Practice Specification
Fence (Code 382)

1. Planning and Design

For clarity in the use of this Practice Specification in conservation planning, a fence will be considered either **permanent** or **temporary** with regards to design and installation.

Permanent Fence: The designation of permanent is utilized to describe a fence that has material quality meeting the practice lifespan (20 years) without requiring replacement. Permanence also signifies that the installation utilizes quantities and placement of materials that require significant labor and equipment to install. Criteria and material requirements listed in this Specification are for permanent installations except as identified in Section 4G.

Temporary Fence (also considered a portable fence): The designation of temporary is utilized to describe a fence that has material quality that will need replacement during the practice lifespan, may not stay in the same location for the practice lifespan, and utilizes fewer materials and less labor to install when compared to permanent. Temporary fence is planned and designed when short-term animal control is directly required for proper implementation of an associated management practice. Implementation of temporary fence will only be certified upon completion and certification of the associated management practice. Technical planning assistance for temporary fence does not specifically warrant or validate financial assistance for implementation. Refer to Section 4G for additional considerations and requirements for temporary fence.

Fence planned as a barrier to animals, specifically livestock, must have a fence type designated that properly controls the livestock type(s) being managed. The designation of livestock type(s) and the fence type needed for animal control sets the criteria for designing Kansas (KS) Conservation Practice Standard (CPS) Fence (Code 382) and is designated on Form KS-ECS-382, Fence Implementation Requirements. Refer to Section 2 for livestock type(s) and associated fence type that can be utilized to meet the practice purpose as well as the designation of permanent fence.

Design, approve, and certify KS CPS Fence (Code 382) on Form KS-ECS-382, Fence Implementation Requirements, utilizing the criteria, procedures, and technical details listed within this Practice Specification and applicable supplements based on planned fence type. Updates and/or changes to the fence design (including but not limited to location) must be documented and approved on Form KS-ECS-382, Fence Implementation Requirements, prior to fence installation. The responsible planner, with proper job approval authority (JAA), can approve variations of materials and installation. The planned and documented variation, along with the resulting fence, must meet or exceed the quality intended by the Specification. An example is utilizing limestone rock posts instead of wood or steel posts.

2. Animal (Livestock) and Fence Type Criteria

Designating the fence type sets the foundation for design criteria for KS CPS Fence (Code 382) and is directly related to the type of animal (livestock) that is being controlled. Utilize suitability descriptions listed in Section 2A in conjunction with requirements listed in Table 1 to properly select the fence type(s) that will be designed to meet the planned purpose(s).

2A. Fence Type and Suitability Descriptions:

1. **Standard Fence** is the most common fence type used in Kansas, especially for livestock fence. It is suitable for an interior (cross-fencing) or boundary location and as a permanent installation. This fence type can be used in areas that receive varying pressure from livestock with more wires withstanding higher livestock pressure. It is constructed with barbed (standard or high tensile type) or barbless (standard type) wire consisting of two strands twisted together.
2. **Suspension Fence** is a variation of the standard fence but utilizes larger spacing of materials. It is suitable for an interior (cross-fencing) location and as a permanent installation. This fence type is typically used on level terrain (within large landscapes) and constructed with barbed and/or smooth wire. The design allows it to sway (move) in the wind and when contacted by animals.

3. **Woven and Mesh (no-climb) Wire Fence** is best utilized in areas where tight control is necessary (such as with sheep, goats, horses, hogs, people, or predator control). It is suitable for an interior (cross-fencing) or boundary location and as a permanent installation. This fence type consists of multiple rows of horizontal, smooth wires held apart by vertical wires. It has various wire sizes and spacing configurations available, depending upon the desired use.
4. **Energized (Electric) Fence** is utilized as an extremely flexible fence type and is typically installed as a low-cost alternative to other fence types. It is suitable for an interior (cross-fencing) or boundary location and as a permanent or temporary installation. The fence is electrified using a solar or mains (plug-in) energizer. The energizer must have sufficient power, often listed in joules, to control the livestock being managed. Livestock must receive adequate training to gain respect for the electrified fence in order for this fence type to meet its intended purpose(s).
5. **Non-Energized, High Tensile Fence** is utilized in areas that receive moderate livestock pressure and are considered safer for animals, especially horses and wildlife, than barbed-wire fence. It is suitable for an interior (cross-fencing) or boundary location and as a permanent installation. This fence type requires more strands of wire (than barbed or energized) in order to maintain the same level of control.
6. **Confined Feeding Area Fence** is utilized where livestock are densely confined and the fence receives constant pressure. It is suitable where livestock are confined (fed all dietary needs) and as a permanent installation. The fence type is typically used on farmstead land use and not intended to enclose areas targeted for grazing (such as range and pasture land use). Refer to Section 4B.
7. **Subcomponent Fence** designates a short section of fence that is built in conjunction with the other fence types listed. The subcomponent portion is designed as a component of the fence types previously listed. It completes the physical barrier but differs in material and/or construction methods (as compared to the adjoining fence). It is suitable for an interior (cross-fencing) or boundary location and as a permanent installation. Subcomponent fence is used in challenging topographical settings, in conjunction with livestock watering points, and/or where short lengths of other fence types cannot be properly installed or maintained. Refer to Section 4C.
8. **Special Area Fence** is utilized in or around construction sites or other sites associated with The Watershed Protection and Flood Prevention Act (PL-566) structures. It is suitable where the fence is critical to the protection of the site and as a permanent installation. Examples of suitable areas include mitigation plantings near or within the watershed. Refer to Section 4D.
9. **Rock Barrier Stub Fence** is utilized around dams and ponds to extend the fence into the water where other fence types cannot be properly installed and/or maintained. It is suitable for use in and around ponds or lakes and as a permanent installation. This fence type starts at two feet above the permanent water elevation and extends down to a minimum depth of six feet below the permanent water level. Refer to Section 4E.

2B. <u>Additional Suitability Considerations</u>:

1. **Livestock:**
   - If livestock deaths resulting from lightning strikes in the fence line is a concern of the client, a steel post may be installed every fourth post in the fence line where all wood was originally planned. A lightning rod driven into the soil and attached to the fence line may also be used.
   - For horses, consider avoiding the use of barbed wire and steel t-posts in fence design. This adjustment can minimize potential injury, especially in small areas of confinement.
2. **Wildlife:**
   - When designing fences to meet the landowner's objectives of both protecting property and managing livestock while reducing injuries to wildlife, consult Section 4F. The level of risk that a fence poses depends upon many factors (such as fence type, total height, wire spacing, visibility, location on the landscape, wildlife species present, and season of wildlife use).

Table 1. Fence requirements based on livestock type being contained for permanent installations.

Livestock Type	Fence Type	Minimum Number of Wires or Cross Members	Average Height of Top Wire or Cross Member[1] (inches)	Max Line Post Spacing w/o Stays (feet)	Max Line Post Spacing w/ Stays (feet)	Max Stay Spacing (feet)	Potential Wire Spacing (start from ground)
Cattle	Standard[2]: Barbed low pressure	3	46	16½	30	10	18,14,14
	Standard[2]: Barbed moderate pressure	4	46	20 [3]			16, 10, 10,10
	Standard[2]: Barbed moderate to high pressure (optional)	5	50	20 [3]			14, 9, 9, 9, 9
	Suspension[2]: Barbed	4	46	NA	100	20	16, 10, 10,10
	Woven plus Barbed/HT	NA	46	16½	NA	NA	4, (32" Woven), 10
	Energized (Permanent): High Tensile, Smooth Wire	3	40	75	150	50	20,10,10
		4	46				16, 10, 10, 10
	Non-Energized, High Tensile: Smooth Wire	5	46	20	30	10	12, 8, 8, 8, 10
	Confined Feeding Area[4]	4	48	12	NA	NA	12, 12, 12, 12
	Special Area (Barbed)	4	48	16½	NA	5½	16, 10, 10, 12
Goats/ Sheep	Standard: Barbed	7	46	20	30	10	6, 6, 6, 6, 6, 8, 8
	Woven plus Barbed/HT	NA	46	20	NA	NA	0-2,(36" Woven), 10
	Energized (Permanent): High Tensile, Smooth Wire	5	38	50	150	30	6, 6, 8, 8, 10
	Non-Energized, High Tensile: Smooth Wire	7	46	20	30	10	6, 6, 6, 6, 6, 8, 8
Horses	Standard[2]: Barbed	4	48	16½	30	10	16, 10, 10,12
	Suspension[2]: Barbed	4	48	NA	100	20	16, 10, 10,12
	Woven Mesh (no-climb) plus Barbed/HT	NA	48	20	NA	NA	6, (36" Mesh), 6
	Energized (Permanent): High Tensile, Smooth Wire	4	48	75	150	50	16, 10, 10, 12
	Non-Energized, High Tensile: Smooth Wire	5	48	20	30	10	12, 8, 8, 10, 10

[1] Average height of top wire or cross member is shown as a goal, but it is permissable to have wire in the fence line averaging two inches above or below the height listed. Additional wires or material can allow heights to exceed two inches above the height listed if it meets the purpose of the fence and does not conflict with a wildlife plan on the land unit. Kansas statute 29-105 states that a legal, 3-wire, barbed-wire fence will have the third wire from the ground not less than 44 inches nor more than 48 inches from the ground, and the bottom wire not more than 24 inches nor less than 18 inches from the ground, with the center wire equidistant, or nearly so, between upper and lower wires.

[2] Barbed wire is the most common wire on standard fences. Standard and suspension fence can utilize all or some of the strands as single-strand smooth or double-strand smooth (barbless) when wildlife considerations or minimal livestock pressure warrant.

[3] Line post spacing on lands and areas around watering and feeding facilities will have a maximum spacing of 16½ feet.

[4] Refer to special section on confined feeding area fence for material and installation details.

3. General Requirements - Fence Components and Installation

3A. Brace Assembly Configuration and Placement: A brace assembly is required at all corners, gates, fence ends, at certain specified distances, and at definite slope and alignment changes in the fence line. Refer to Table 2 for maximum pull lengths based on fence type.

1. **End Brace Assembly (also identified as End Panel):** 2-Post End Brace Assemblies are required where fences end and on both sides of gate openings where the pull is from only one direction. A 2-Post End Brace Assembly consists of an anchor/pull post and one brace post extending in the direction of the pull. Where shallow soil depth restricts post depth, a rock crib can be utilized. For additional information, refer to Figure 1 and "End Panel" of fence details for standard livestock fence.
2. **In-Line Brace Assembly (also identified as Pull Post Assembly):** 2- or 3-Post In-Line Brace Assemblies are required in straight sections of the fence line where the distance between anchor/pull posts of brace assemblies exceeds the maximum pull length (see Table 2). 3-Post In-Line Brace Assemblies are also required where an upward angle needs additional embedment (to properly anchor the upward pull of the stretched wire). With changes in slope exceeding ten degrees (17%), consider this type of brace assembly. The center post of the brace assembly is set as near as possible to the point where the slope breaks. Section 3G has criteria for utilizing a deadman in lieu of a 3-Post In-Line Brace Assembly for elevation changes. Refer to Figure 2 and "Pull Post Assembly" of special area fence details for additional design information.
3. **Corner Brace Assembly:** 3-Post Corner Brace Assemblies are required at all points where the fence alignment has a change of greater than 60 degrees horizontally and the pull is from two directions. Refer to Figure 3 and "Corner Assembly" of fence details for standard livestock fence for additional information.
4. **Inside Brace Assembly:** 2-Post Inside Brace Assemblies are required at all points where the fence alignment has a change in direction of ≥15 degrees and ≤60 degrees. 2-Post Inside Brace Assemblies are constructed with the same requirements of a 2-Post End Brace Assembly, but they are installed to bisect the corner angle and the wires pass around the anchor/pull post. A 3-Post Corner Brace Assembly can be utilized in lieu of the Inside Brace Assembly. However, wires will be terminated at the corner post in the assembly, instead of having wires pass by the assembly. Refer to Figure 3.

Figure 1. End Brace Assembly configurations (also identified as End Panel).

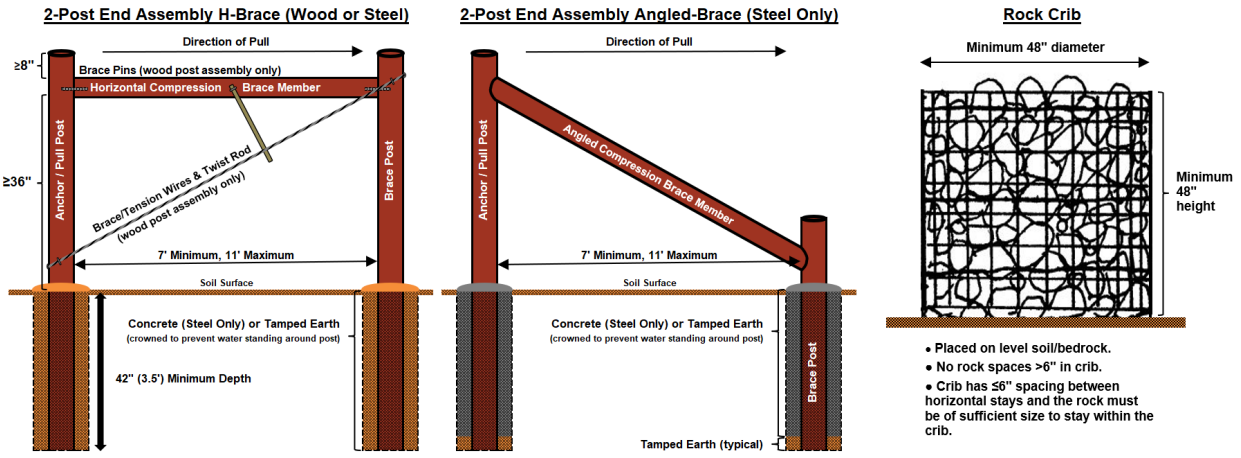


Figure 2. In-Line Brace Assembly configurations (also identified as Pull Post Assembly).

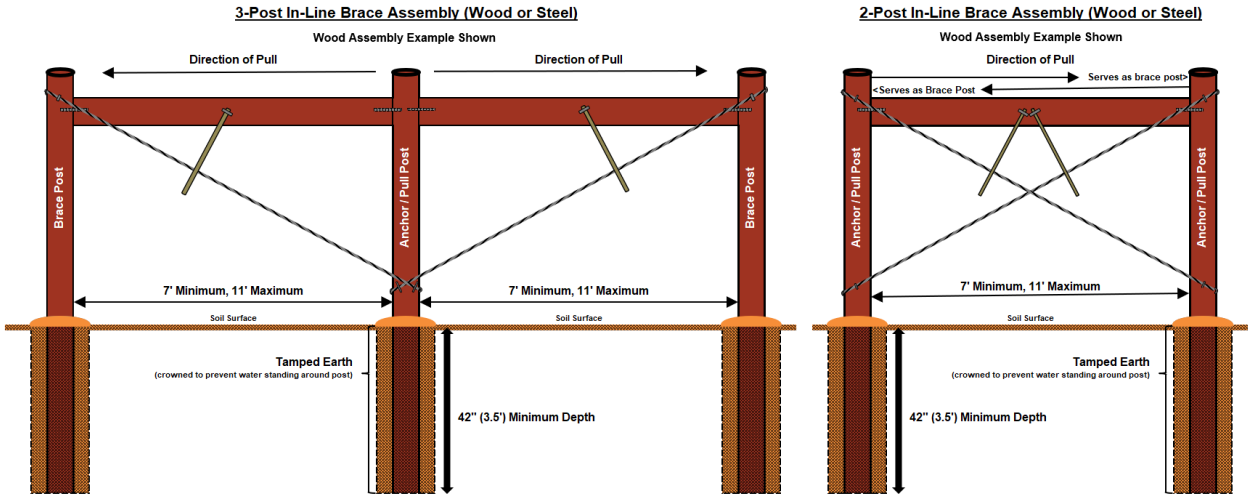
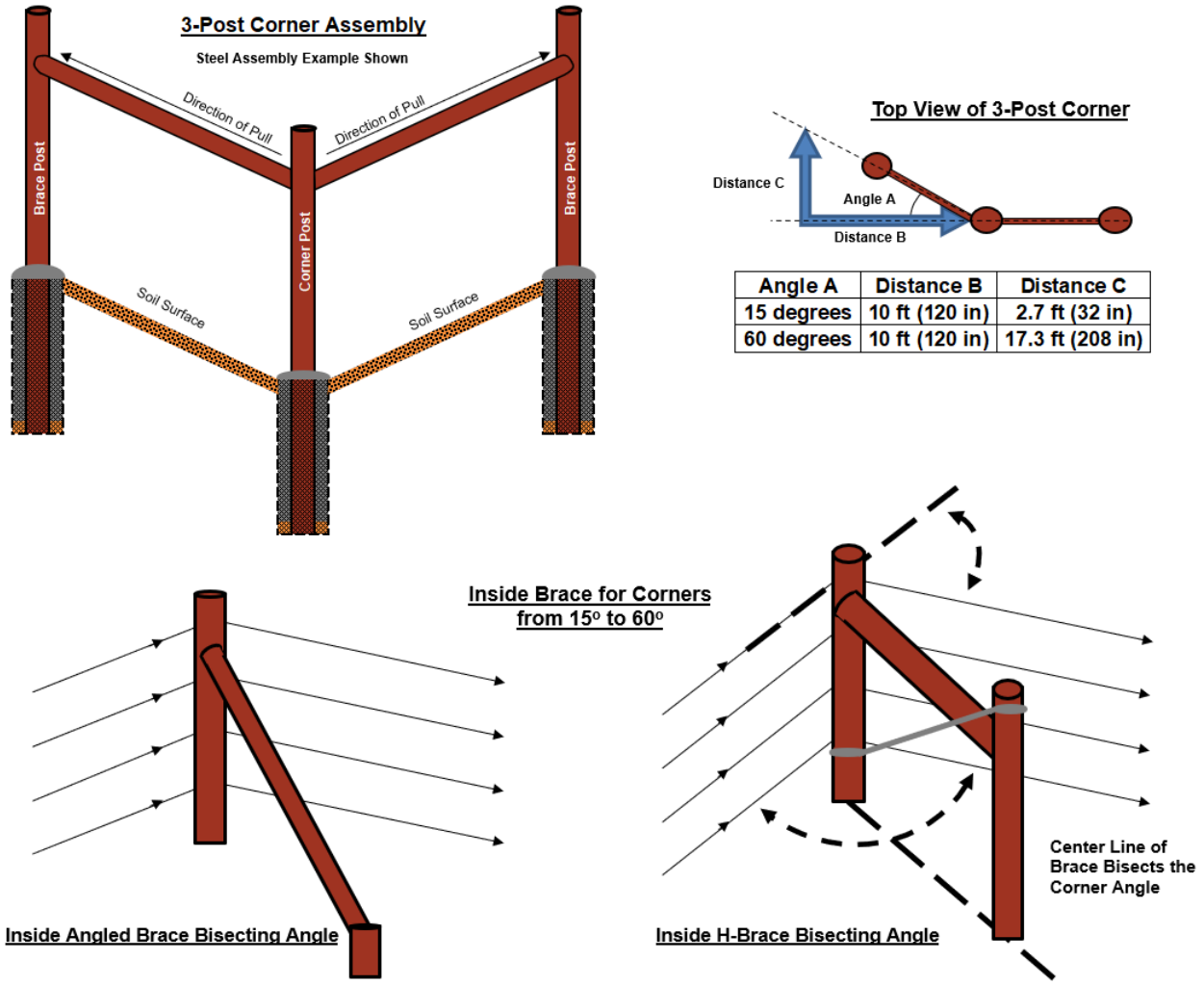


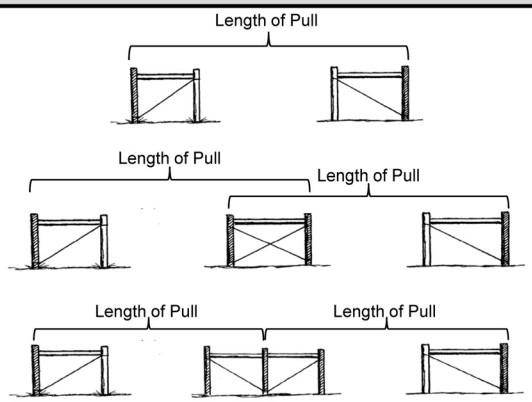
Figure 3. Corner Assembly and Inside Brace Assembly configurations for change in direction of fence.



Angle A	Distance B	Distance C
15 degrees	10 ft (120 in)	2.7 ft (32 in)
60 degrees	10 ft (120 in)	17.3 ft (208 in)

Table 2. Maximum pull length of a fence section as determined by fence type.

Fence Type	Maximum Pull Length (feet)
Standard and Suspension (barbed and/or smooth wire) & Non-Energized, High Tensile (smooth wire)	1,320'
Special Area (barbed wire) & Woven (including Mesh)	660'
Energized, High Tensile (smooth wire) ≤5 wires	2,000'
Energized, High Tensile (smooth wire) ≥5 wires	1,320'

Determining Length of Pull


3B. <u>Brace Assembly Installation</u>: Installation of the brace assembly will depend upon the post type and compression brace type.

1. **Wood Post Assembly:**

   a. **Setting Posts (Wood):** Requirements for post size and setting depth (based on installation method) is provided in Table 4. Installation ensures that adequate fence height is maintained based on its purpose (see Table 1).

   - Wood posts will be set in the earth or driven. Concrete will not be used to set wood posts.
   - Posts to be backfilled with soil will be centered in a hole at least six inches larger in diameter than the diameter or side dimension of the post. It will be thoroughly tamped in four-inch lifts up to ground level.
   - When driven, wood posts will have the end sharpened into a dull point for ease of setting and to achieve a firmer setting. An auger-drilled pilot hole can be used.

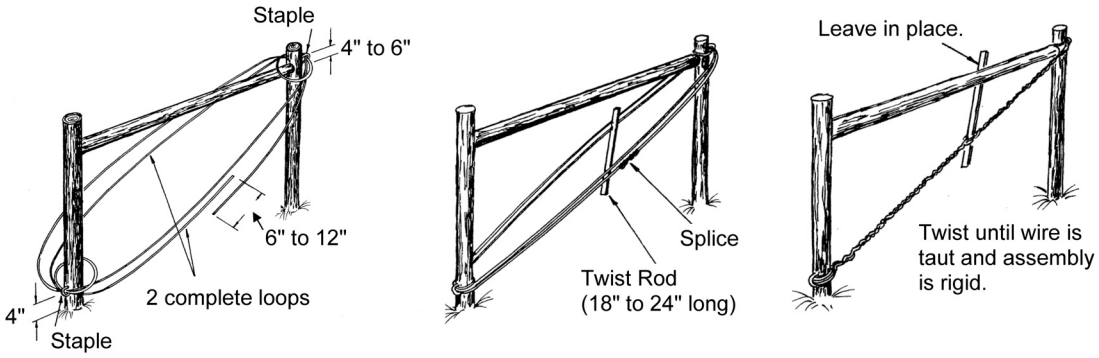
   b. **Installing Compression Brace Member (Wood):** Wood or steel compression brace is placed horizontally. Material requirements are listed in Table 5.

   - Minimum compression brace length is seven feet. In sands and wet areas, consider increasing the length of the horizontal compression brace member to a length of nine to ten feet (do not exceed 11 feet).
   - Placement of the horizontal compression brace member is a minimum of three feet above the ground and eight inches from the top of the post when placed at a 90-degree angle to the anchor/pull posts. Refer to Figure 1.
   - The wood brace posts and anchor/pull posts are notched to achieve a secure fit.
   - Wood horizontal compression brace members are attached to the brace and anchor posts using ⅜ inch diameter steel rod (four inches long). They are set two inches into the brace or anchor posts and the hole drilled as close to the rod diameter as possible.
   - Steel and angle iron compression brace members are supported by a ⅜ inch diameter steel rod (four inches long) set two inches into the wooden brace and anchor posts.

c. **Installing Tension/Brace Wire (Wood):** Refer to figure 4.

- The diagonal tension/brace wire consists of two complete loops of 9-gauge smooth wire. It may also be two complete loops of 12½-gauge double strand barbed or smooth wire, or a single loop of 12½-gauge high tensile, smooth wire.
- The tension/brace wire is stapled at quarter points to the brace post at a height of four to six inches above the brace member and stapled to the anchor (pull) post at a point approximately four inches above the ground level.
    - If oversized wood posts are installed, a groove cut into the wood posts (at the appropriate heights) can be used in lieu of stapling at quarter points, as long as the core of the post still meets the minimum post diameter (excluding the groove depth). The groove must be of sufficient depth to prevent the tension/brace wire from slipping when tightening.
- The tension/brace wire consisting of two complete loops must be twisted or strained in order to provide the necessary rigidity with a twist rod (18 to 24 inches long) that will remain in place approximately midway along the brace wire.
- The tension/brace wire consisting of a single loop of 12½-gauge high tensile, smooth wire is tightened (to provide the necessary rigidity), with an in-line strainer (placed approximately midway along the brace wire).

Figure 4. Tension/brace wire installation.



2. **Steel Post Assembly:**

a. **Setting Posts (Steel):** Requirements for post size and setting depth based on the installation method is provided in Table 4. Installation ensures that adequate fence height is maintained based on its purpose (see Table 1).

- Steel pipe posts may be driven, set in earth, or set in concrete.
- Posts to be backfilled with soil must be centered in a hole at least six inches larger in diameter than the diameter or side dimension of the post. It must be thoroughly tamped in four-inch lifts up to ground level.
- Steel pipe posts to be backfilled with concrete will be centered in a hole that is a minimum of 12 inches in diameter. Posts will be backfilled with four to six inches of thoroughly tamped soil. Concrete backfill around the post will be rodded into place in layers no thicker than 12 inches. The hole will be completely filled and crowned (mounded) at post base with concrete in order to prevent water from ponding around the post at ground level. The concrete will be proportioned as follows: one part cement, two parts sand, and three parts gravel (maximum size 1½ inch). Sufficient water will be added to obtain a slump between three and five inches. The concrete must be placed around the post within one hour after mixing. No stress will be applied to the posts until at least 24 hours after the concrete has been poured.

b. **Installing Compression Brace Member (Steel):** Steel compression brace is placed horizontally or angled. Material requirements are listed in Table 5.

- Minimum compression brace length is seven feet. In sands and wet areas, consider increasing the length of the horizontal compression brace member to a length of nine to ten feet (do not exceed 11 feet).
- Placement of the horizontal compression brace member is at a minimum of three feet above the ground and two inches from the top of the post when placed at a 90-degree angle to the anchor/pull/corner posts.
- Placement of the angled brace member is a minimum of three feet above the ground and two inches from the top of the post (on the anchor/pull/corner post) and a maximum of 12 inches above the ground (on the brace post).
- Steel and angle iron compression brace members are welded to the steel brace and the anchor/pull posts in the assembly.

3. **Rock Crib:** Where site conditions (such as rocky or shallow soil conditions) do not allow for setting posts and/or large rock is readily available, rock cribs may be used for corners, ends, and in-line pull assemblies. Additional information is located in Table 4.
   - Place rock crib on level soil or bedrock.
   - Spaces or voids in the placed rock must not be greater than six inches in the crib and the rocks must be large enough to stay within the crib wires.
   - Rock crib dimensions will be a minimum of four feet in diameter and four feet tall.
   - Utilize 12½ gauge woven wire or livestock panels to form the crib. Spacing between horizontal stays in the wire or panels must not exceed six inches. Livestock panels, when used, must be a minimum of 4-gauge wire and wrapped (so that the welded vertical rods are on the inside of the horizontal rings).

3C. <u>Line Post Installation</u>: Installation of line posts depends on the fence type and the material type. Follow the spacing guidance found in Table 1 and utilize the appropriate materials set at the proper depths according to Table 4.

1. **General:**
   - Minimum lengths will allow for the required buried (setting) depth and the fence height plus at least two inches of post above the top wire.
   - Spacing may need to be narrower depending upon the terrain and pressure from livestock.
   - Lanes and areas around watering and feeding facilities must have ≤16½ feet spacing.
   - Line posts will be set in as straight a line as possible between corners or turns.
   - When fencing along curved lines, use straight sections with appropriate in-line or inside bracing.
   - Set a wood or steel pipe post in the fence line at the top of a slope where the downward pull of the stretched fence wire is excessive.
2. **Installation Procedures by Post Type:**
   - **Wood Post:** Follow the guidance found in Section 3B. Brace Assembly Installation, 1. Wood Post Assembly, a. Setting Posts (Wood).
   - **Steel Pipe Post:** Follow the guidance found in Section 3B. Brace Assembly Installation, 2. Steel Post Assembly, a. Setting Posts (Steel).
   - **Steel "T" or "U" Post:** Posts will be driven unless the technician specifies otherwise.
   - **Fiberglass, Composite, or PVC Post:** Follow the manufacturer recommendations on proper methods of installation. Some post styles may require a specific drive cap or tool in order to prevent damage to the post while driving.

3D. Wire Installation: Wire must be attached on the side of the fence post receiving the most pressure. The installation of wire depends on the fence type, material type, and post type. Follow the guidance in Table 1 for fence type, numbers of wire strands, and/or heights meeting livestock needs. Follow the guidance in Table 3 to meet material specification requirements.

1. **Splicing Wire:**

   a. Standard Wire:

   - The Western Union splice will be used to splice standard wire fence. The Western Union splice must have a minimum of eight wraps on each side of the center, tightly wound, and closely spaced. Refer to Table 6 for a diagram of the splice.
   - Compression fittings, splice sleeves, or manufactured connectors may be used in lieu of a Western Union splice to splice standard wire. The fittings, sleeves, or connectors must have tensile strength no less than 100 percent of the wire tensile strength. Ends of the wire will be overlapped at least two inches with two sleeves (or as many as recommended by the manufacturer for the wire type) fitted over the wires and firmly crimped. Refer to Table 6 for a diagram of a compression fitting.

   b. High Tensile Wire:

   - Compression fittings, splice sleeves, or manufactured connectors (that have a tensile strength no less than 100 percent of the wire tensile strength) will be used to splice high tensile wire. Ends of the wire will be overlapped at least two inches with two sleeves (or as many as recommended by the manufacturer for the wire type) fitted over the wires and firmly crimped. Refer to Table 6 for a diagram of a compression fitting.

2. **Stretching Wire:**

   a. Standard: Fence wire will be stretched to sufficient tension to allow minimal sag prior to being fastened to the posts. Temperature variations must be considered (wire will tighten in cold weather and expand/loosen in hot weather) when determining the amount of tension to use.

   b. Suspension: Wire tension is critical. Wires should be stretched to prevent more than three inches of sag between the posts (set at 100 feet apart), and 1½ inches of sag between posts (set at 50 feet apart).

   c. Smooth Wire (energized and non-energized): In-line strainers will be placed near the center of the fence line, between brace assemblies (in order to achieve equal tension on both ends of the wire). Prior to tensioning, place the wire in insulators (make sure the wire has free movement) along the entire fence reach. High tensile wires will be tensioned (with the strainer) to prevent more than three inches of sag between posts.

   d. Woven/Mesh: Fence will be stretched to sufficient tension. A good rule of thumb is to stretch it tightly enough so that about half of the “curve” in the wire is pulled out during installation. The use of a stretcher bar specifically designed to attach to the full width of the woven/mesh fence is recommended. This results in a uniform pull across the height of the fence.

3. **Attaching Wire to Anchor/Pull/Corner Posts:**

   a. Standard/Suspension/Smooth Wire (non-energized): Wires will be attached to anchor/pull/corner posts by two complete wraps around the post. The end will be tightly wound and closely spaced around the stretched wire at least eight times. High tensile wire can utilize compression fittings in lieu of wrapping around the wire.

   b. Woven/Mesh: Wires will be attached to the anchor/pull/corner posts by two complete wraps around the post. The ends will be tightly wound and closely spaced around the stretched wire at least eight times. Determine the amount of wire needed to fully wrap around the post twice plus enough to twist around the stretched wire. Then remove enough vertical stays to provide the length needed. High tensile wire can utilize compression fittings in lieu of wrapping around the wire.

c. Smooth Wire (energized): Insulators made of porcelain, UV stabilized high density polyethylene (HDPE), or high density polypropylene (HDPP) will be secured to the anchor/pull/corner posts. The smooth wire will be attached to the insulator with compression fittings or tying method (end knot).

- The top wire is always hot (energized).
- Wires alternate hot (energized)/ground from the top wire down, unless specific livestock control requirements dictate a separate pattern. This must be noted in the implementation requirements.

4. **Wire Height and Spacing:**

a. Woven/Mesh Wire Fences:

- The minimum height of woven wire will be 32 inches and mesh wire will be 36 inches.
- The bottom wire of a woven/mesh wire fence is placed near ground level or as suggested in Table 1.
- Woven/mesh wire fences require at least one barbed or smooth wire placed above the woven/mesh wire as a fence top deterrent. The height placement of the top deterrent wire is the top wire height listed in Table 1. Another option is to place it a minimum of two inches above the woven/mesh wire height, whichever is higher. A second wire is required between the top wire height and the top of the woven/mesh wire if that space exceeds 12 inches.

b. All Other Wire Fences (not woven/mesh wire):

- Top wire heights will be based on the intended use according to Table 1.
- Bottom wire heights will be 12 to 18 inches above the ground surface for large animals (not sheep and goats).
- Middle wires will be spaced at equal intervals between the top and bottom wire unless specific spacing is needed for the identified livestock type being contained. This must be noted on the implementation requirements.

5. **Attaching Wire to Line Posts:**

a. Wood Post:

- **Staples:** Refer to Table 6 for material specifications for the staples. Drive staples diagonally to the wood grain at a slight downward angle (upward angle, if the pull is up) in order to avoid splitting the post. Space will be left between the post and the staple to allow free movement of wire. This will also help to avoid damage to the wire's protective coating. Manufactured fasteners can be utilized in lieu of staples if the materials are corrosion-resistant and if the fastener does not pinch the wire or scar the protective coating during the installation process.
- **Wire:** In lieu of stapling, the line wire can be placed in a groove cut no deeper than ¼ inch into the wood posts. Secure the line wire to the post with 12½-gauge galvanized wire to prevent wire slippage up and down the post.
- **Insulators:** Utilized for energized, smooth wire only. Install a manufactured insulator designed specifically for the post type and that meets energizer requirements. Durable nails or screws should be used to secure the insulator to the post.

b. Steel Pipe Post:

- **Wire:** Secure the line wire to the post with 12½-gauge galvanized wire in order to prevent wire slippage up and down the post.
- **Welded Clip or Link:** Various methods of securing the line wire to pipe posts with clips or links can be utilized. Ensure the clip or link is of sufficient quality to persist over time (typically a minimum of ¼ inch material thickness). Ensure that the wire's protective coating is not damaged or scarred during clip/link installation.

c. Steel "T" or "U" Post:

- **Manufactured Clip:** Utilizing the manufactured clips sold with the posts is the preferred method to attach fence line wire to the "T" or "U" post.
- **Wire:** In lieu of the manufactured clips, 12½-gauge galvanized wire can be used to secure fence line wire to posts.
- **Insulators:** Utilized for energized, smooth wire only. Install a manufactured insulator designed specifically for the post type and that meets energizer requirements. Be aware that using steel posts with energized fence increases the chances of electrical fence shorts if the fence line wire comes off the insulator and makes contact with the steel post.

d. Fiberglass, Composite, or PVC Post: Utilize fiberglass, composite, or PVC posts with energized, smooth wire fence installation only. The post holds the line wire and acts as the insulator.

- **Drilled Holes:** Posts (if not already pre-drilled) can be drilled to provide a hole large enough for the wire to slide freely through. However, the hole size should not be so large as to jeopardize the integrity of the post. The wire will be guided through each post before securing it to the brace assembly or strainer.
- **Manufactured Clip or Cotter Pin:** Clips shall be sized to securely fit on the post. They must prevent wire slippage up and down the post and allow free movement of the wire through the clip when tensioning. Cotter pins can also be utilized, when recommended by the post manufacturer or dealer. Clips and pins will have a protective coating or be made of stainless steel.
- **Wire:** In lieu of other methods, 12½-gauge galvanized wire can be used to secure fence line wire to posts. This may be used in conjunction with drilled holes, where the line wire is secured, allowing the line wire to slide freely through (rather than guided through the holes in the post).

3E. Stay Installation: Installation of stays depends on the fence type being installed. Follow the guidance in Table 1 for proper spacing of stays. Follow the guidance in Table 6 to meet material specification requirements.

- Stays are required when line post spacing exceeds the maximum distance without stays.
- Space the stays at equal distances between the posts with spacing, not to exceed the maximum specified in Table 1.
- Length of stays are fence height plus two inches and installed so that stays swing free of the ground and allow the fence to move when touched by the animal.
- Stays made of non-conductive material can be used on all fences requiring stays. Wire stays can only be used on non-energized fences and are the twist-on, one-piece design. See Table 6.
- Refer to "Wire Gate Section" or "Line Fence Section" in Figure 8 for additional information.

3F. Gates: Gates are designed to accommodate the client's objectives.

1. **Wire Gates:** Refer to "Wire Gate Section" and "Gate Closer" in fence details for additional information.
   - Wire gates are made of the same materials, kind, grade, and size specified for the field fence.
   - Stays in wire gates do not exceed a four-foot spacing.
2. **Other Gates:** Gates constructed of wood panels, aluminum, or steel must have galvanized or painted hinges and are attached directly to a braced end/gate post.

3G. Depressions, Watercourses, and Elevation Changes: Special considerations in fence design are needed when crossing depressions and watercourses or when encountering abrupt elevation changes in the landscape. Properly designed and constructed fence will prevent washouts and the lifting of posts out of the ground.

1. **Fence Span:** Free span of a fence (the distance between posts on each edge of a deep depression or watercourse) will not exceed 30 feet. Refer to Figure 5. Distances greater than 30 feet require the installation of a brace assembly on each side of the depression or watercourse.

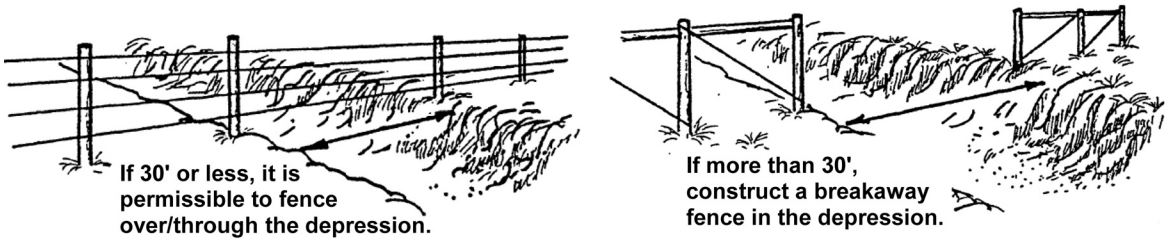
   a. Free Span ≤30 feet: Free span of a fence not exceeding 30 feet will either require the construction of the fence with wires parallel to the ground or with top wires straight across.

   - **Fence Installed Parallel to the Ground:** Line posts subjected to upward pull will be adequately anchored to prevent lifting out. This may be accomplished by extra embedment (such as setting the posts in concrete or the use of weights). Refer to "Crossing at Small Depressions and Watercourses" and "Flood Gate" within Figure 8 and Figure 9.
   - **Fence Installed With the Top Wire Straight Across:** Use extra length posts to allow the normal post embedment and add wire to fill the space between the bottom of the fence and the ground.
     - Floodgates, where needed, are attached below the bottom wire and are designed to allow water and debris to pass without damaging the fence wire above. Hinged or breakaway floodgates are allowed.
     - Energized fences may use a "Floodgate Controller" with galvanized link chains spaced ten to 14 inches apart to a point approximately eight inches above static water level or the ground surface.

   b. Free Span >30 feet: Free span of fence exceeding 30 feet requires the installation of an end brace assembly on each side of the depression or watercourse. Also required is a separate section of breakaway fence, installed between the brace assemblies and through the depression (or watercourse). Refer to guidelines in Section 3A. Brace Assembly Configuration and Placement, for details on end assembly.

   - Utilizing a breakaway fence will prevent damage to the adjacent fence during high water flows.
   - The section of breakaway fence will be attached to the main fence brace with a light gauge wire and is meant to break if the fence in the depression fails.
   - Post setting depth for breakaway fence may be reduced to prevent damage to the posts if/when the fence in the depression fails.
   - Utilize fence materials that meet specifications in Section 5, except for the wire used for breakaway. Breakaway wire must be lighter gauge to break and release before adjoining fence material is damaged.

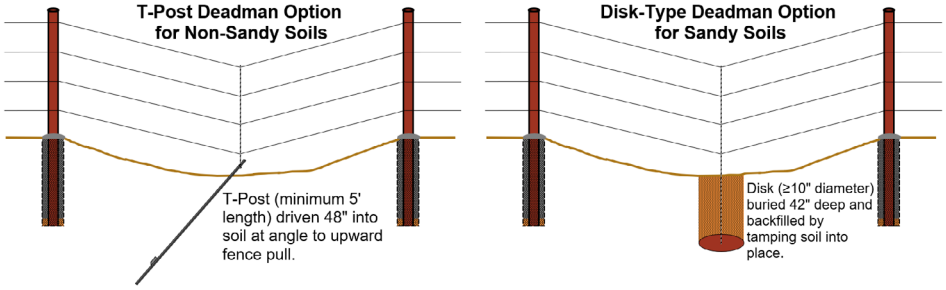
Figure 5. Fencing across depressions and watercourses.



2. **Elevation Changes:**
   - Elevation changes along the fence line (depending on how steep and abrupt) can prevent the proper wire heights from being consistently maintained. This may cause additional strain (such as upward pull) on the line posts.
   - Significant and abrupt elevation changes in the fence line (greater than ten degrees) should trigger the consideration of installing a 3-Post In-Line Brace Assembly. The center post of this brace assembly is set as near as possible to the point where the slope breaks.

- A deadman (see Figure 6), line post with extra embedment (see Figure 8), or heavy weighted object can be installed in lieu of a 3-Post In-Line Assembly (as site conditions warrant). Ensure the installation has all fence line wires properly spaced, wrapped, and secured via a drop wire that will then be secured to the deadman or heavy object.
  - **Deadman for Non-Sandy Soil:** Drive a five foot or longer t-post a minimum of 48 inches diagonally into the soil. Secure the drop wire to the t-post with multiple wraps to avoid slippage up the post.
  - **Deadman for Sandy Soil:** Utilize a disk or coulter blade that is a minimum of ten inches in diameter and placed flat in the bottom of a 42-inch drilled or dug hole. Then, secure it in place by back-filling with tamped soil. Secure the buried blade to the drop wire by using two to four loops of galvanized 9-gauge wire. Alternatively, use galvanized chain (minimum ¼ inch diameter), a t-post (welded to the blade), or a metal rod (minimum ½ inch diameter). The rod shall contain an eye loop for attaching the wire.
- Indicate the installation type required on Form KS-ECS-382, Fence Implementation Requirements, that will maintain fence integrity through the elevation change.

Figure 6. Deadman installation options based on soil type.



4. Special Fence Considerations and Unique Installations

4A. Locations of Fences on Dams: All fences are planned and installed to achieve minimum interference with the hydraulic operation of the structure. The top wire of the fences crossing the inlet and exit channel of the emergency spillway is at (or below) the crest elevation of the emergency spillway.

1. **Structure and Emergency Spillway Area Fence:** The fence is located around the earth embankment and emergency spillway which ties into the stub fence that extends into the permanent water of the reservoir.
2. **Frontslope Fence:** A front slope fence (when determined necessary) is located across the face of the structure between the top of the dam and the emergency spillway elevation. It ties into the fence around the dam and spillway areas near the end of the structure.

4B. Confined Feeding Area Fence: Refer to Table 3 in Section 5 for crossmember requirements and Table 4 for post requirements when installing fencing for confined feeding areas. As noted in Table 1, the maximum line post spacing is 12 feet, a minimum of four cross members is required, and the average height of the top cross member is 48 inches. Setting steel pipe posts in concrete is the preferred method. Cross members will be welded directly to line posts or attached with steel clips designed for the application.

4C. Subcomponent Fence: Short lengths of fence and high pressure areas around watering facilities can utilize subcomponent fence materials listed in Table 3. Utilize an end assembly to transition from subcomponent fence to wire fence sections.

- Minimum installation for fence panels (16 feet in length) will have a line post set every eight feet with the ends of each panel requiring a wood or steel pipe line post. See Table 4 for line post size requirements. Attach the panels to the posts with wire.

- Minimum installation for continuous fencing (tubing) will have posts set no greater than 12 feet apart. Post size will meet confined feeding line post or brace assembly requirements (see Table 4). Continuous fencing will be attached to the steel pipe posts via welding or welded clips and attached to the wood posts via clips bolted to posts.
- Additional materials can be designed (cable, sucker rod, etc.) and approved by the conservation planner if materials meet or exceed the rigidity and sturdiness of the adjacent wire fence.

4D. Special Area Fence: Find additional specifications for special area fences (such as those installed via The Watershed Protection and Flood Prevention Act [PL-566]) in the National Engineering Handbook, Part 642. Additional requirements (such as galvanizing of steel materials and maximum distances of pull length) will be clearly identified on Form KS-ECS-382, Fence Implementation Requirements.

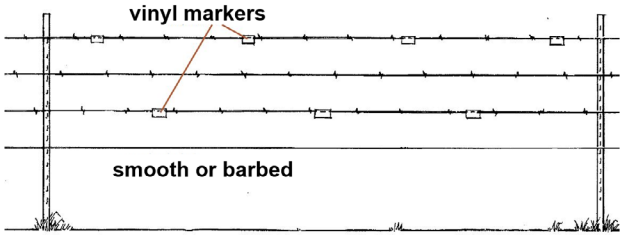
4E. Rock Barrier Stub Fences: A rock barrier stub fence section is used to extend the fence into the water. Refer to Figure 10 in Section 5 for additional information.

- Stub fence starts two feet above the permanent water elevation and extends down to a minimum depth of six feet below the permanent water elevation. This fence results in a low maintenance stub fence.
- Construction is according to the Rock Barrier Fence Details in Figure 10. Required materials are according to Material Specification 523, “Rock for Riprap”, found in the National Engineering Handbook, Part 642, Chapter 3.

4F. Wildlife-Friendly Fence: Wildlife-friendly fences allow for the safe passage of wildlife over or under fences and are highly visible. Utilizing the guidance in this section can help prevent or minimize the fence installation from causing injury and/or creating barriers to wildlife. Without proper considerations, animals can collide or become entangled with fences, which frequently results in injury or death. Additionally, the fence could create a new barrier that limits access to important habitat resources or separates young wildlife from adults. Utilize the following guidance in wildlife-friendly fence designs.

1. **All:** Woven wire is not recommended where enhancing wildlife movement is a planned objective.
2. **Big Game:** Fences considered “Wildlife-Friendly” for big game traffic areas will have the top two wires at least 12 inches apart and the top wire installed no higher than the minimum allowed height.
3. **Antelope:** Fences considered “Wildlife-Friendly” for antelope to pass through the fence will have bottom wire heights at a minimum of 16 inches (18 inches preferred) from the ground. To further benefit safe antelope passage, consider installing a smooth or barbless bottom wire in lieu of barbed wire.
4. **Prairie Grouse/Prairie-chicken:** Fence marking is only planned for areas adjacent to known leks, tops of ridges or upper hill-slopes, and areas where prairie-chickens travel frequently.
    - For five-wire fences, the top and third wires are marked. Four-wire fences have the top two wires marked. Wires are marked with 3-inch strips of white vinyl house siding, or a similar type of marker material. The top wire marking is every four feet starting two feet from the post. The next wire marked begins four feet from the post, or offset from the top wire marking. The lower wire contains one less marking device than the top wire. Four, seven, or nine markers per post spacing are required for 12- to 20-foot post spacings.

Figure 7. Fence marking for grouse.



4G. Temporary Fence (also considered a portable fence): Designation is only applicable to an energized (electric) fence installation requiring less labor and materials, as well as less durability of materials, than are identified for permanent installations. Installations may include less than three wires, using single-post brace assemblies, and spacing materials at greater distances to save material and labor. Materials (such as step-in posts and polywire, polytape, polybraid, or electric netting) have an approximate life span of five years depending on UV exposure and seasonal use. These materials will need replaced multiple times during the practice lifespan. Therfore, they do not meet the material requirements for a permanent fence.

- Wire height will be set at two-thirds the height of the animal being contained for a single-wire fence.
- Energizer will have sufficient rating and grounding to meet the output requirements as designated in Section 5, Table 6, but will not require lightning protection.
- Polywire, polytape, and polybraid will contain at least six conducting wires.
- Wire (aluminum or galvanized) will be at least 14-gauge and can be standard or high tensile.
- Electric netting will meet the manufacturer's recommendations for the type/size of material needed to control the livestock type(s) listed.
- Single-post pull assemblies can be utilized as long as fence tension and height can be maintained for the duration of use.
- Insulators will meet requirements in Section 5, Table 6, based on application.
    - Extremely portable systems may only require an insulated gate handle on one end and the fence reel on the opposite end of the fence. This type of installation would not require terminating at an insulator.

4H. Offsets: An energized fence offset is utilized to improve livestock control or supply power to a temporary energized fence. An offset can be used to contain small ruminants within a barbed-wire fence (originally designed for cattle) or keep breeding livestock separated. An offset can also be used to extend the power supply (along an existing fence) from a mains (plug-in) energizer to far parts of a field or ranch.

- Materials used for offset installation will meet permanent energized fence requirements.
- Offset wires used for control purposes shall be placed at a height equal to two-thirds the height of the animal being controlled.
- Offset interval spacing along the fence will depend on the length of the offset. Offsets will maintain wire at a minimum of five inches away from non-energized wires, but ideally greater than ten inches. Maintain wire tautness of non-energized fence as well as the offset wire(s). Place offsets at intervals that do not allow the electric wire to sag or contact the non-energized fence.

5. Material Specifications and Drawings

Use materials in accordance with the requirements listed and that meet (or exceed) in size, strength, durability, and lifespan. The producer/cooperator/contractor is responsible for providing adequate documentation to ensure the material specifications are met.

5A. Wire and Enclosure Material: Use only new galvanized wire material, in accordance with criteria outlined in Table 3, that follows the American Society of Testing and Materials (ASTM) Standards as designated. Galvanization is critical for rust protection of the wire and different classes of galvanization provide different levels of protection. Most wire manufacturers include wire specifications on fence tags. If information is not provided or known, lab testing may be needed to determine the strength of the wire.

5B. Posts: Use the type, height, size, and spacing of posts that best meets the needs for the style of fence required and is best suited for the topography of the landscape. Minimum lengths will allow for required buried (setting) depth and fence height plus at least two inches of post above top wire. See Table 4 for post criteria, depending on the location or purpose of the fence construction.

5C. Compression Brace: The type, placement, size, and length of the compression brace will be used that best meets the needs for the style of fence required. See Table 5 for compression brace criteria.

5D. Miscellaneous Components: Various components are utilized in the construction of the fence. Use materials that best meet the needs for the style of the fence required. See Table 6 for miscellaneous component criteria.

Table 3. Wire and enclosure material requirements used in constructing fence. (NOTE: All material listed in Table 3 will be new, unless specifically stated otherwise.)

Fence Wire or Enclosure Material	Minimum Size	Minimum Protective Coating	Requirements and American Society for Testing and Materials (ASTM) Reference
Standard, single-strand, smooth wire	9 gauge	Class 1 galvanized	≥950 lbs breaking load (ASTM A121)
Standard, double-strand, barbed wire	12½ gauge	Class 1 galvanized (Class 3 for Special Area Fence)	≥950 lbs breaking load; barbs (2- or 4-point) are 14 gauge or heavier and placed on ≤ 5-inch centers. (ASTM A121)
Standard, double-strand, smooth wire	12½ gauge	Class 1 galvanized	≥950 lbs breaking load (ASTM A121)
Standard, woven wire	11 gauge for top and bottom wires; 14½ gauge for intermediate and stay wires	Class 1 zinc coating or equivalent	Minimum height of 32 inches. Maximum 12 inch spacing between stay wires for larger animals and horned goats, and 6 inch spacing for smaller animals. Woven wire must have a fence top deterrent. (ASTM A116)
Standard, mesh wire (no-climb)	10 gauge for top and bottom wires; 12½ gauge for intermediate and stay wires	Class 1 zinc coating or equivalent	Minimum of 36 inches high; ≤ 2-inch by 4-inch mesh spacing; smooth on both sides. Woven mesh wire must have a fence top deterrent. (ASTM A116)
High-tensile, single-strand, smooth wire	12½ gauge	Class 3 galvanized	≥170,000 PSI (ASTM A854)
High-tensile, double-strand, barbed wire	15½ gauge	Class 3 galvanized	≥950 lbs breaking load; barbs are a minimum of 14 gauge for 2-point or 16½ gauge for 4-point and placed on ≤ 5-inch centers. (ASTM - A121)
High-tensile, woven wire	14½ gauge	Class 3 galvanized	Minimum height of 32 inches; maximum 12 inch spacing between stay wires for larger animals and horned goats and 6 inch spacing for smaller animals; woven wire must have a fence top deterrent. (ASTM A116)
Confined Feeding Area - horizontal pipe cross members	1½-inch Nominal (1.90" Outside Diameter) Schedule 40 (2.72 lb/ft)	None required, but painting or galvanizing for protection is recommended.	Steel pipe that is new (or used) and round. Used pipe must be of good quality and free of pitting. Pipe must conform to the requirements of ASTM A53.
Subcomponent - fence panels	4 gauge	Galvanized	Manufactured panels of appropriate height can be utilized to complete fence sections as subcomponent.
Subcomponent - continuous fencing	1½-inch Outside Diameter 14 gauge	None required, but painting or galvanizing for protection is recommended.	Material supplied as "continuous fence" (offered in round or square tubing) can be utilized if appropriate height and minimum number of wires/cross members meets other requirements.

Table 4. Post material requirements used in constructing fence.

Fence Item	Post Type	Material	Installation	Minimum Diameter / Weight	Mininum Setting Depth	Notes
Brace Assembly Post (Corner, End, In-Line, or Inside)	Wood	Osage orange (hedge)[1] or treated[2] post that is new (never been used), round, free of splintering and decay, and sound overall.	Driven or Set in Earth	5-inch top diameter[3]	3 feet 6 inches (42")	Requires a horizontal wood or steel compression brace member as part of the assembly.
	Steel	Steel pipe[4] that is new (or used), round, and permanently capped or enclosed on top. Used pipe must be good quality and free of pitting.	Set in Earth or Set in Concrete	3-inch Nominal (3.5" Outside Diameter) Schedule 40 (7.58 lb/ft)	3 feet 6 inches (42")	Requires a horizontal or angled steel compression brace member as part of the assembly.
			Driven	4-inch Nominal (4.5" Outside Diameter) Schedule 40 (10.79 lb/ft)		
	Rock Crib	Woven wire or cattle panel (≥ 48" height) that is new, formed into a cylinder, and filled with available rock.	Set on Level Earth/Rock	Crib diameter: ≥ 48 inches Crib height: ≥ 48 inches Rock must be of sufficient size to stay within crib.	Not Applicable	Refer to the special section on rock crib for additional details of materials and installation.
Line Post (all but confined feeding)	Wood	Osage orange (hedge)[1] or treated[2] post that is new (never been used), round, free of splintering and decay, and sound overall.	Set in Earth	3-inch top diameter[3]	Soil Type Rocky - 18" Sandy - 30" All Other - 24"	Utilize appropriate insulator when installed for energized fence.
			Driven	4-inch top diameter[3]		
	Steel	Steel pipe[4] that is new (or used), round, and capped or enclosed on top. Used pipe must be good quality and free of pitting.	Set in Earth, Set in Concrete, or Driven	2-inch Nominal (2.375" Outside Diameter) Schedule 40 (3.65 lb/ft)	Soil Type Rocky - 18" Sandy - 30" All Other - 24"	Utilize appropriate insulator when installed for energized fence. Special fittings may be needed to properly attach insulators to round pipe posts.
		Standard “T” or “U” that is new, high carbon steel, galvanized, enameled and baked, or painted with weather resistant steel paint. Will have an anchor plate and be studded, embossed, or punched for wire attachment.	Driven	1.33 pounds per foot of length, exclusive of anchor plate (Conform to the requirements of ASTM A702)	Anchor plate must be fully into and below ground surface (Approx. 15-18 inches).	Utilize appropriate insulator when installed for energized fence.
Line Post (energized only)	Fiberglass	Round post that is new, has protection from splintering & UV, and meets or exceeds the requirements provided by energizer manufacturer.	Driven	3/8-inch diameter	18 inches or manufacturer recommended depth, whichever is deeper.	Fiberglass is a composite of marble fiberglass and polymer resin treated by thermosetting.
	Rigid PVC	"T" post that is new, has protection from splintering & UV, and meets or exceeds the requirements provided by energizer manufacturer.	Driven	1½-inch cross section	18 inches or manufacturer recommended depth, whichever is deeper.	Rigid PVC (example is a Plastic Innovations product for Timeless Fence Systems).
	Composite	Round post that is new, has protection from splintering & UV, and meets or exceeds the requirements provided by energizer manufacturer.	Driven	1-inch diameter	18 inches or manufacturer recommended depth, whichever is deeper.	Composite of polypropylene and wood.
Line Post (confined feeding)	Steel	Steel pipe[4] that is new or used, round, and capped or enclosed on top. Used pipe must be good quality and free of pitting.	Set in Earth or Set in Concrete	2½-inch Nominal (2.875" Outside Diameter) Schedule 40 (5.79 lb/ft)	3 feet (36 inches)	Post sizes listed in Brace Assembly section can also be utilized for confined feeding line posts.

1 Posts will be reasonably straight with limbs trimmed flush or nearly flush with the body of the post.

2 Except for Osage orange, all wood posts shall be treated with a preservative which is approved by either Federal Specification TT-W-571 or the American Wood Preservers Association (AWPA).

3 Measurement assumes top diameter of the post is the smallest diameter along the post. Entire post length must meet minimum diameter listed.

4 Pipe must conform to the requirements of American Society for Testing and Materials (ASTM) A53 except that the A53 requirements for hydrostatic test will not apply. Pipe is referenced by nominal and outside diameter (OD) sizes. Ensure communication of pipe sizing on the implementation requirements is clear. Painting or galvanizing for protection is recommended, but not required.

Table 5. Compression brace material requirements used in constructing fence.

Compression Brace Material	Assembly Placement	Assembly Type	Minimum Diameter / Weight	Length	Notes
Osage orange (hedge)[1] or treated[2] post that is new (never been used), round, free of splintering and decay, and sound overall.	Horizontal	Wood Post Only	3-inch diameter	Minimum 7 ft. Maximum 11 ft.	Must be secured by notching, steel rod[3], and brace/tension wires.
Steel angle iron[4] that is new.	Horizontal	Wood or Steel Post	2½-inch x 2½-inch x ¼-inch (4.1 lb/ft)	Minimum 7 ft. Maximum 11 ft.	Must be secured by notching, steel rod[3], and brace/tension wires for wood OR by welding for steel.
Steel pipe[5] that is new or used, straight, and round. Used pipe must be of good quality and free of pitting.	Horizontal	Wood or Steel Post	1½-inch Nominal (1.90" Outside Diameter) Schedule 40 (2.72 lb/ft)	Minimum 7 ft. Maximum 11 ft.	Must be secured by notching, steel rod[3], and brace/tension wires for wood OR by welding for steel.
	Angled	Steel Post Only	2-inch Nominal (2.375" Outside Diameter) Schedule 40 (3.65 lb/ft)	Minimum length to reach posts at proper heights (posts set between 7 ft. and 11 ft. apart).	Must be secured by welding. Length will be determined by distance between steel posts and placement height on each post.

1 Posts will be reasonably straight with limbs trimmed flush or nearly flush with the body of the post.

2 Except for Osage orange, all wood posts shall be treated with a preservative which is approved by either Federal Specification TT-W-571 or the American Wood Preservers Association (AWPA).

3 Attach brace member using a 3/8-inch diameter steel rod (4 inches long) set 2 inches into each post of the brace assembly with the hole drilled as close to the rod diameter as possible.

4 Angle iron must meet standard weight as per American Society for Testing and Materials (ASTM) A36. Painting or galvanizing for protection is recommended, but not required.

5 Pipe must conform to the requirements of ASTM A53 except that the A53 requirements for hydrostatic test will not apply. Pipe is referenced by nominal and outside diameter (OD) sizes. Ensure communication of pipe sizing on the implementation requirements is clear. Painting or galvanizing for protection is recommended, but not required.

Table 6. Miscellaneous component requirements used in constructing fence. (NOTE: All material listed in Table 6 will be new.)

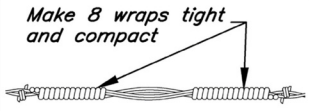
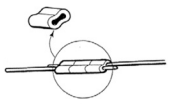
Fence Component	Minimum Size and/or Quality	Details
Tension/Brace Wire (Woody Brace Assembly)	9 gauge - Class 1 galvanized	Standard (low carbon) single-strand smooth wire. Two complete loops are required.
	12½ gauge - Class 1 galvanized	Standard (low carbon) double-strand barbed or barbless wire. Two complete loops are required.
	12½ gauge - Class 3 galvanized	High Tensile (≥170,000 PSI). One complete loop and tightened with a ratchet-style strainer/tightener is required.
Twist Rod (Twist Stick)	½" diameter steel rod or 1" diameter wood stick being 18" to 24" long	Utilized to twist the tension/brace wire for proper rigidity of the assembly and will remain in place approximately midway along the brace wire.
Staples (wood post)	9 gauge - Galvanized	1½" minimum length for softwoods 1" minimum length for hardwoods
Manufactured Clips (t-post or fiberglass)	Galvanized	Utilize manufactured clips (often provided when purchasing the posts) that are appropriately sized for the post. Stainless steel clips can also be utilized.
Standard Wire (Tying)	12½ gauge - Galvanized	Can be used on all line posts in lieu of manufactured wire clips or staples. Placing the line wire in a groove cut no deeper than one-quarter inch into wood posts then wiring the line wire to the post will prevent wire slippage up and down the post.
Stays	9½ gauge galvanized wire (one-piece, twist-on design)	Length of stays are fence height plus two inches and installed so that stays swing free of the ground and allow fence to move when touched by animal. Use only with non-energized fence.
	Minimum 1" diameter or cross section made of UV-protected fiberglass, rigid PVC, high-density polyethylene, or wood-plastic composite.	Length of stays are the fence height plus two inches and installed so that the stays swing free of the ground and allow the fence to move when touched by the animal(s).
Energizer	High power, low impedance, with a minimum of 5,000 volt peak output and a pulse that is less than 300 milliamps (mAmps) in intensity, finished within 0.0003 of a second, and at a rate of 35 to 65 pulses per minute.	● Solid state circuitry and high impact weather resistant case. ● Safety pace fuse to prevent over pulsing. ● Joule rating high enough to provide a minimum shock at the farthest point as follows: Cattle—1,600 volts Sheep and hair goats—2,000 volts Horses, hogs, and meat goats—1,200 volts ● Chargers are properly grounded and protected from lightning according to energizer manufacturer recommendations.
Insulators (Line Posts)	Meet or exceed energizer manufacturer's recommendations.	Porcelain, ceramic, high quality ultraviolet (UV) stabilized polyethylene, or equivalent, insulators will be used on wood and steel posts.
Insulators (Anchor/Corner/ Pull Posts)	Meet or exceed energizer manufacturer's recommendations.	Only porcelain, UV stabilized high density polyethylene (HDPE), or high density polyproylene (HDPP) insulators may be used at tension points along the fence.
Strainer (Tightener) 	In-line ratchet-type design being galvanized, zinc-coated, or stainless steel.	Will be placed near the center of the length of pull in the fence line (halfway between brace assemblies) to achieve equal tension on both ends of the wire. Also utilized to tighten tension/brace wire when high-tensile wire is used.
Wire Splice - Western Union (Standard Wire)		The Western Union splice will have a minimum of eight wraps on each side of the center that are tightly wound and closely spaced.
Wire Splice - Compression Fittings or Splice Sleeves (Standard or High Tensile Wire)	Fittings or sleeves will have tensile strength not less than 100 percent of the wire tensile strength.	Ends of the wire will be overlapped at least two inches with two sleeves (or number recommended by manufacturer) fitted over wires and firmly crimped. 

Figure 8. Barbed Wire Fence Drawing (NOTE: References to galvanization may not apply to all installations. Refer to implementation requirements.)

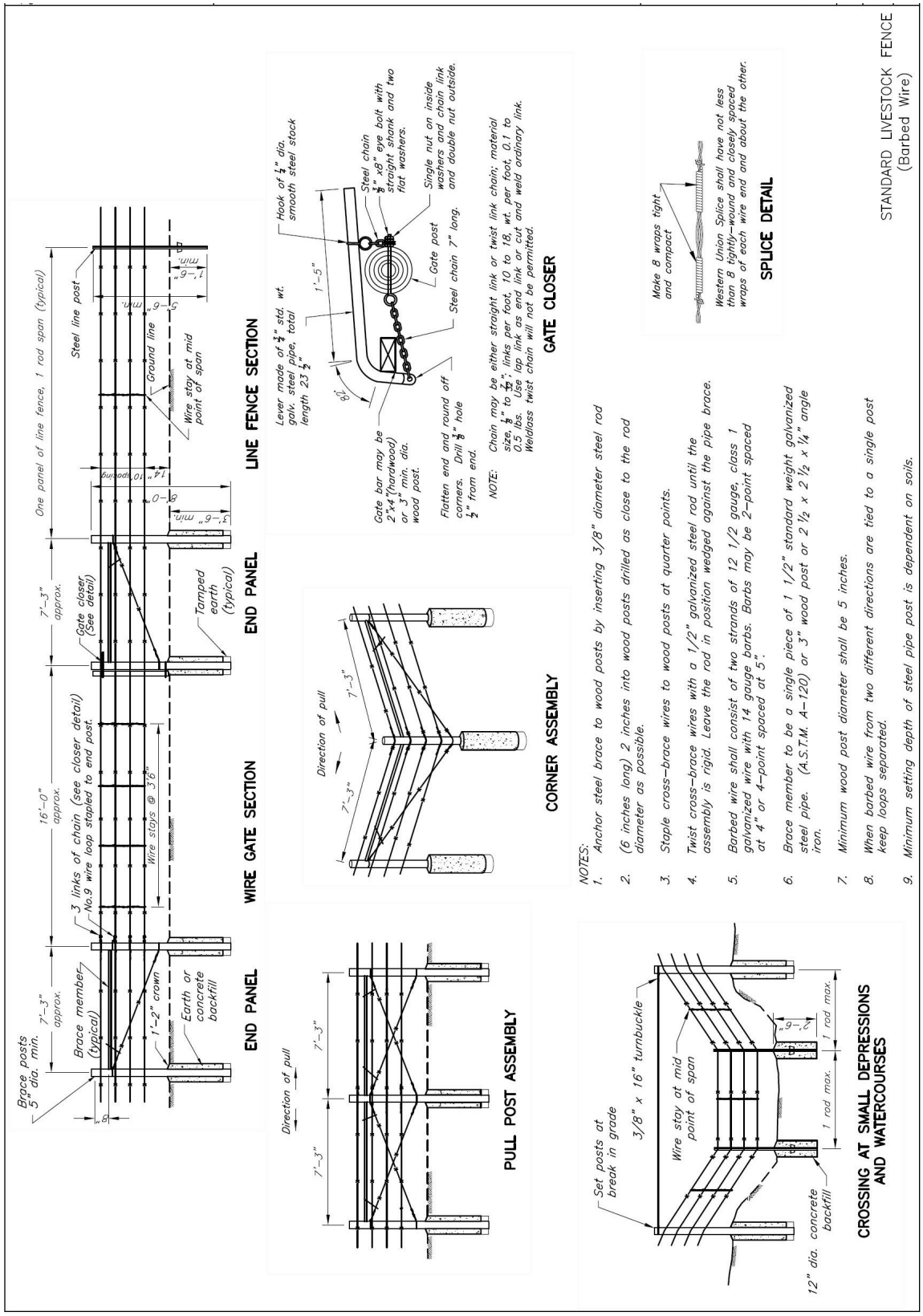


Figure 9. Energized Fence Drawing

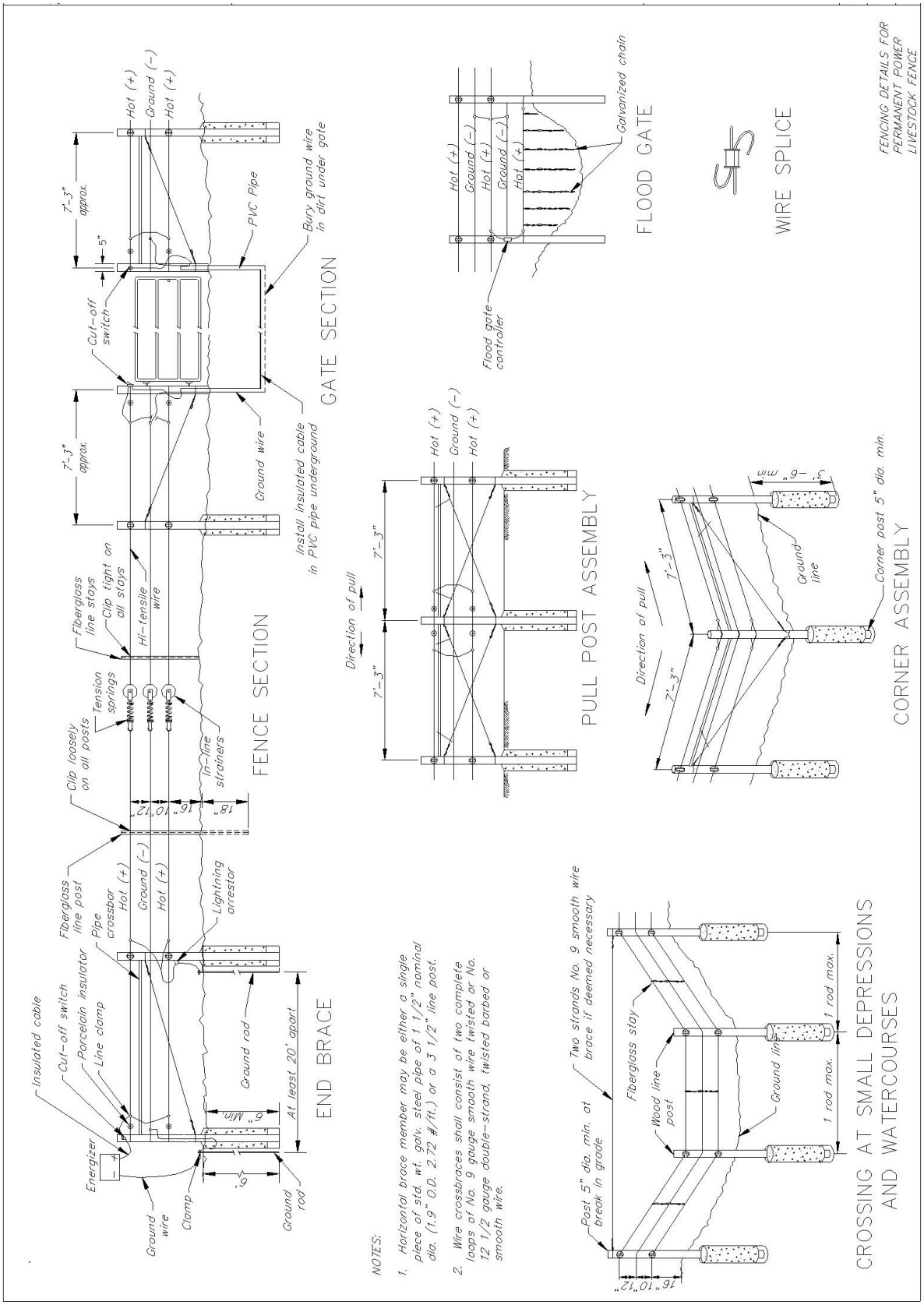
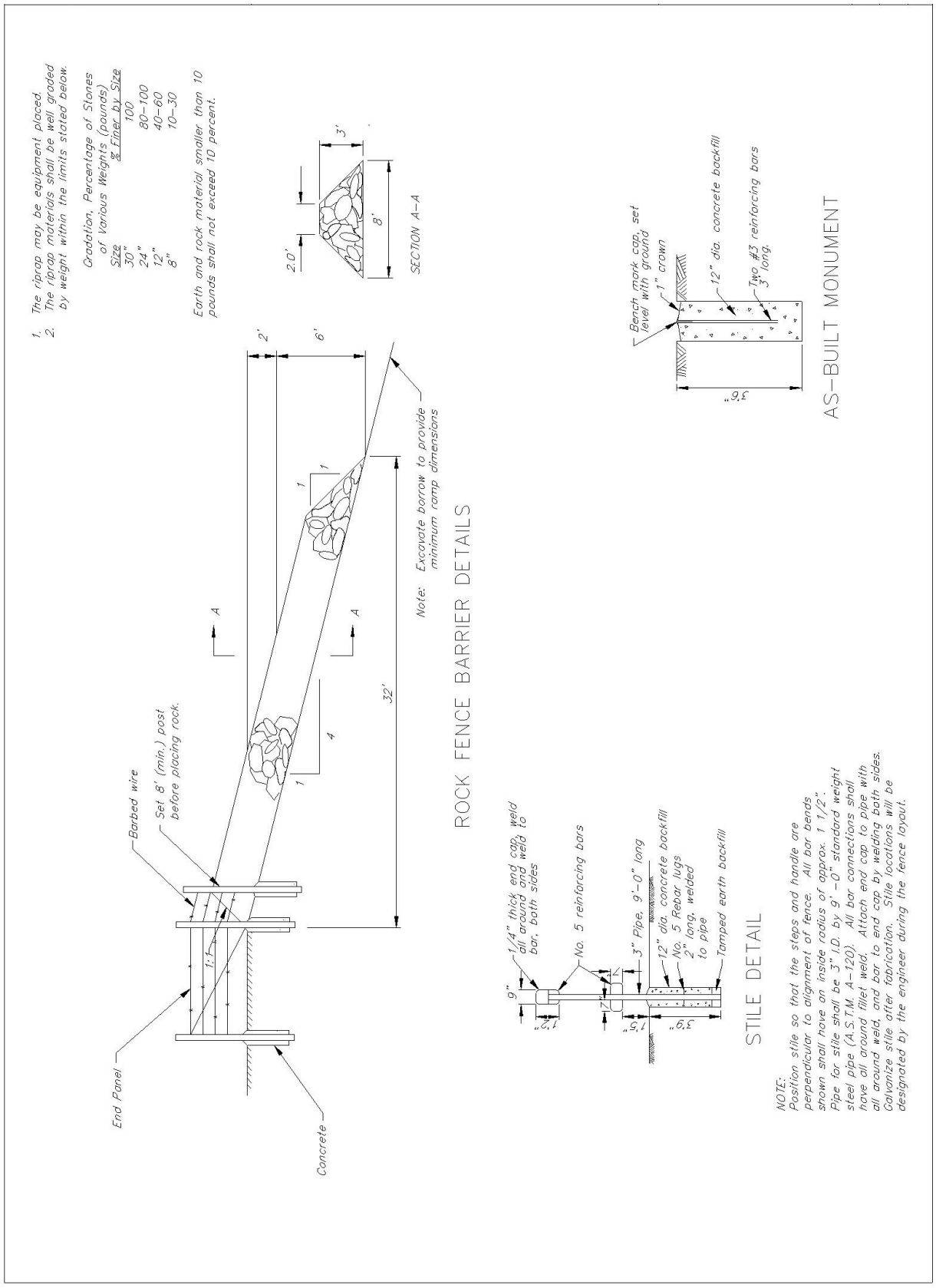


Figure 10. Rock Barrier Stub Fence Drawing



6. References

Planning Fences, American Association for Vocational Instructional Materials, Third Printing, 1997.

Building Fences, American Association for Vocational Instructional Materials, 1974.

Planning and Building Fences on the Farm, University of Tennessee, Agricultural Extension Service, PB1541.

Fence Brace Assemblies, Circular 792, Institute of Food and Agriculture Sciences, Rev. 1992.

ASTM Standard A53, A116, A121, and A854, American Society of Testing and Materials.

Fences, USDA Forestry Service Handbook, February 1999.

Engineering Material Specifications 523, Rock for Riprap, National Engineering Handbook, Part 642, Specifications for Construction Contracting.

Paige, C. 2012. *A Landowner's Guide to Wildlife Friendly Fences*. Second Edition. Private Land Technical Assistance Program, Montana Fish, Wildlife & Parks, Helena, Montana. 56 pp.

7. Specific Site Requirements