  - If three or more wires are used, alternate hot (+) and ground (-), starting with the hot (+) top wire.

### C. INSULATORS

- All electric insulators must be capable of withstanding a minimum of 10,000 volts.
- The following types of insulators are approved for use with wood and steel posts:
  - Porcelain.
  - Ceramic.
  - High-quality UV stabilized polyethylene, or equivalent.
  - Insultube.
- Offset brackets can be attached to typical woven wire fences at intervals of 50 to 60 feet at a height equal to 2/3 the height of the animal controlled.

### D. IN-LINE STRAINERS

- Shall be used to maintain tension in permanent high-tensile smooth wire electric fences.
- Shall be placed near center of the fence line to achieve equal tension at both ends of the line.
- Shall be installed on each wire between each pull assembly and at a distance not to exceed 4,000 feet for straight line pulls.

### E. SPLICES

- High-tensile wires may be spliced by using any of the methods described in Figure 13b:
  - “Figure 8” knots.
  - Nicopress sleeves.
  - Wire link joiners.

#### F. GATES

- Electric gates shall be wired so they are not energized when unhooked.
- Gates for electric fences shall be installed according to manufacturer's recommendations.
- Metal components of gate handles, switches, and other hardware used to conduct electrical current must be galvanized.
- All ground (-) wires run underground at gates must meet the minimum specifications for high-tensile electric wire listed above.
  - Must be insulated with molded high density polyethylene or polypropylene with ultraviolet (UV) stabilizer.
  - Must be capable of withstanding 10,000 volts.
  - Must be permanently attached to the grounded (-) line wire with a permanent galvanized steel line tap.
- All energized (+) wires run underground at gates:
  - Must be insulated with molded high density polyethylene or polypropylene with ultraviolet (UV) stabilizer.
  - Must be capable of withstanding 10,000 volts.
  - Must be permanently attached to the energized (+) line wire with a permanent galvanized steel line tap.
  - Must be buried at least 12 inches in  $\frac{3}{4}$  inch non-metal pipe conduit
    - Conduit must be water-tight.
    - Ends of conduit must have sweep elbows and be sealed.

#### G. OTHER ACCESSORIES & CONSIDERATIONS

- Warning Signs:
  - Posting electric fence warning signs is recommended around barns, troughs, and other facilities as required by any local, state, or federal regulations.
  - If electric fencing is used on any part of an exterior fence, it is recommended that electric fence warning signs be posted every 300 feet.
- Digital read-out volt meters are recommended for checking to ensure the energizer and fence are functioning properly and to help identify shorts, grounds, and power drains.
- Safety:
  - Do not allow guide or line wires to contact any power lines.
  - Always disconnect the power when repairing, adjusting, or otherwise working on electric fences.
  - Do not tether livestock near electric fences.

**TABLE 1**

**NRCS-PIA Minimum Specifications for Non-Electric Fences**

NOTE: These are minimum specifications. All materials must meet or exceed these specifications.

**LINE POSTS**

Material	Diameter	Buried Depth	Length	lbs/ft	Spacing	Coating or Preservative
Wood	4 inches	24 inches	All line posts must be of sufficient length to allow for buried depth of 18 inches plus 2 inches of post clearance above the top wire.	n/a	14 feet	Commercial wooden fence posts must be new material, sound, free from decay and sufficiently pressure treated with pentachlorophenol, creosote, or chromated copper arsenate (CCA) as described in the practice specification. Kiawe posts are approved for use. Ohia, Koa, and Eucalyptus posts are approved if cut surfaces are painted with wood preservative to prevent rot and the bark is removed.
Steel Pipe	2 3/8 in (OD)	24 inches		3.65 (Sch. 40)	14 feet	Galvanized or painted with rust-protective enamel. Tops must be permanently capped or sealed to prevent water from entering posts.
Steel T or U	n/a	18 inches		1.33	14 ft w/ 0 stays 20 ft w/ 1 stay 30 ft w/ 2 stays	Galvanized or painted with baked enamel.
Concrete	6 in (round) 5 in x 5 in 6 in x 4 in	24 inches		n/a	14 feet	Concrete must conform to NRCS-PI Specification 103 - Concrete. Concrete strength must be at least 3,000 PSI at 28 days. Each post shall have at least one grade 40 deformed #4 reinforcing steel bar (or larger) centered in the middle of the post and covered by at least 3 inches of concrete on both ends of the post.

**BRACE POSTS AND IN-LINE PULL POSTS**

Material	Diameter	Buried Depth	Length	lbs/ft	Spacing	Coating or Preservative
Wood	6 inches	36	All line posts must be of sufficient length to allow for buried depth of 18 inches plus 2 inches of post clearance above the top wire.	n/a	Every 1,320 feet (660 ft for woven wire), at ends of fence spans, at large changes in slope, or where fence angle changes by more than 20 degrees.	Same as for Line posts (see above)
Steel Pipe	2 3/8 inches (OD)	36		3.65 (Sch. 40)		Galvanized or painted with rust-protective enamel. Tops must be permanently capped or sealed to prevent water from entering posts.

**COMPRESSION MEMBERS FOR H-BRACES, DOUBLE H-BRACES (IN-LINE PULL) AND ANGLE BRACES**

Material	Diameter	Length	lbs/ft	Coating or Preservative
Wood	4 inches	see note below	n/a	Same as for Line and Brace Posts (see above).
Steel Pipe	2 3/8 in (OD)	see note below	3.65 (Sch. 40)	Galvanized or painted with baked enamel.

Notes: For H and double H braces, six (6) foot brace lengths are allowed if pull length for barbed (or smooth) wire fences / woven wire fences is less than 1,320 / 660 feet, respectively. Angle brace posts must always be at least 8 feet long.

**TENSION WIRE FOR H-BRACES**

Material	Wire Type	Gauge	Galvanization	Installation
Wood	Malleable - Single Strand Smooth	9	Class III or Zn-Al	Tension wires will be double wrapped (with two complete loops) and stapled to brace posts at a height of 4 to 6 inches above the compression member & the anchor post at a height of 4 to 6 inches above ground level. Both the brace & anchor post will be notched to accept the tension wire. Staples must be at least 9 gauge steel, have either Class III or Zn-Al galvanization, & must be 1 inch long (hardwood posts) or 1.5 inches long (softwood posts).
Wood	Malleable - Double Strand Barbless	12.5	Class III or Zn-Al	
Wood	Malleable - Double Strand Barbed	12.5	Class III or Zn-Al	
Wood	High-Tensile	12.5	Class III or Zn-Al	
Steel Pipe	Tension wire is not required for welded H-Braces constructed from steel pipe.			

**BARBED & WOVEN WIRE**

Wire Type	Material	Gauge	Galvanization	Wire Height	Fence Ht.	Installation
Barbed	Malleable	12.5	Class III or Zn-AL	n/a	44 inches	All barbed wire fences must have a minimum four (4) strands of barbed wire & a minimum height of 44 inches.
Barbed	High-Tensile	15.5	Class III or Zn-AL	n/a	44 inches	
Woven	Malleable	11 - Top & Bottom wires	Class III or Zn-AL	39 inches	44 inches	All woven wire fences must meet or exceed 44 inches in total height. This includes at least one course of woven wire 39 inches or greater in height, topped by at least one strand of barbed wire, placed no more than 5 inches above the top of the woven wire. For example, a 39 inch course of woven wire set at ground level must be topped with no less than one strand of barbed wire placed 5 inches above the top of the woven wire.
		14.5 - Line and Stay wires				
Woven	High-Tensile	12.5 - Top & Bottom wires	Class III or Zn-AL	39 inches	44 inches	
		14.5 - Line and Stay wires				

**TABLE 2**

**NRCS-PIA Minimum Specifications for Electric Fences**

NOTE: These are minimum specifications. All materials must meet or exceed these specifications.

**LINE POSTS**

Material	Diameter	Buried Depth	Length	lbs/ft	Spacing	Coating or Preservative
Wood	2 inches (exception: 4 inches for koa)	18 inches	All line posts must be of sufficient length to allow for buried depth of 18 inches plus 2 inches of post clearance above the top wire.	n/a	50 feet	Commercial wooden fence posts must be new material, sound, free from decay and sufficiently pressure treated with pentachlorophenol, creosote, or chromated copper arsenate (CCA) as described in the practice specification. Kiawe posts are approved for use. Ohia, Koa, and Eucalyptus posts are approved if cut surfaces are painted with wood preservative to prevent rot and the bark is removed.
Steel Pipe	1 3/8 in (OD)	18 inches		1.68 (Sch. 40)	50 feet	Galvanized or painted with rust-protective enamel. Tops must be permanently capped or sealed to prevent water from entering posts.
Steel T or U	n/a	18 inches		1.33	50 feet	Galvanized or painted with baked enamel.
Composite or Fiberglass / Insultimber	1 inch	18 inches		n/a	50 feet	n/a
Concrete	6 in (round) 5 in x 5 in 6 in x 4 in	18 inches		n/a	50 feet	Concrete must conform to NRCS-PI Specification 103 - Concrete. Concrete strength must be at least 3,000 PSI at 28 days. Each post shall have at least one grade 40 deformed #4 reinforcing steel bar (or larger) centered in the middle of the post and covered by at least 3 inches of concrete on both ends of the post.

**BRACE POSTS AND IN-LINE PULL POSTS**

Material	Diameter	Buried Depth	Length	lbs/ft	Spacing	Coating or Preservative
Wood	4 inches	36	All line posts must be of sufficient length to allow for buried depth of 18 inches plus 2 inches of post clearance above the top wire.	n/a	Every 1,320 feet, at ends of fence spans, at large changes in slope, or where fence angle changes by more than 20 degrees.	Same as for Line posts (see above)
Steel Pipe	2 3/8 in (OD)	36		3.65 (Sch. 40)		Galvanized or painted with rust-protective enamel. Tops must be permanently capped or sealed to prevent water from entering posts.

**COMPRESSION MEMBERS FOR H-BRACES, DOUBLE H-BRACES (IN-LINE PULL) AND ANGLE BRACES**

Material	Diameter	Length	lbs/ft	Coating or Preservative
Wood	4 inches	6 feet	n/a	Same as for Line and Brace Posts (see above).
Steel Pipe	2 3/8 in (OD)	6 feet	3.65 (Sch. 40)	Galvanized or painted with rust-protective enamel.

Notes: Angle brace posts must always be at least 8 feet long.

**TENSION WIRE FOR H-BRACES**

Post Material	Wire Type	Gauge	Galvanization	Installation
Wood	Malleable - Single Strand Smooth	9	Class III or Zn-Al	Tension wires will be double wrapped (with two complete loops) and stapled to brace posts at a height of 4 to 6 inches above the compression member & the anchor post at a height of 4 to 6 inches above ground level. Both the brace & anchor post will be notched to accept the tension wire. Staples must be at least 9 gauge steel, have either Class III or Zn-Al galvanization, & must be 1 inch long (hardwood posts) or 1.5 inches long (softwood posts).
Wood	Malleable - Double Strand Barbless	12.5	Class III or Zn-Al	
Wood	Malleable - Double Strand Barbed	12.5	Class III or Zn-Al	
Wood	High-Tensile	12.5	Class III or Zn-Al	
Steel Pipe	Tension wire is not required for welded H-Braces constructed from steel pipe.			

**WIRE**

Wire Type	Material	Gauge	Galvanization	Wire Height	Fence Height	Installation
Barbed	Malleable	<i>Electrified barbed wire is dangerous and will not be planned by NRCS-PIA conservationists under any circumstances. Fences that contain electrified barbed wire or combinations of electrified smooth wire placed adjacent to non-electrified barbed wire are ineligible for certification and payment under NRCS financial assistance programs.</i>				
Barbed	High-Tensile					
Smooth, Single Strand	High-Tensile	12.5	Class III or Zn-AL	Top wire (+) : 36 inches, Bottom wire: 18 to 24 inches.	36 inches	All permanent electric fences must have at least two (2) courses of 12.5 gauge smooth, single-strand high tensile wire. In areas receiving less than 35 inches of annual rainfall, the bottom wire must be grounded (-). In areas receiving 35 or more inches of annual rainfall, the bottom wire may either be grounded (-) or energized (+).

Notes: High-tensile wire may be spliced with a "figure 8" knot or compression fittings or splice sleeves. Compression fittings or splice sleeves must have a tensile strength of at least 80% of the wire (136,000 PSI). Use one 3/4 inch sleeve or two 3/8 inch sleeves when splicing high-tensile wire.

**TABLE 2 (continued)**

**NRCS-PIA Minimum Specifications for Electric Fences**

NOTE: These are minimum specifications. All materials must meet or exceed these specifications.

**ENERGIZERS**

Power Source	Impedence	Voltage	Pulses / minute	Pulse Duration	Intensity	Additional Criteria
110 V AC	Low or Ultra-Low	5,000	35 to 65	0.003 seconds	300 milliamps (mAmps) or less	All energizers must have solid-state circuitry & be housed in a high-impact weather resistant case. Energizers must have a safety fuse to prevent overpusling, and must be grounded and protected from lightning according to manufacturer's recommendations. All 110 or 120 V AC energizers must have a surge protector to protect the energizer from power surges from the energizer plug.
220 V AC	Low or Ultra-Low					
12 V DC Battery / Solar	Low or Ultra-Low					

*Note: Energizers must provide sufficient power rating to provide the minimum required shock for the type(s) of livestock contained and for the size of the pastures served by the electric fence, according to manufacturer's recommendations.*

**GROUNDING RODS**

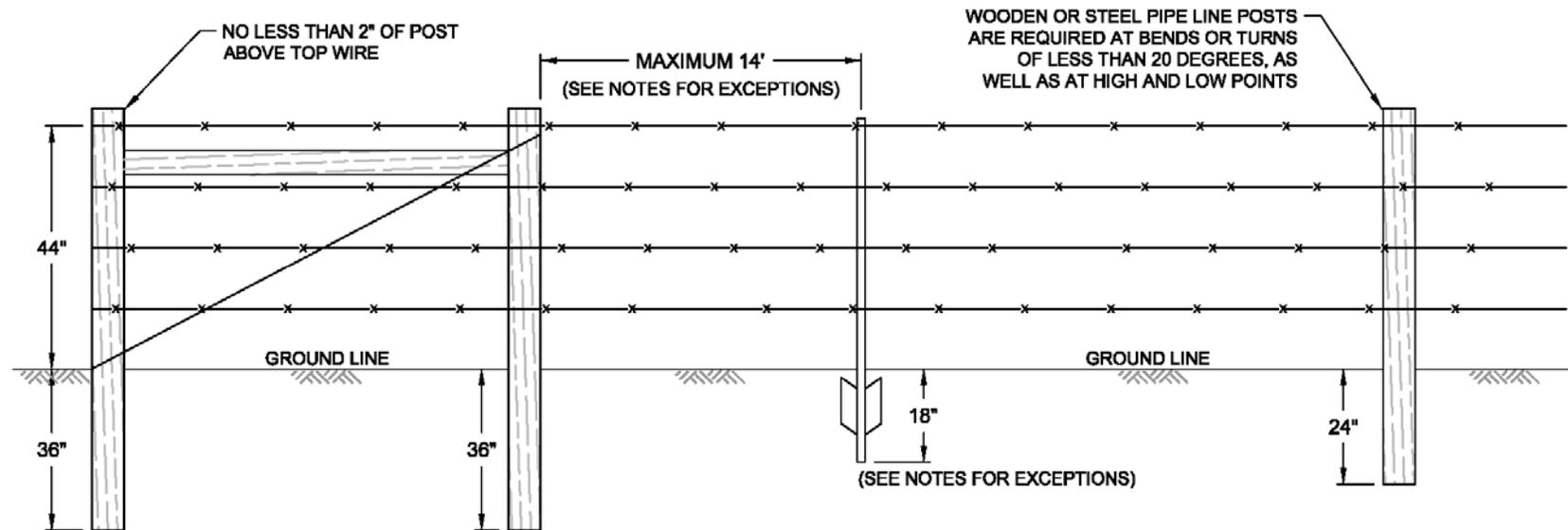
Material	Diameter	Length	Number	Spacing	Connecting Wire	Additional Criteria
Galvanized Steel	1/2 inch	6 feet	As recommended by the manufacturer. If not specified, use 3 grounding rods for energizers producing 6 joules or less. For energizers producing more than 6 joules, add three feet of grounding rod for each additional joule.	10 feet	One continuous course of 12.5 gauge, High-tensile steel wire, Class III or Zn-Al galvanization	Locate grounding rods near the energizer perferably in a moist area or fenceline or dripline of roof where energizer is housed. Do not mix dissimilar metals (i.e. do not use copper components) to prevent electrolysis.

**LIGHTNING PROTECTION**

Material	Diameter	Length	Number	Spacing	Connecting Wire	Additional Criteria
Galvanized Steel grounding rods	1/2 inch	6 feet	At least one more rod than the energizer grounding rod system	Grounding rods should be spaced 10 feet apart from each other; grounding system should be placed > 65 feet away from energizer grounding sysyem.	One continuous course of 12.5 gauge, High-tensile steel wire, Class III or Zn-Al galvanization	A minimum of four (4) grounding rods shall be installed at least 65 feet away from the energizer and spaced at ten (10) foot intervals for energizers with an output of six (6) joules or less. Energizers that produce greater than six (6) joules must have at least three additional feet of ground rod installed for each additional joule of output, plus one additional grounding rod for lightning protection. Carefully locate the lightning protection grounding system away from sites where people or livestock congregates or where equipment, fuel or flammable materials are stored. Starting from the energizer, first install the lightning choke on lead-out energized wire (+) , then connect one side of lightning arrestor to the lead-out energized wire (+) and connect the other side to the lightning grounding system. See Diagrams. Do not mix dissimilar metals (i.e. do not use copper components) to prevent electrolysis.

### FIGURE 1 – NRCS PIA TYPICAL BARBED WIRE FENCE

[This figure & associated specifications also apply to smooth wire fences in areas with the Hawaiian hoary bat by substituting “barbless/smooth” for “barbed”]



Notes: All barbed wire fences planned by the NRCS in the PIA must meet or exceed these minimum specifications. Refer to the Fence (382) practice specification for additional details regarding materials and construction specifications for barbed wire fences.

Brace (H, Double H / Pull) Assemblies: All brace assemblies must meet NRCS-PIA approved designs including but not limited to:

- Must have a buried post depth of no less than 36 inches.
- Maximum spacing between braces of no more than 1,320 feet in straight pulls on flat terrain.
- Required placement of braces at terminal points, corners, locations where the pull is from two different directions, gate openings, and where there are bends, turns or changes in terrain such as the tops and bottoms of steep slopes.

Line Posts:

- Wooden or steel pipe line posts are required at bends or turns less than 20 degrees, as well as at high and low spots to ensure the fence follows the terrain and remains at the appropriate height.
- Steel T-posts must have a buried depth of not less than 18 inches while all other types of line posts must have a buried depth of not less than 24 inches.
- Maximum Spacing of Line Posts: 14 feet with no stays; 20 feet with one (1) stay; 30 feet with two (2) stays.

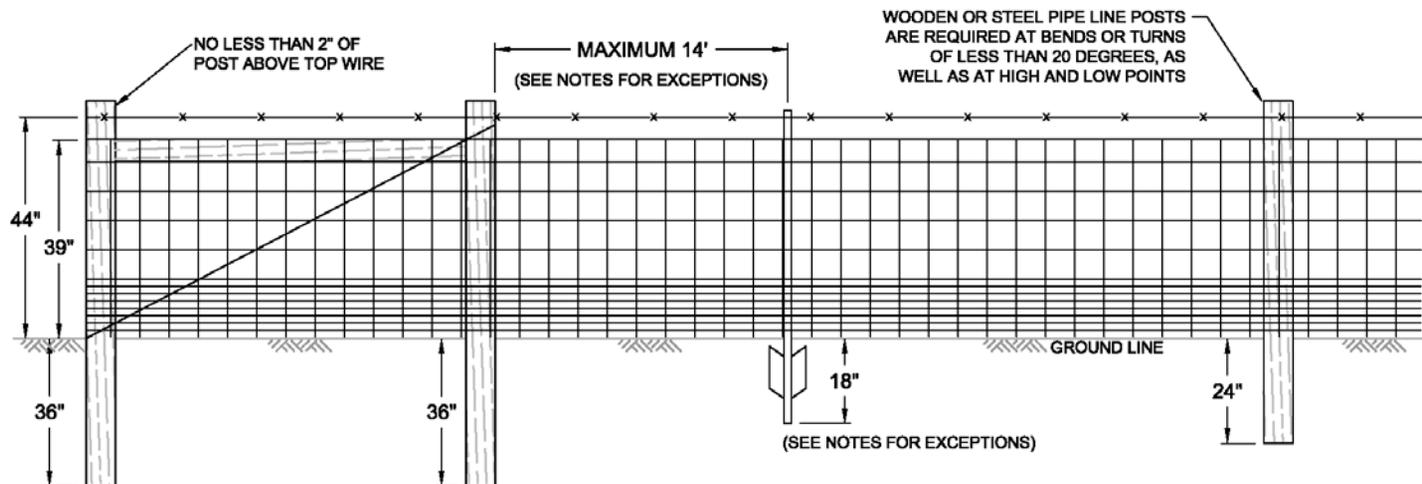
Barbed Wire Fence Must Consist of:

- At least four (4) courses of barbed wire.
- Top wire no less than 44 inches in height.
- Minimum wire spacing is not specified. Wire spacing should be sufficient to provide adequate control of the kind/class of livestock for which the fence is planned. Additional wires may be required to achieve specific producer objectives.

Minimum Wire Specifications:

- 12.5 gauge double-stranded barbed *malleable* wire OR 15.5 gauge double stranded barbed *high-tensile* wire.
- All barbed and barbless/smooth wire must have Class III or Zn-AL galvanization.

**FIGURE 2 - NRCS PIA TYPICAL WOVEN WIRE FENCE**



Notes: All woven wire fences planned by the NRCS in the PIA must meet or exceed these minimum specifications. Refer to the Fence (382) practice specification for additional details regarding materials and construction specifications for woven wire fences.

Brace (H, Double H / Pull) Assemblies: All brace assemblies must meet NRCS-PIA approved designs including but not limited to:

- Must have a buried post depth of no less than 36 inches.
- Maximum spacing between braces of no more than 1,320 feet in straight pulls on flat terrain.
- Required placement of braces at terminal points, corners, locations where the pull is from two different directions, gate openings, and where there are bends, turns or changes in terrain such as the tops and bottoms of steep slopes.

Line posts:

- Wooden or steel pipe line posts are required at bends or turns less than 20 degrees, as well as at high and low spots to ensure the fence follows the terrain and remains at the appropriate height.
- Steel T-posts must have a buried depth of not less than 18 inches while all other types of line posts must have a buried depth of not less than 24 inches.
- Maximum Spacing of Line Posts: 14 feet.

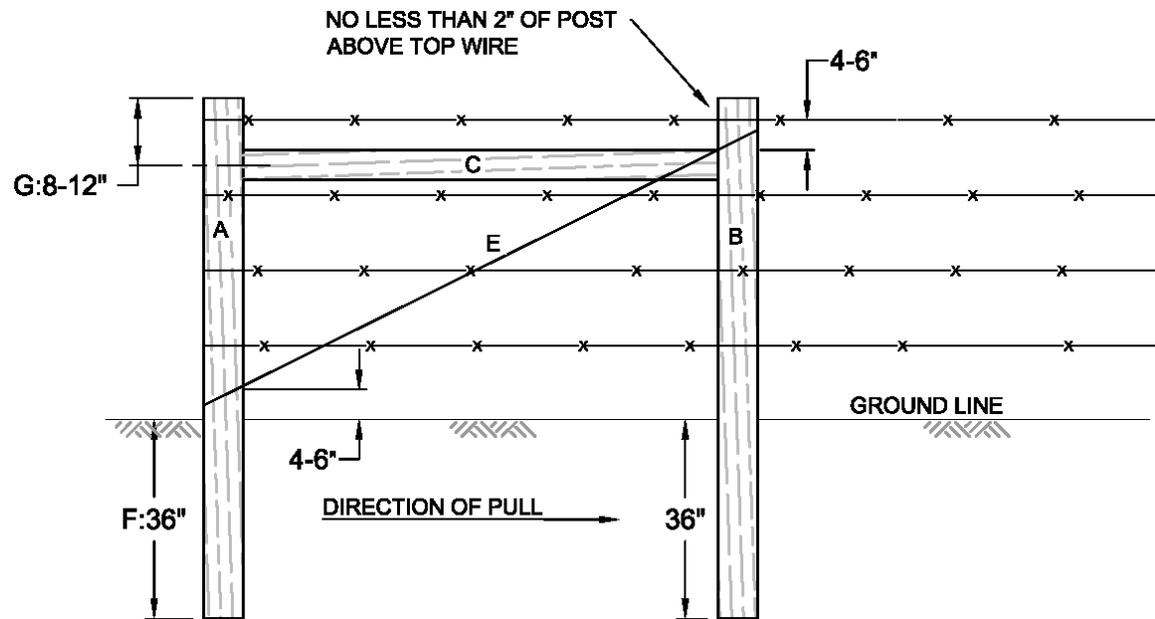
Woven Wire Fence Must Consist of:

- At least one (1) course of woven wire, no less than 39 inches in height.
- At least one (1) barbed wire placed 0 to 5 inches above the woven wire (exception - substitute barbless/smooth wire in areas with the Hawaiian hoary bat).
- The total minimum height of the fence must meet or exceed 44 inches.

Minimum Wire Specifications:

- Woven wire:
  - o High tensile: top & bottom strands must be no less than 12.5 gauge; Line and stay wires must be no less than 14.5 gauge.
  - o Malleable: top & bottom strands must be no less than 11 gauge; Line and stay wires must be no less than 14.5 gauge.
- Barbed wire (exception - substitute barbless/smooth wire in areas with the Hawaiian hoary bat):
  - o Malleable wire: 12.5 gauge double-stranded.
  - o High-tensile wire: 15.5 gauge double stranded.
- Additional wires may be required to achieve specific producer objectives. Wire spacing should be sufficient to provide adequate control of the kind/class of livestock for which the fence is planned.
- All woven, barbed and barbless/smooth wire must have Class III or Zn-AL galvanization.

**FIGURE 3 - NRCS PIA TYPICAL H BRACE ASSEMBLY FOR NON-ELECTRIC FENCES**



Notes: All H brace assemblies planned by the NRCS in the PIA must meet or exceed these minimum specifications. Refer to the Fence (382) practice specification for additional details regarding materials and construction specifications for H braces. Diagram labels A, B, C, E, F and G also correspond to sections of the PIA Fence (382) Jobsheet.

**A. Anchor/Pull Posts:** Minimum Diameter: Wood Posts: 6 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum length: must allow for buried depth of 36 inches plus at least 2 inches of post clearance above top wire.

**B. Brace Posts:** Minimum Diameter: Wood Posts: 6 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum length: must allow for buried depth of 36 inches plus at least 2 inches of post clearance above top wire.

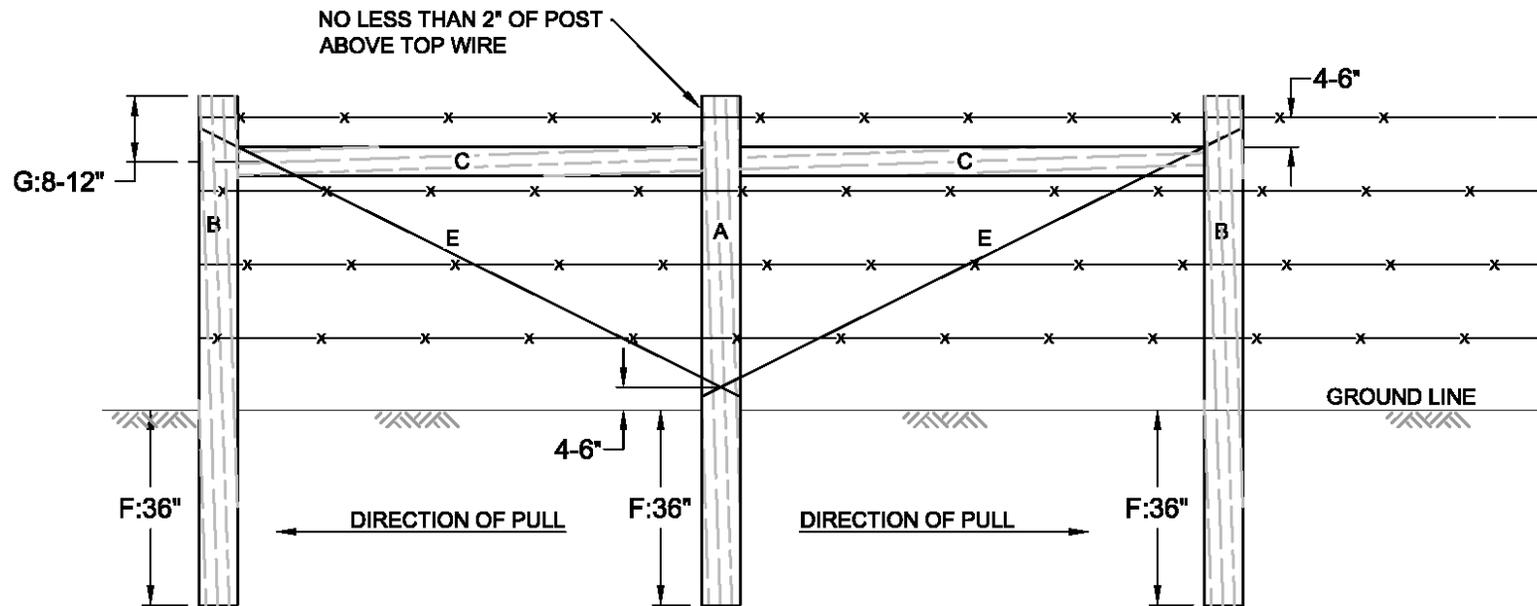
**NOTE:** The tops of steel pipe posts must be permanently capped to prevent water entry. All steel pipe brace and pull assemblies must be galvanized or painted for rust protection.

**C. Compression Members:** Minimum Diameter: Wood: 4 inches; Steel Pipe: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Center line of compression members must be spaced 8 to 12 inches from the top of the Brace and Pull Posts. Minimum Length:

- Barbed or non-barbed/woven wire fences: eight (8) feet if pull length > 1,320 feet, six (6) feet if pull length < 1,320 feet.
- Woven wire fences: eight (8) feet if pull length > 660 feet, six (6) feet if pull length < 660 feet.

**E. Tension Wire:** Tension wires shall be two complete wraps of malleable wire or one complete wrap for high tensile wire, twisted or strained to provide necessary rigidity to assure brace integrity. Acceptable wire sizes include: 9 gauge single-strand malleable wire, 12.5 gauge double-strand barbed or smooth malleable wire, or 12.5 gauge single-strand high-tensile wire. Tension wires must be stapled to the Anchor/Pull Post 4 to 6 inches above the ground and the Brace post 4 to 6 inches above the compression member. Tension wires are not required on welded steel pipe H brace assemblies.

**FIGURE 4 - NRCS PIA TYPICAL DOUBLE H BRACE (PULL) ASSEMBLY FOR NON-ELECTRIC FENCES**



Notes: All double H brace (pull) assemblies planned by the NRCS in the PIA must meet or exceed these minimum specifications. Refer to the Fence (382) practice specification for additional details regarding materials and construction specifications for double H brace (pull) assemblies. Diagram labels A, B, C, E, F and G also correspond to sections of the PIA Fence (382) Jobsheet.

**A. Anchor/Pull Posts:** Minimum Diameter: Wood Posts: 6 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum length: must allow for buried depth of 36 inches plus at least 2 inches of post clearance above top wire

**B. Brace Posts:** Minimum Diameter: Wood Posts: 6 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum length: must allow for buried depth of 36 inches plus at least 2 inches of post clearance above top wire

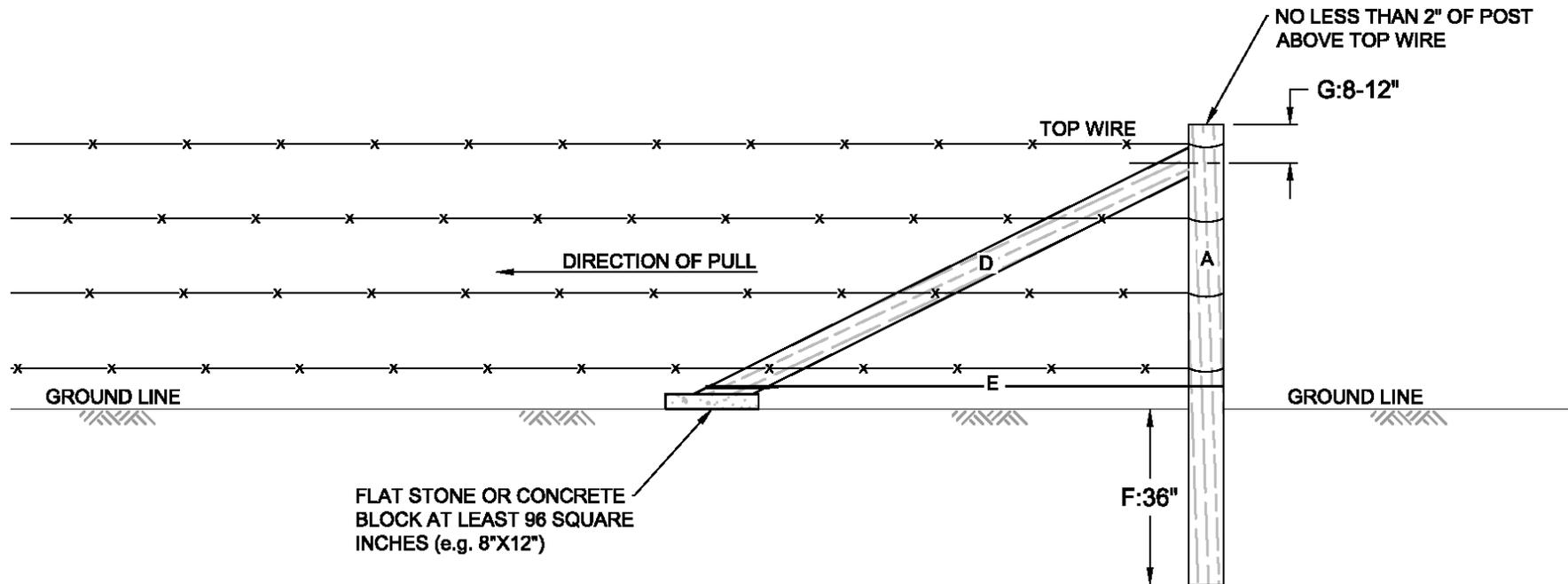
**NOTE:** The tops of steel pipe posts must be permanently capped to prevent water entry. All steel pipe brace and pull assemblies must be galvanized or painted for rust protection

**C. Compression Members:** Minimum Diameter: Wood: 4 inches; Steel Pipe: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Center line of compression members must be spaced 8 to 12 inches from the top of the Brace and Pull Posts. Minimum Length:

- Barbed or non-barbed/woven wire fences: eight (8) feet if pull length > 1,320 feet, six (6) feet if pull length < 1,320 feet
- Woven wire fences: eight (8) feet if pull length > 660 feet, six (6) feet if pull length < 660 feet

**E. Tension Wire:** Tension wires shall be two complete wraps of malleable wire or one complete wrap for high tensile wire, twisted or strained to provide necessary rigidity to assure brace integrity. Acceptable wire sizes include: 9 gauge single-strand malleable wire, 12.5 gauge double-strand barbed or smooth malleable wire, or 12.5 gauge single-strand high-tensile wire. Tension wires must be stapled to the Anchor/Pull Post 4 to 6 inches above the ground and the Brace post 4 to 6 inches above the compression member. Tension wires are not required on welded steel pipe double H brace (pull) assemblies.

**FIGURE 5 - NRCS PIA TYPICAL ANGLE BRACE ASSEMBLY FOR NON-ELECTRIC FENCES**



Notes: All angle brace assemblies planned by the NRCS in the PIA must meet or exceed these minimum specifications. Refer to the Fence (382) practice specification for additional details regarding materials and construction specifications for angle brace assemblies. Diagram labels A, D, E, F and G also correspond to sections of the PIA Fence (382) Jobsheet. Angle brace assemblies shall not be used for fences exceeding 54 inches in height.

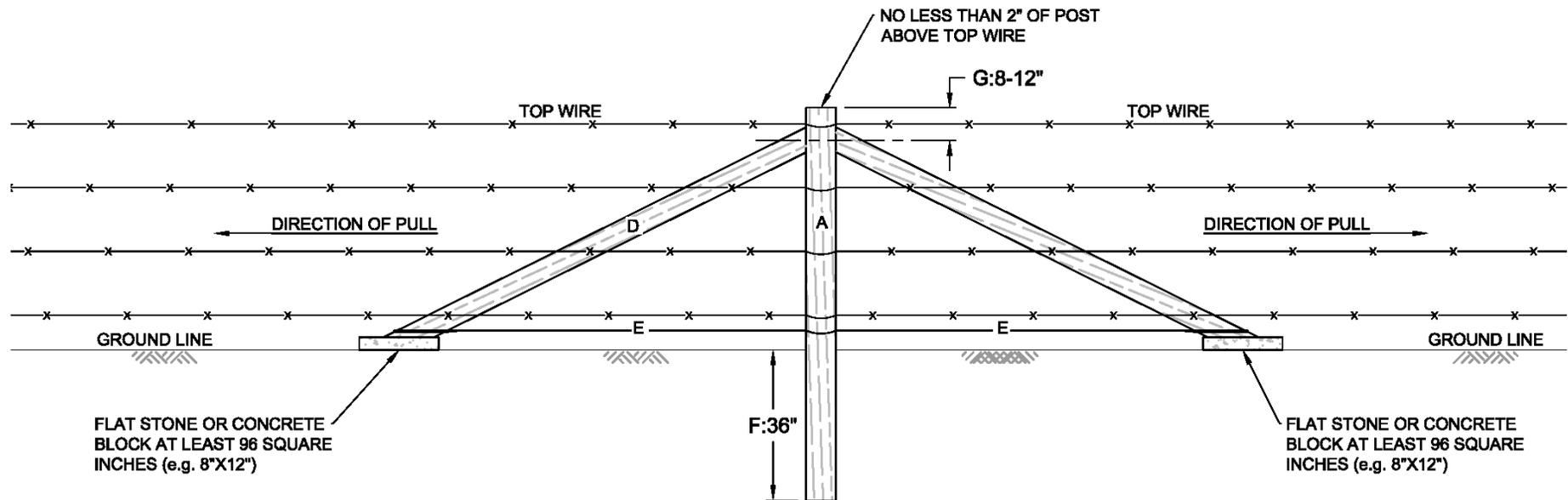
A. Anchor/Pull Posts: Minimum Diameter: Wood Posts: 6 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum length: must allow for buried depth of 36 inches plus at least 2 inches of post clearance above top wire.

D. Angle Brace Posts: Minimum Diameter: Wood Posts: 4 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum angle brace post length shall be eight (8) feet for fence heights up to 48 inches or nine (9) feet for fence heights of 49-54 inches.

NOTE: The tops of steel pipe posts must be permanently capped to prevent water entry. All steel pipe angle brace assemblies must be galvanized or painted for rust protection.

E. Tension Wire: Tension wires shall be two complete wraps of malleable wire or one complete wrap for high tensile wire, twisted or strained to provide necessary rigidity to assure brace integrity. Acceptable wire sizes include: 9 gauge single-strand malleable wire, 12.5 gauge double-strand barbed or smooth malleable wire, or 12.5 gauge single-strand high-tensile wire. Tension wires must be stapled (wood) or attached to a welded clip (steel pipe) for both the Anchor/Pull Post and Angle Brace Post 4 to 6 inches above the ground.

**FIGURE 6 - NRCS PIA TYPICAL DOUBLE ANGLE BRACE (PULL) ASSEMBLY FOR NON-ELECTRIC FENCES**



Notes: All double angle brace (pull) assemblies planned by the NRCS in the PIA must meet or exceed these minimum specifications. Refer to the Fence (382) practice specification for additional details regarding materials and construction specifications for double angle brace (pull) assemblies. Diagram labels A, D, E, F and G also correspond to sections of the PIA Fence (382) Jobsheet. Angle brace assemblies shall not be used for fences exceeding 54 inches in height.

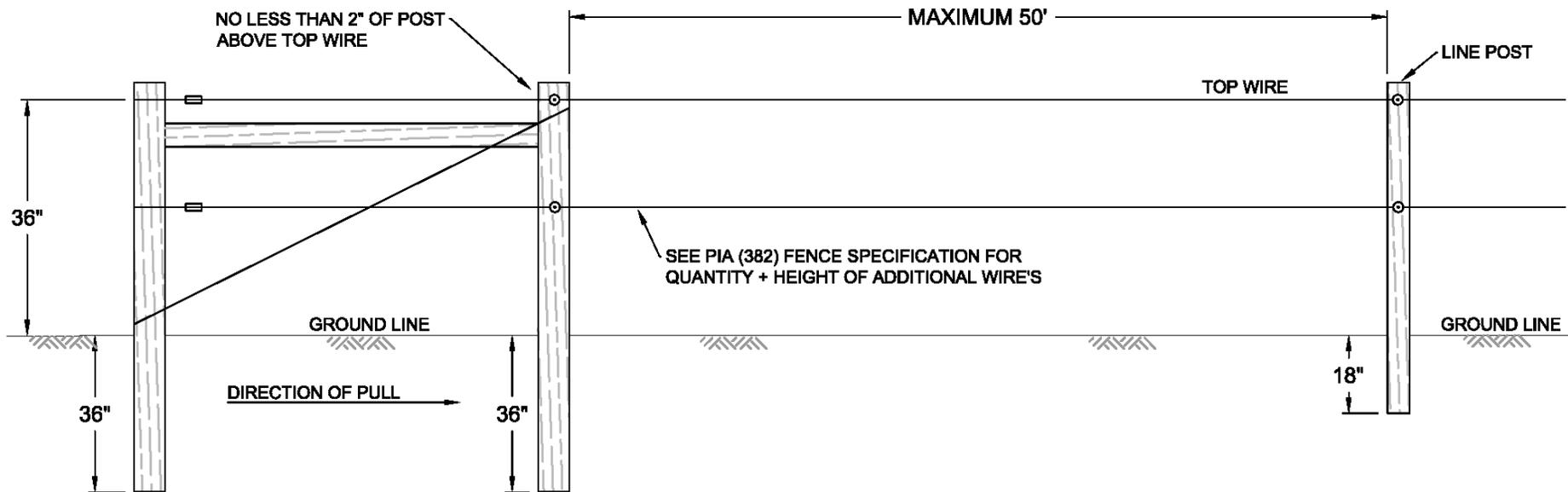
**A. Anchor/Pull Posts:** Minimum Diameter: Wood Posts: 6 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum length: must allow for buried depth of 36 inches plus at least 2 inches of post clearance above top wire.

**D. Angle Brace Posts:** Minimum Diameter: Wood Posts: 4 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum angle brace post length shall be eight (8) feet for fence heights up to 48 inches or nine (9) feet for fence heights of 49-54 inches.

**NOTE:** The tops of steel pipe posts must be permanently capped to prevent water entry. All steel pipe angle brace assemblies must be galvanized or painted for rust protection.

**E. Tension Wire:** Tension wires shall be two complete wraps of malleable wire or one complete wrap for high tensile wire, twisted or strained to provide necessary rigidity to assure brace integrity. Acceptable wire sizes include: 9 gauge single-strand malleable wire, 12.5 gauge double-strand barbed or smooth malleable wire, or 12.5 gauge single-strand high-tensile wire. Tension wires must be stapled (wood) or attached to a welded clip (steel pipe) for both the Anchor/Pull Post and Angle Brace Post 4 to 6 inches above the ground.

**FIGURE 7: NRCS PIA TYPICAL ELECTRIC FENCE**



Notes: All electric fences planned by the NRCS in the PIA must meet or exceed these minimum specifications. Refer to the Fence (382) practice specification for additional details regarding materials and construction specifications for electric fences.

Brace (H, Double H / Pull) Assemblies: All brace assemblies must meet NRCS-PIA approved designs including but not limited to:

- Must have a buried post depth of no less than 36 inches.
- Maximum spacing between braces of no more than 4,000 feet in straight pulls on flat terrain.
- Required placement of braces at terminal points, corners, locations where the pull is from two different directions, gate openings, and where there are bends, turns or changes in terrain such as the tops and bottoms of steep slopes.

Line Posts:

- Must have a buried depth of no less than 18 inches.
- Maximum Spacing of Line Posts: 50 feet.

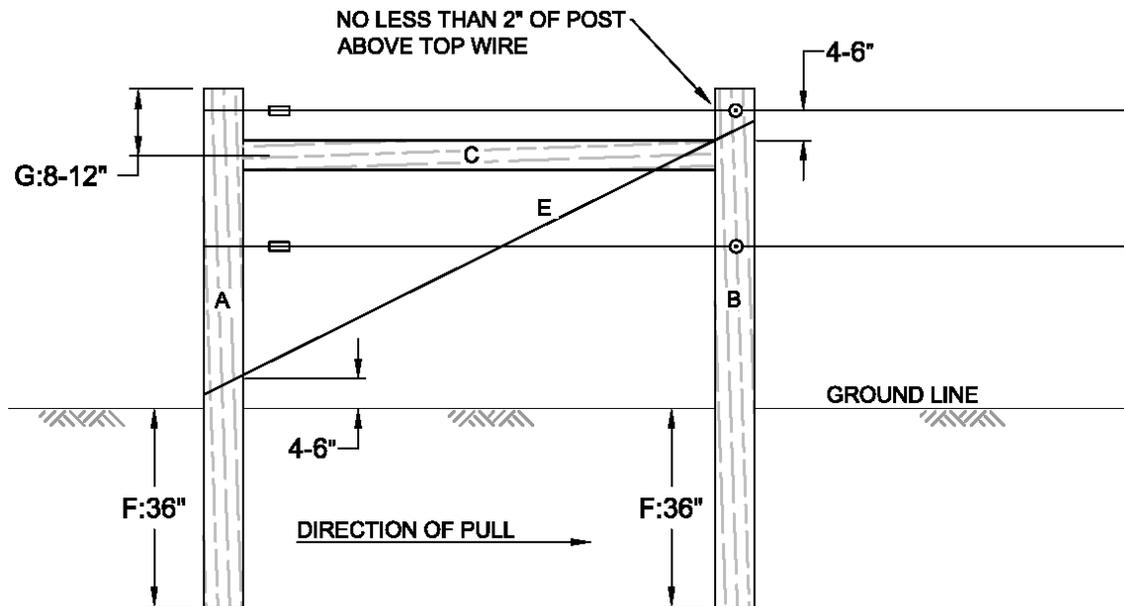
Electric fence must consist of:

- At least two (2) courses of electric wire (cattle & horses) or five (5) courses of electric wire (sheep & goats).
- Minimum height of top wire is 36 inches.
- Minimum wire spacing for cattle and horses: Top wire (+) should be at 36 inches in height. Bottom wire (+ or -) should be set from 18 to 24 inches.
- Minimum wire spacing for sheep and goats: Top wire (+) should be at 36 inches in height. Refer to PIA Fence (382) Specification for other strands.
- Note: Wire spacing should be sufficient to provide adequate control of the kind/class of livestock for which the fence is planned. Additional wires may be required to achieve specific producer objectives.

Minimum Wire Specifications:

- 12.5 gauge single-strand high-tensile wire.
- Class III or Zn-AL galvanization.

**FIGURE 8 - NRCS PIA TYPICAL H BRACE ASSEMBLY FOR ELECTRIC FENCES**



Notes: All H brace assemblies planned by the NRCS in the PIA must meet or exceed these minimum specifications. Refer to the Fence (382) practice specification for additional details regarding materials and construction specifications for H braces. Diagram labels A, B, C, E, F and G also correspond to sections of the PIA Fence (382) Jobsheet.

**A. Anchor/Pull Posts:** Minimum Diameter: Wood Posts: 4 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum length: must allow for buried depth of 36 inches plus at least 2 inches of post clearance above top wire.

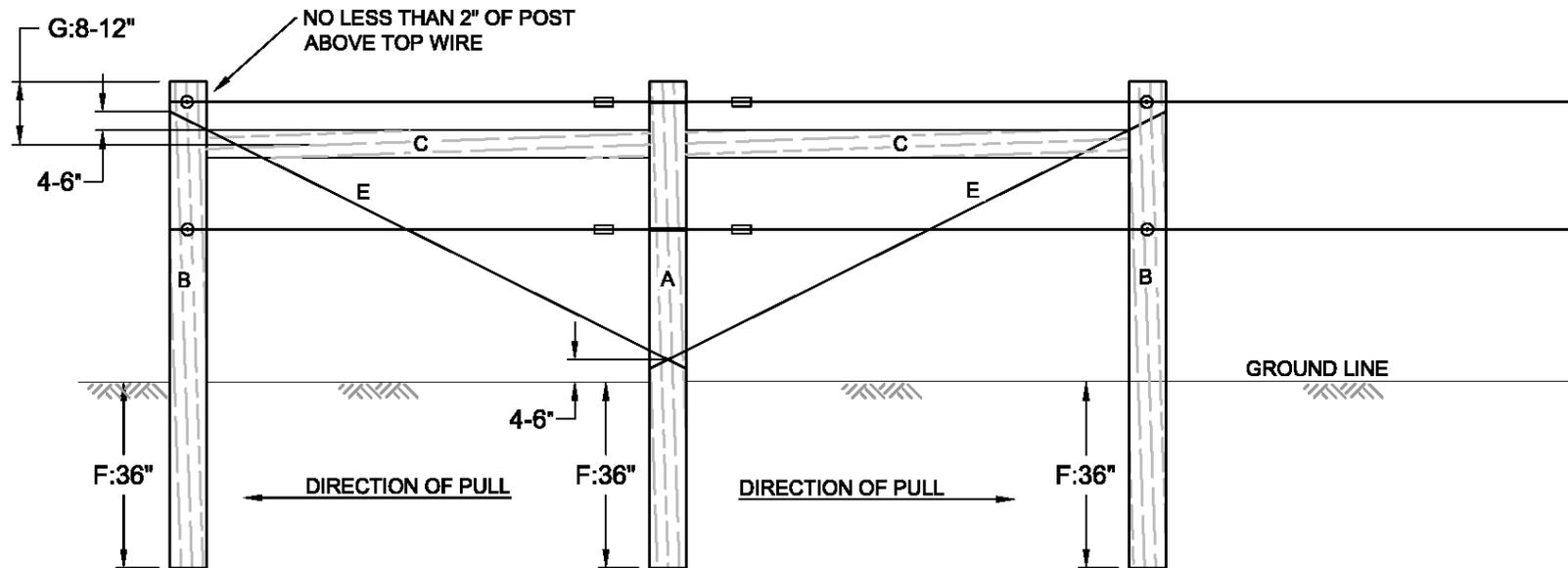
**B. Brace Posts:** Minimum Diameter: Wood Posts: 4 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum length: must allow for buried depth of 36 inches plus at least 2 inches of post clearance above top wire.

**NOTE:** The tops of steel pipe posts must be permanently capped to prevent water entry. All steel pipe brace and pull assemblies must be galvanized or painted for rust protection.

**C. Compression Members:** Minimum Diameter: Wood: 4 inches; Steel Pipe: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Center line of compression members must be spaced 8 to 12 inches from the top of the Brace and Pull Posts. Minimum length six (6).

**E. Tension Wire:** Tension wires shall be two complete wraps of wire, twisted or strained to provide necessary rigidity to assure brace integrity. Acceptable wire sizes include: 9 gauge single-strand malleable wire, 12.5 gauge double-strand barbed or smooth malleable wire, or 12.5 gauge single-strand high-tensile wire. Tension wires must be stapled to the Pull Post 4 to 6 inches above the ground and the Brace post 4 to 6 inches above the compression member. Tension wires are not required on welded steel pipe H brace assemblies.

**FIGURE 9 - NRCS PIA TYPICAL DOUBLE H BRACE (PULL) ASSEMBLY FOR ELECTRIC FENCES**



Notes: All double H brace (pull) assemblies planned by the NRCS in the PIA must meet or exceed these minimum specifications. Refer to the Fence (382) practice specification for additional details regarding materials and construction specifications for double H brace (pull) assemblies. Diagram labels A, B, C, E, F and G also correspond to sections of the PIA Fence (382) Jobsheet.

**A. Anchor/Pull Posts:** Minimum Diameter: Wood Posts: 4 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum length: must allow for buried depth of 36 inches plus at least 2 inches of post clearance above top wire

**B. Brace Posts:** Minimum Diameter: Wood Posts: 4 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum length: must allow for buried depth of 36 inches plus at least 2 inches of post clearance above top wire

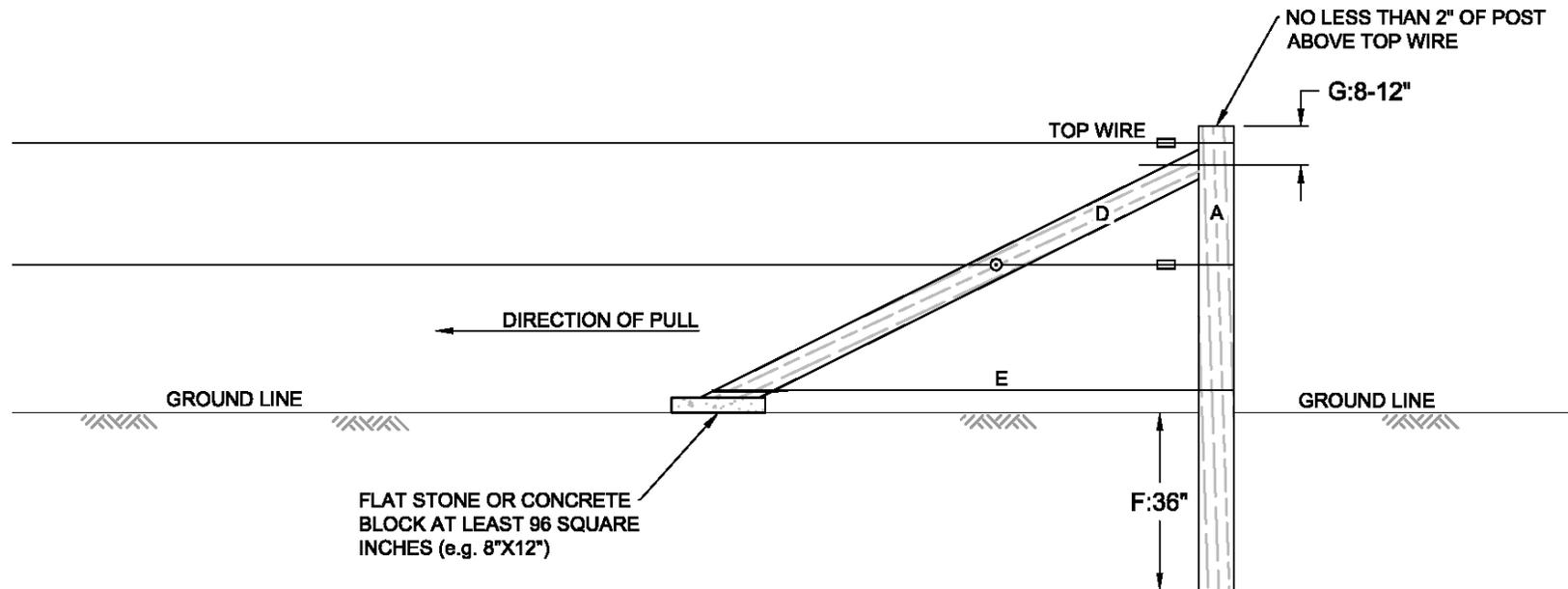
**NOTE:** The tops of steel pipe posts must be permanently capped to prevent water entry. All steel pipe brace and pull assemblies must be galvanized or painted for rust protection.

**C. Compression Members:** Minimum Diameter: Wood: 4 inches; Steel Pipe: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Center line of compression members must be spaced 8 to 12 inches from the top of the Brace and Pull Posts. Minimum length six (6) feet

**E. Tension Wire:** Tension wires shall be two complete wraps of wire, twisted or strained to provide necessary rigidity to assure brace integrity. Acceptable wire sizes include: 9 gauge single-strand malleable wire, 12.5 gauge double-strand barbed or smooth malleable wire, or 12.5 gauge single-strand high-tensile wire.

Tension wires must be stapled to the Pull Post 4 to 6 inches above the ground and the Brace post 4 to 6 inches above the compression member. Tension wires are not required on welded steel pipe double H brace (pull) assemblies.

**FIGURE 10 - NRCS PIA TYPICAL ANGLE BRACE ASSEMBLY FOR ELECTRIC FENCES**



Notes: All angle brace assemblies planned by the NRCS in the PIA must meet or exceed these minimum specifications. Refer to the Fence (382) practice specification for additional details regarding materials and construction specifications for angle brace assemblies. Diagram labels A, D, E, F and G also correspond to sections of the PIA Fence (382) Jobsheet. Angle brace assemblies shall not be used for fences exceeding 54 inches in height.

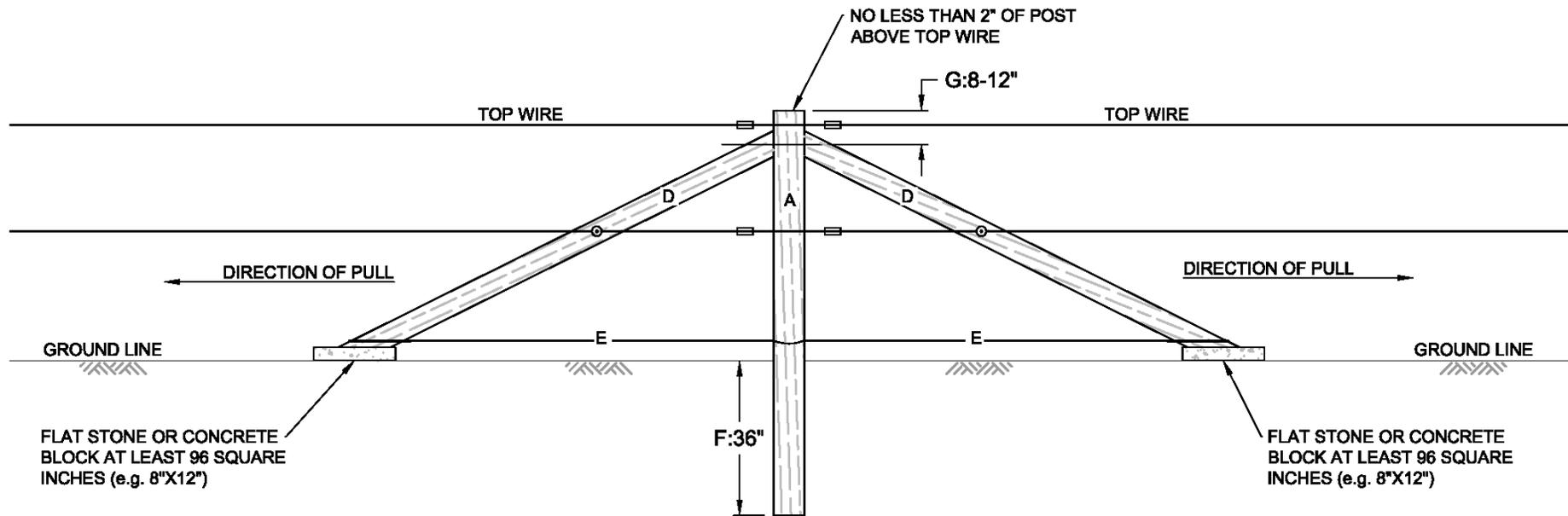
**A. Anchor/Pull Posts:** Minimum Diameter: Wood Posts: 4 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum length: must allow for buried depth of 36 inches plus at least 2 inches of post clearance above top wire.

**D. Angle Brace Posts:** Minimum Diameter: Wood Posts: 4 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum angle brace post length shall be eight (8) feet for fence heights up to 48 inches or nine (9) feet for fence heights of 49-54 inches.

**NOTE:** The tops of steel pipe posts must be permanently capped to prevent water entry. All steel pipe angle brace assemblies must be galvanized or painted for rust protection.

**E. Tension Wire:** Tension wires shall be two complete wraps of malleable wire or one complete wrap for high tensile wire, twisted or strained to provide necessary rigidity to assure brace integrity. Acceptable wire sizes include: 9 gauge single-strand malleable wire, 12.5 gauge double-strand smooth malleable wire, or 12.5 gauge single-strand high-tensile wire. Tension wires must be stapled (wood) or attached to a welded clip (steel pipe) for both the Anchor/Pull Post and Angle Brace Post 4 to 6 inches above the ground.

**FIGURE 11 - NRCS PIA TYPICAL DOUBLE ANGLE BRACE (PULL) ASSEMBLY FOR ELECTRIC FENCES**



Notes: All double angle brace (pull) assemblies planned by the NRCS in the PIA must meet or exceed these minimum specifications. Refer to the Fence (382) practice specification for additional details regarding materials and construction specifications for double angle brace (pull) assemblies. Diagram labels A, D, E, F and G also correspond to sections of the PIA Fence (382) Jobsheet. Angle brace assemblies shall not be used for fences exceeding 54 inches in height.

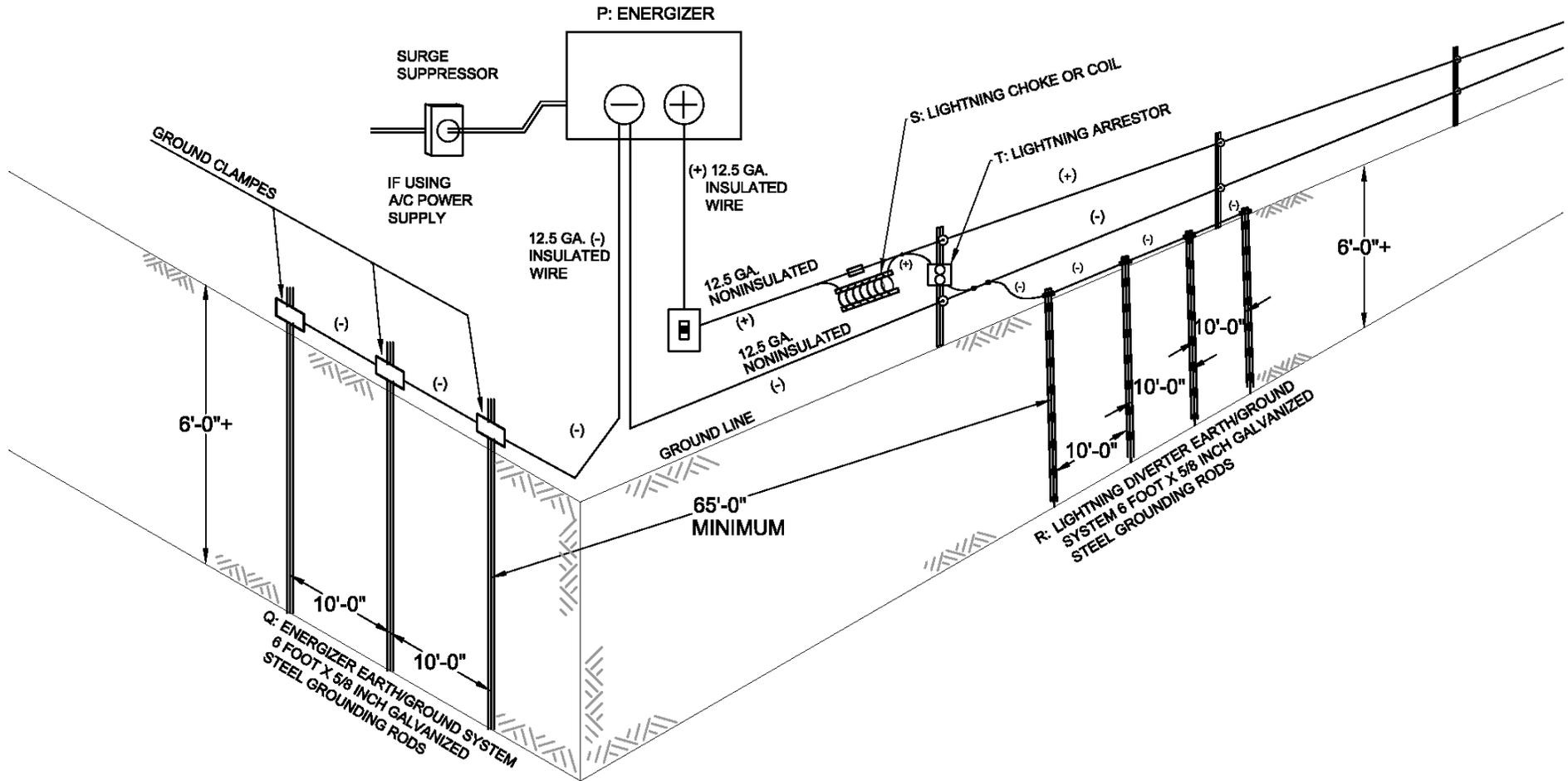
A. Anchor/Pull Posts: Minimum Diameter: Wood Posts: 4 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum length: must allow for buried depth of 36 inches plus at least 2 inches of post clearance above top wire.

D. Angle Brace Posts: Minimum Diameter: Wood Posts: 4 inches; Steel Pipe Posts: 2 inches nominal (2 3/8 in OD), Schedule 40 (3.65 lbs/foot). Minimum angle brace post length shall be eight (8) feet for fence heights up to 48 inches or nine (9) feet for fence heights of 49-54 inches.

NOTE: The tops of steel pipe posts must be permanently capped to prevent water entry. All steel pipe angle brace assemblies must be galvanized or painted for rust protection.

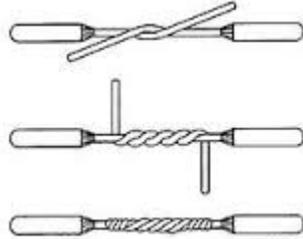
E. Tension Wire: Tension wires shall be two complete wraps of malleable wire or one complete wrap for high tensile wire, twisted or strained to provide necessary rigidity to assure brace integrity. Acceptable wire sizes include: 9 gauge single-strand malleable wire, 12.5 gauge double-strand smooth malleable wire, or 12.5 gauge single-strand high-tensile wire. Tension wires must be stapled (wood) or attached to a welded clip (steel pipe) for both the Anchor/Pull Post and Angle Brace Post 4 to 6 inches above the ground.

FIGURE 12: NRCS PIA TYPICAL ELECTRIC FENCE ENERGIZER AND GROUNDING SYSTEM INSTALLATION



### FIGURE 13a: NRCS PIA APPROVED TECHNIQUE FOR SPLICING MALLEABLE WIRE

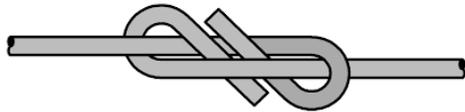
- “Western Union” splice: Use a minimum of eight (8) wraps on each side of the center, tightly wound and closely spaced.



### FIGURE 13b: NRCS PIA APPROVED TECHNIQUES FOR SPLICING HIGH-TENSILE WIRE

High-tensile wire can withstand bends up to 90 degrees and re-straightening without significantly reducing the breaking strength of the wire. Bends greater than 90 degrees should be cut out and the wire spliced at these points. The following methods are approved for use when splicing high-tensile wire:

- “Figure 8” knot: Overlap the ends of the wires to be spliced 10 to 12 inches and bend a loop in the end of each around each other wire, but in opposite directions. Bring the end of the wire in each loop under itself so that the ends of the wires are parallel but pointing in different directions. Pull the loops together until the ends of the wires are touching. After final tensioning, cut the surplus ends of the wires as close as possible to the loops.



- Nicopress sleeves: Two wires can be lap-spliced by threading three 3/8 inch or two 3/4 inch nicopress sleeves onto one wire, then sliding them forward and threading them on the opposite wire, then crimping them with a crimping tool. Bend the ends of the wires to prevent slipping.



- Wire link & wire lock joiners: Two wires can be butt-spliced or parallel-spliced by inserting both ends fully into or through the joiner holes and pulling in the opposite direction.

