

## CONSTRUCTION SPECIFICATION

### FENCE

(Ft.)

#### CODE 382

#### 1. SCOPE

The work shall consist of furnishing materials and installing all components of the fence as outlined in this specification and the drawings.

There are many different types and purposes for fences. While this specification includes details for livestock fence, other types of fence may be used to control wildlife. It is generally recommended that a deer exclusion fence be between 5 and 8 feet high (depending on the design of the fence) in order to be effective. See the references section of this specification for more information concerning exclusion fences for deer and other wildlife. Other types of fences may be applicable for other purposes

#### 2. MATERIALS

Fencing materials shall be new, of high quality and durability, and constructed to meet the intended purpose of the practice. Use of high quality serviceable materials that are not new requires prior approval by *the NRCS State Grassland Specialist*. *Landscape timbers are not acceptable materials for fence posts, battens, or braces.*

Any materials or construction features that exceed these specifications, or have equivalent or greater effectiveness as specified by the manufacturer, may be acceptable for meeting the requirements of this specification. *Before using alternative materials or installation methods not specifically described in this specification, contact the NRCS State Grassland Specialist for approval.* Consider the practice life span of the fence when using alternative materials and installation methods.

The following Exhibits in this specification provide specific information for various types of livestock fences:

Exhibit 1 - Fence Type by Species for **Critical Confinement/Exclusion**; page 5 and 6

Exhibit 2 – Fence Type by Species for **Non-Critical Confinement/Exclusion**; page 7

Exhibit 3 – **Non-Electric** High Tensile Smooth Wire, Woven Wire, and Barbed Wire Fences for Critical Confinement/Exclusion; page 8, 9, 10, and 11

Exhibit 4 – **Wooden Board Fence** for Critical Confinement/Exclusion; page 12

Exhibit 5 – **Chain Link Fence** for Hazardous confinement/exclusion; page 13

Exhibit 6 – **Electric** High Tensile for Critical Confinement/Exclusion Fences and Non-Critical Confinement/Exclusion (or Divisional) Fences; page 14, 15, and 16

Exhibit 7 – **Electroplastic** Twine (Polywire) and Electrified Ribbon for Non-Critical Confinement/Exclusion (or Divisional) Fences; page 17

Exhibit 8 – **Summary of Fence Types** and Selected Materials; page 18, 19, and 20

Exhibit 9 – **Fence Curve Construction**, is an illustration for installing fences that deviate from a straight line.

Exhibits 1 and 2 are to be used to determine the types of fences, fence heights, and wire spacings that are recommended for controlling specific types of livestock. Exhibits 3 to 7 are to be used for additional criteria for each type of fence. Exhibit 8 is a brief summary of some of the major components and installation requirements for each fence type.

Fences are categorized based on the degree of protection provided for the intended use, as follows:

1. **Critical confinement/exclusion fences:**  
Are used in areas where a high level of confinement or exclusion is needed. Fences along property lines, near roads, or adjacent to environmentally sensitive areas are included in this category. Exhibit 1 provides a selected list of recommended fence types for various types of livestock. Details and criteria for these are included in the additional conditions and/or drawings. Others not

shown must be reviewed and approved in advance by the Engineer.

2. **Non-critical confinement/exclusion fences:** Can be used in areas where a lower level of confinement or exclusion is acceptable. Divisional fences in pastures (either permanently installed or moveable), streambank fencing, alleyways, and other light-duty fences are included in this category. Exhibit 2 provides recommendations for non-critical confinement electric fences for various types of livestock. Other types of non-critical confinement/exclusion fences may also be appropriate, but must be approved in advance by the Engineer.
3. **Hazardous confinement/exclusion fences:** Are used for a high level of exclusion of small children and animals. These are required on Waste Storage Facilities, non-grated openings around Manure Transfer Systems, and on Heavy Use Areas adjacent to waste storage facilities or adjacent to vertical drops. These fences will be at least 4' high, limit the spacing of the posts to 8', limit the distance between horizontal members to 4" unless the horizontal distance is 6" or less then the spacing can go up to 6". This applies to gates at pushoffs. This is common for fencing on Heavy Use Areas. Examples include pipe, guiderail, and cable fence. Other types of fences may also be appropriate. Details and criteria are included in the additional conditions and /or drawings. Others not shown must be reviewed and approved in advance by the Engineer.

The criteria listed in this specification for size, gauge, amount, weight or type of materials for each fence type, and the post seating depths shall be regarded as minimums, unless otherwise specified by the fence manufacturer. Post spacing and wire spacing shall be regarded as maximums, unless otherwise specified by the fence manufacturer. Refer to Exhibits 3 to 6, which describe the materials requirements for specific types of fences.

**Fence Posts** – A post is a linear piece of wood, steel, or other material set upright in the ground to serve as support for the fence material. For each type of fence, criteria are established for line, corner, end,

gate, and brace post, as applicable. Posts are defined as follows:

1. **Line posts** – Primarily support the fence material, and are not under significant tension. One or more line posts are set between the corner, end, gate, and brace posts;
2. **Corner, end, gate, and brace posts** – These posts support the fence material, and are also under tension from the pull of the fence. They are usually larger in diameter and are set deeper in the ground than line posts.
3. **Horizontal brace rails** – These posts are set horizontally between end, corner, or gate post and the brace post.

**Battens** – Battens are narrow, slotted strips of poly or fiberglass that are used as wire spacers to keep strands apart in high tensile smooth wire or barbed wire fences. Battens are supported by the fence wires using clips to attach the wire to the battens and are not set in the ground.

**Access Gates** – Install gates at locations suitable for providing controlled access. Select gates of appropriate size and materials for the specific fencing system. Install prefabricated gates according to the manufacturer's instructions. Use properly installed undergrounds to carry electric charge under a gate if using electric fence.

**Flood Gates** – Where a fence crosses a stream at a livestock crossing, install a flood gate (or water gap section) across the stream as needed to keep livestock within the fenced area. Construct the flood gate so as to minimize debris buildup and prevent structural damage to the fence during flooding events

**Grounding Rods** – Nonelectrical fences shall be grounded to protect livestock from lighting strikes. Electrical fences shall have the electrical fence charger grounded as per manufacturers recommendations. Lighting arrestors on electrical fences shall also be grounded, all as per manufacturer's recommendations.

**Electrical Fence Chargers** – Electrical fence chargers provide an electrical charge to control livestock. Electrical chargers are usually rated in joules. The greater the joules the greater amount of fence can be charged. Electric fence chargers may be AC powered, battery powered, or solar powered with battery backups.

**Insulators** – Electric fence will need insulators. They shall be UV stabilized (plastic) high density

polypropylene, on ends and corners use high strain tube insulators or high strain porcelain corner insulators.

**Fasteners and Hardware**- All hardware that touches the fence post and/ or wire shall be galvanized.

### 3. INSTALLATION

#### **Preparation**

Once the fence location is determined in the field clear all trees, brush and mow as needed to install the fence

#### **Fence Alignment**

Construction shall be as straight as practicable between corners or turns. Construct fences along curved lines by using straight segments with posts adjusted closer together or install brace assemblies to facilitate the bends.

#### **Posts**

Set posts in the ground by driving, augering, or hand digging. Backfill material shall be hand tamped in 6-inch lifts. Posts need to be set below the frost line to prevent heaving. For corner and end posts, and line posts on curves, install posts approximately 2 inches off vertical (leaning away from the direction of pull). In extremely wet or very sandy soils, and in cases where posts cannot be set to the specified depth, the posts of permanently installed fences must be set in concrete to secure them. *In all cases, posts must be set firmly so that they cannot be moved horizontally or vertically by hand.*

#### **Grounding Rods**

For electrical fence chargers ground rods shall be at least ten feet apart and at least 50 feet from other existing grounding systems. Avoid water pipes or buildings where the electrical charge may affect livestock or people. Install the proper number of grounding rods as per manufacturers recommendations.

#### **Electrical Fence Chargers**

The electrical fence charger shall be low impedance, high voltage, and shall be installed as per manufacturer's recommendations. No constant current chargers shall be used. The electrical fence charger shall have proper surge protection and lightning protection as per manufacturer's recommendations. Electric fence warning signs shall be installed every 300 feet where the public has access to the fence. Size the charger for the miles of

fence and the livestock that it needs to control following manufacturer's recommendations.

#### **Undergrounds and Electrical Connections**

Undergrounds shall be installed using insulated wire of the same size and material as the fences it is connecting. Place the insulated wire inside plastic water pipe to protect it from damage by livestock and equipment before burying at a minimum depth of 6 inches.

Electrical connections shall be made by using crimping sleeves, split bolt connectors, or proper hand tied knots. Follow manufacturers recommendations.

#### **Streams/Water courses**

For streams or water crossings where the depth of the stream is less than 1/3 the height of the fence, the fence may run uninterrupted. For streams of greater depth, end the main fence at the top of the streambank on each side with an appropriate brace end assembly. From separate end brace assemblies construct a separate section of fence that will run at 90 degree angles to the stream to cross the watercourse that shall be de-energized during high flow or flooding conditions. The only tie between the main fence and the section spanning the watercourse shall be a single electrical connection.

#### **Waste Storage Facilities, Waste Transfer, and Heavy Use Areas**

Install at location shown on drawings and construct as per details provided under the additional conditions and /or drawings.

#### **Re-vegetation**

Vegetated areas that were disturbed during fence construction shall be replanted as needed. Based on land use and site conditions, use one of the following Pennsylvania NRCS conservation practice standards to specify the appropriate grasses or other vegetation: Conservation Cover (Code 327), Critical Area Planting (Code 342), or Pasture and Hay Planting (Code 512).

### REFERENCES

American Association for Vocational Materials 1980. *Planning Fences*. Second Edition. Winterville, Georgia.

Craven, Scott R., and Scott E. Hygnstrom, 1994. *Deer Damage Prevention and Control*. Contained in the series: *Prevention and Control of Wildlife Damage*, issued by University of Nebraska Cooperative Extension, Great Plains Agricultural Council, and USDA-APHIS.

<http://www.ces.ncsu.edu/nreos/wild/pdf/wildlife/deep.pdf>

Gallagher, W.M. 2005. *Gallagher Power Fence Systems Manual*. 12<sup>th</sup> Edition. New Zealand.

Knapp, J.W. 1980. *How to Build Fences with Max-Ten 200 High-Tensile Fence Wire*. USSC Pittsburgh, PA.

Kencove Farm Fence Inc. *Kencove Farm Fence Supplies 2008*.

[www.kencove.com](http://www.kencove.com)

*Pennsylvania Engineering Field Manual Chapter 5 Standard Detail Drawings*

#### **4. ADDITIONAL CONDITIONS**

**EXHIBIT 1: Fence Type by Species for *Critical Confinement/Exclusion*<sup>1/</sup>**

Type of Livestock	Type of Fence	Non-Electric High Tensile Smooth Wire	Woven Wire	Barbed Wire	Wooden Board (minimum 4 inch wide boards)	Electric High Tensile Smooth Wire
Equine and Foals	Special considerations for visibility should be taken when using high tensile fence. Plastic coated wire or rail products can be used. Minimum 4 strands spaced 20, 30, 42 and 54 inches above the ground. Adjust spacing for small or large Equine.	Minimum of 48 inches high – Max. opening 3 ½ inches x 3 inches on first 18". Verticals, minimum 3 inches apart on entire height. Install at least one additional electrified smooth wire at the top. Alternatively, a wooden rail (board) or a plastic coated product may be added at the top of the woven wire to prevent Equine from stretching the fence.	Not recommended.	Minimum of 3 and a maximum of 4 boards. Boards spaced on 16-inch centers; bottom board at approximately 16 inches above the ground.  3-board fence – top board at 48 inches above the ground.  4-board fence – top board at 64 inches above the ground.	Special considerations for visibility should be taken when using high tensile fence. Plastic coated wire or rail products can be used. Equine (no foals) – Minimum 3 strands spaced 30(+) <sup>3/</sup> , 40(+), 50(+) above the ground. Equine with foals – Minimum 5 strands spaced 10, 20(+), 30(+), 40, 50(+) above ground.	
Beef – Steers, Cows and Calves	Minimum of 7 strands spaced at 9, 14, 19, 25, 31, 38 and 46 inches above the ground.	Minimum of 48 inches high – 5 horizontal wires woven, plus at least one additional wire (either barbed or electrified smooth) at the top. Put the first additional wire, if barbed, no more than 3 inches above the top of the woven wire.	Minimum of 3 stands spaced at 10 to 17 inches, 20 to 27 inches, and 32 to 38 inches above the ground.	Minimum of 3 and a maximum of 4 boards. 3-board fence – top board at 48 inches above the ground. Boards spaced on 16-inch center; bottom board at approximately 16 inches above the ground. 4-board fence – top board at 56 inches above the ground. Boards spaced on 14-inch center; bottom board at approximately 14 inches above the ground.	Minimum of 3 strands – spaced at 18(+), 30(+), and 42(+) inches above the ground.  Or a minimum of 4 strands (only 2 electrified) – spaced at 10, 22(+), 34(+), and 46 inches above the ground.	
Dairy Cows and Heifers	Minimum of 7 strands spaced at 9, 14, 19, 25, 31, 38 and 46 inches above the ground.	Minimum of 48 inches high 5 horizontal wires woven plus at least one additional wire (either barbed or electrified smooth) at the top. Put the first additional wire, if barbed, no more than 3 inches above the top of the woven wire.	Minimum of 3 strands spaced at 10 to 17 inches, 20 to 27 inches, and 32 to 38 inches above the ground.	Minimum of 3 and a maximum of 4 boards. 3-board fence – top board at 48 inches above the ground. Boards spaced on 16-inch center; bottom board at approximately 16 inches above the ground. 4-board fence – top board at 56 inches above the ground. Boards spaced on 14-inch center; bottom board at approximately 14 inches above the ground.	Dairy Cows only – Minimum 2 strands (2 electrified), spaced at 20(+) and 34(+) inches above the ground.  With Heifers – Minimum of 3 strands (2 electrified), spaced at 18, 30(+) and 42(+) inches above the ground.	

<b>EXHIBIT 1: Fence Type by Species for <i>Critical Confinement/Exclusion</i><sup>1/</sup></b>					
Type of Livestock	Non-Electric High Tensile Smooth Wire	Woven Wire	Barbed Wire	Wooden Board (minimum 4 inch wide boards)	Electric High Tensile Smooth Wire
Goats and Kids	See Note 2, below.	Minimum of 36 inches high – 5 horizontal wires woven, plus one additional electrified smooth wire as an offset 5 inches from the inside of the fence at a height of 12-18 inches above the ground.	Not recommended.	Not recommended	Minimum of 5 strands all are electrified – spaced at 6(+), 12(+), 20(+), 28(+) and 36(+) inches above the ground.
Sheep and Lambs	See Note 2, below.	Minimum of 40 inches high – 5 horizontal wires woven, plus one additional electrified smooth wire as an offset 5 inches from the inside of the fence at a height of 12-18 inches above the ground.	Not recommended.	Not recommended.	Minimum of 5 strands (at least 2 electrified) – spaced at 6, 12(+), 20(+), 28 and 36 inches above the ground. Or a minimum of 4 strands, if all are electrified – spaced at 6(+), 13(+), 23(+), 35(+) inches above the ground.
Hogs	Not recommended.	Minimum of 35 inches high – 5 horizontal wire woven, plus one additional wire (either barbed or electrified smooth) at 8 inches above the ground.	Not recommended.	Not recommended.	Minimum of 5 strands (at least 2 electrified) – spaced at 6, 12(+), 20(+), 28 and 36 inches above the ground.

## EXHIBIT 1 NOTES:

<sup>1/</sup> Based on the type of livestock use the information in this table only as a guide to determine the number of strands and spacing. Adjustments to the number of strands and spacing may be made based on the fence manufacturer's recommendations and landowner preference for critical confinement/exclusion fences.

<sup>2/</sup> Non-electric high tensile fence is not recommended for these animals unless: (a) there are electric fences elsewhere on the farm and, as a result, the animals are trained to avoid wire fences, or (b) the fence will be used for non-critical confinement/exclusion.

<sup>3/</sup> (+) indicates wire is electrified.

<b>EXHIBIT 2: Fence Type by Species for <u>Non-Critical Confinement/Exclusion</u></b>	
<b>Type of Livestock</b>	<b>Recommended Number of Strands and Spacing <sup>1/</sup></b>
Mature Equine	Minimum of 1 strand – spaced at 28 to 34 inches above the ground. Consider fence visibility.
Equine and Foals	Minimum of 2 strands – spaced at 17 to 22 inches, and 32 to 38 inches above the ground. Consider fence visibility.
Cows and Calves	Minimum of 2 strands – spaced at 17 to 22 inches, and 32 to 38 inches above the ground.
Mature Beef and Dairy Cattle	Minimum of 1 strand – spaced at 28 to 34 inches above the ground. For hard to hold animals, use: Minimum of 3 strands – spaced at 10 to 17 inches, 20 to 27 inches, and 32 to 38 inches above the ground.
Goats and Kids	Minimum of 2 strands – spaced at 14 inches and 30 inches above the ground. For kids and stream bank fencing, an additional wire may be needed and the bottom wire should be set at 7, 14 and 30 inches above the ground.
Sheep and Lambs	Minimum of 2 strands – spaced at 14 inches and 30 inches above the ground. Minimum of 4 strands for lambs and stream bank fencing – spaced at 7, 14, 21, and 30 inches above the ground with the 21 inch high strand being non-electric.
Hogs	Minimum of 2 strands – spaced at 10 inches and 18 inches above the ground for sows and growing-finishing pigs, or spaced at 6 inches and 18 inches above the ground for nursing pigs.

## EXHIBIT 2 NOTE:

<sup>1/</sup> Electric fence materials for non-critical confinement may consist of high tensile smooth wire, plastic coated wire, electroplastic twine (polywire), electrified ribbon, or other materials as specified by the manufacturer. Electrification of barbed wire is not recommended. Based on the type of livestock, use the information in this table as a guide to determine the number of strands and spacing. Adjustments to the number of strands and spacing may be made based on the fence manufacturer's recommendations and landowner preference for non-critical confinement/exclusion fences.

**EXHIBIT 3: *Non-Electric* High Tensile Smooth Wire, Woven Wire, and Barbed Wire Fences for Critical Confinement/Exclusion**

Non-electric high tensile smooth wire, woven wire, and barbed wire fences are suitable for applications where a high level of confinement is needed, such as near roads and on property lines.

**Wire** – All wire shall be new ASTM Class 3 galvanized. For optimum strength of fencing, attach the wire to the side of the fence that will receive the greatest pressure from animals. Place wire on the outside of posts on curves and corners. The type of wire, number of wires, spacing, and minimum height of fence is based on the type of livestock to be confined. See Exhibit 1 for details. Fence wire shall consist of one of the following materials:

1. **High tensile smooth** – Wires shall be 12 ½ gauge minimum with at least 200,000 PSI tensile strength and at least 1,540 pounds breaking strength. Tension shall be set with in-line wire strainers and/or tension indicator springs at 250 pounds. Tension springs shall be full-strength Class 3 galvanized springs. Tension springs are recommended for use in the top one to two strands in areas where the fence is near trees or where animal pressure will be heavy. Tension springs may also be used for all strands. Wrap and twist wires or use crimping sleeves on end and gate posts. In flood prone areas, use no more than six strands of non-electrified high tensile wire. There is a greater possibility of flood damage if more strands are used.
2. **Woven wire** – Woven wire shall have a minimum 12 ½ gauge top and bottom wire with minimum 12 ½ gauge wire in between. High tensile woven wire may be used. Install the fencing so that the bottom wire is at ground level to exclude predators. If predators are not a concern, the bottom wire can be installed at 3 inches above ground level to facilitate maintenance. Add at least one additional wire (either barbed or electrified smooth) above the top of the woven wire. The first additional wire, if barbed, shall be no more than 3 inches above the top of the woven wire. This reduces the possibility that livestock will put their heads through the gap and push down on the woven wire fence. Woven wire is not recommended for use in flood prone areas.
3. **Barbed wire** – Standard barbed wire shall be double-strand, a minimum 12 ½ gauge with 4-point barbs spaced no more than 6 inches apart, or 15 ½ gauge for high tensile barbed wire. Barbed wire may be used in flood prone areas, but it is more subject to flood damage than high tensile smooth wire fence. Barbed wire shall not be used for Equine, goats, sheep, and hogs.

**EXHIBIT 3: *Non-Electric* High Tensile Smooth Wire, Woven Wire, and Barbed Wire Fences for Critical Confinement/Exclusion**

**Line Posts** – Shall be either wooden or steel, and shall meet the following criteria for type of material, size, and spacing:

1. **Wooden Post** – Shall be well seasoned or kiln-dried to minimize warping. Use untreated durable disease free posts of species such as southern yellow pine, red cedar, black locust or osage-orange with bark removed, or non-durable wood that is preservative pressure treated. Do not use red pine, landscape timbers, or peeler cores. Treated limber shall be treated with a minimum retention of 0.40 lbs./cubic foot chromated copper arsenate (CCA), type A, B, or C, or equivalent non-CCA treatment. Wooden line posts shall be at least 4 inches in diameter, or 4 inches square. Posts shall be of sufficient length to accommodate the minimum fence height and long enough for a minimum depth of 2 ½ feet driven in the ground. When set in depressions or low places, line posts shall be anchored in the ground or set at an angle to prevent lifting or longer posts may be needed. Where posts cannot be set to the specified depth, they must be set in concrete to secure them. Set posts in a hole that is at least 12 inches deep, with a diameter that is at least three times the diameter of the post. (For example, a 4-inch diameter post shall have a minimum 12-inch diameter hole filled and set with concrete.) Install a ring of stapes 3 inches from the end of the post to be set in concrete to help prevent heaving. Concrete shall be of a Portland type mix and sloped at the top to provide positive drainage away from the post. Fence wire shall not be attached to posts until at least 5 days after setting the posts in concrete. Other methods for securing posts at less than required depth may be used with prior approval from NRCS.
2. **Steel posts** – Shall be studded or punched “T”, “U”, or “Y” shaped with anchor plates, with a minimum weight of 1.25 lbs. per foot (excluding the anchor plate). Posts shall be either galvanized or painted. Galvanized posts shall be hot-dipped with at least 2 ounces of zinc coating per square foot. Painted posts shall be clean of loose scale with one or more coats of weather resistant paint applied. Steel line posts shall be at least 5 feet long, and driven into the ground to the top of the anchor plate. Where extra strength and support for the fence is needed, use a wooden post instead of steel for every third or fourth line post.
3. **Spacing** – For non-electric high tensile fencing, line posts shall be spaced a maximum of 16 feet apart on center. When battens are used, the maximum line post spacing is 30 feet on center with battens installed at 10 and 20 feet. For conventional woven wire fences, the maximum line post spacing is 10 feet. If high tensile woven wire is used, the maximum line post spacing shall be 20 feet or as based on the manufacturer’s recommendation. For barbed wire fences, the maximum line post spacing is 16 feet.
4. **Installing curves** – Installing curves in high tensile, woven wire and barbed wire fences is permissible as long as the change in direction from one post to the next does not exceed 20 degrees. **Exhibit # 9** Fence Curve Construction illustration.

**Post numbers** – 1 post is needed for changes in direction of up to 20 degrees, a minimum of 2-posts for up to 40 degrees, a minimum of 3-posts for up to 60 degrees, a minimum of 4-posts for up to 80 degrees and a minimum of 5-posts for up to 100 degrees.

**Installing wire and posts** – Posts must be driven 48 inches deep with a 4 inch lean to the outside of the curve. Post spacing along these curves must be no closer than 4 feet. Wire should be attached to the outside of the posts starting with the post where the direction changes.

**Post Sizing** – Use posts that are a minimum of 4 inches in diameter for changes in direction of up to 7 degrees, 5 inch minimum for changes in direction between 7 and 14 degrees and 6 inch minimum diameter for changes between 14 and 20 degrees.

**Checking angles** – To estimate the changing in direction in degrees continue along a line projected out from the straight section of fence for 8-feet and measure the distance from the straight line to the planned fence location. If the distance is 1-foot the change in direction is approximately 7 degrees, 2-feet is approximately 14 degrees and 3-feet is approximately 20 degrees.

**EXHIBIT 3: Non-Electric High Tensile Smooth Wire, Woven Wire, and Barbed Wire Fences for *Critical Confinement/Exclusion***

**Battens** – If battens are used, distances between line posts in high tensile fences can be increased (see Spacing, previous page). Battens shall be poly, fiberglass or other NRCS approved material with UV stabilization. Standard “T”, “U”, or “Y” shaped steel posts with anchor plates may be used in place of battens. Spacing between battens shall be 10 feet maximum for non-electric high tensile wire. Wires must be attached to the battens using Class 3 galvanized clips.

**Corner, End, Gate and Brace Posts** – Shall meet the following criteria for type of material and size:

1. **Wooden posts** – Shall be well seasoned or kiln-dried to minimize warping. Use untreated durable disease free posts of species such as southern yellow pine, red cedar, black locust or osage-orange with bark removed, or non-durable wood that is preservative pressure treated. Do not use red pine, landscape timbers or peeler cores. Treated lumber shall be treated with a minimum retention of 0.40 lbs./cubic foot chromated copper arsenate (CCA), type A, B, or C, or equivalent non-CCA treatment. Corner, end, and gate posts shall be at least 6 inches in diameter, or 6 inches square. Brace posts shall be at least 5 inches in diameter. Posts shall be of sufficient length to accommodate the minimum fence height and long enough for a minimum depth of 3 ½ feet driven in the ground or below frost level, whichever is greater. Where posts cannot be set to the specified depth, they must be set in concrete to secure them. Set posts in a hole that is at least 24 inches deep, with a diameter that is at least three times the diameter of the post. (For example, a 6 inch diameter post shall have a minimum 18-inch diameter hole filled and set with concrete.) Install a ring of staples 3 inches from the end of the post to be set in concrete to help prevent heaving. Concrete shall be of a Portland type mix and sloped at the top to provide positive drainage away from the post. Fence wire shall not be attached to posts until at least 5 days after setting the posts in concrete. Other methods for securing posts at less than the required depth may be used with prior approval from NRCS.
2. **Spacing** – Brace post shall be set at a minimum distance of 2 times the height of the fence from each corner, end, or gate post. Brace assemblies shall be installed as described in the next section of this exhibit.

**Brace Assemblies** – **Single span or double span brace assemblies** are required at all corners, ends, and gates, and where the fence alignment changes direction by more than 40 degrees. **Line brace assemblies** shall also be installed at appropriate intervals in a run of fence and at all sharp breaks in grade. A **run** is the distance between a corner, end, or gate post and the next corner, end, or gate post. Types and maximum intervals for bracing are listed below. Refer to Pennsylvania Standard Drawings for typical brace assembly designs for the different types of fences located in Chapter 5 of the Engineering Field Manual.

1. **High Tensile** – For 2-6 wires a single brace assembly is needed at corner, end and gate posts (exception for a 2 wire fence, if corner, end and gate posts can be buried 4 feet deep and a 6 inch diameter post is used, no brace assemblies are needed). For more than 6 wires, double brace assemblies are needed.
2. **Woven Wire and Barbed Wire** – Single brace assemblies are needed at corner, end and gate posts. If a run is longer than 1,320 feet a single in-line brace assembly is needed.

**EXHIBIT 3: Non-Electric High Tensile Smooth Wire, Woven Wire, and Barbed Wire Fences for Critical Confinement/Exclusion**

**Horizontal brace rails** shall consist of one of the following materials:

1. **Galvanized steel pipe** – Minimum 2 times height of fence, 2-inch diameter, Schedule 40 pipe.
2. **Wooden post** – Minimum 2 times height of fence, 4-inch square or 3 ½-inch diameter round.

**Brace post pins** shall be Class 3 galvanized pins a minimum of 3/8-inch x 9-inch and 3/8-inch x 4-inch.

**Brace wires shall** consist of 12 ½ gauge or stronger, galvanized, high tensile wire, double wrapped with a 1 1/2-inch x 2-inch x 2-foot twist stick. A double wire with a tightener or a double wire crimped together may also be used. Brace wires shall be tightened to secure the brace and post assemblies.

If a wide stream or gully is to be crossed, the fence section shall be terminated on each bank with a brace assembly and a separate section constructed between these ends. In flood prone areas see Exhibit 2 for minimum number of strands and spacing. There is a greater possibility of flood damage if more strands are used.

Refer to Pennsylvania Standard Drawings for typical brace assembly designs for the different types of fences located at [http://www.pa.nrcs.usda.gov/technical/Engineering/standard\\_drawings/standard\\_drawings.html](http://www.pa.nrcs.usda.gov/technical/Engineering/standard_drawings/standard_drawings.html)

**Fasteners** – For wood posts, use minimum 9-gauge galvanized wire staples to attach wire to the posts. Staples shall be a minimum of 1 ½ inches long for softwood and a minimum of 1 inch long for hardwood such as black locust. Staples shall be driven diagonally across the wood grain and staggered to avoid splitting. For high tensile fencing material, the staples shall not be driven into the posts (including line, corner, end, gate, and brace posts) so deeply that the wire will not move when tightened or with expansion and contraction.

For steel line posts, attach wires by wrapping with 12 ½ to 14-gauge galvanized wire or by use of the manufacturer's specially designed clips.

**Grounding Rods** – Non-electrified wire fences shall be grounded at least every 1,000 feet to protect livestock from lightning strikes. Grounding rods shall be galvanized or copper coated rods. Grounding rods and clamps shall be of similar materials. Fences built with metal posts set in earth will provide sufficient lightning protection, and do not require additional grounding.

**EXHIBIT 4: Board or Plastic Coated Rail Fence for Critical Confinement/Exclusion**

Board fences are suitable for applications where a high level of confinement or exclusion is needed, such as near roads and on property lines. Wooden boards (horizontal rails) and posts shall be well seasoned or kiln-dried to minimize warping. Use untreated durable disease free wood of such species as red cedar, black locust, oak, or osage-orange, or a non-durable wood that is preservative pressure treated. Treated lumber shall be treated with a minimum retention of 0.40 lbs./cubic foot ACQ or Natural Select. Boards and posts may be painted if desired. For optimum strength of fencing, attach the boards to the side of the fence that will receive the greatest pressure from animals. Where appearance is important, the boards may be placed on the outside of the fence. The number of boards, board spacing, and minimum height of fence is based on the type of livestock to be confined. Plastic coated rail fence may be used. See Exhibit 1 for details.

**Posts** – Shall meet the following criteria for size, installation, and spacing:

1. **Size** – Line posts shall be at least 4 inches in diameter or 4 inches square, posts shall be of sufficient length to accommodate the minimum fence height and long enough for a minimum depth of 2 ½ feet driven in the ground. Corner, gate and end posts shall be at least 6 inches in diameter or 6 inches square, posts shall be of sufficient length to accommodate the minimum fence height and long enough for a minimum depth of 3 ½ feet driven into the ground or below frost level, whichever is greater. Where posts cannot be set to the specified depth, they must be set in concrete to secure them. Set posts in a hole that is at least 24 inches deep, with a diameter that is at least three times the diameter of the post. (For example, a 6-inch diameter post shall have a minimum 18-inch diameter hole filled and set with concrete.) Install a ring of staples 3 inches from the end of the post to be set in concrete to help prevent heaving. Concrete shall be of a Portland type mix and sloped at the top to provide positive drainage away from the post. Fence rails shall not be attached to posts until at least 5 days after setting the posts in concrete. Other methods for securing posts at less than the required depth may be used with prior NRCS approval.
2. **Spacing** – Posts shall be spaced a maximum of 8 feet on center to accommodate rail lengths of a maximum of 16 feet.

**Rails** – The rails (horizontal boards) shall be a nominal minimum of 1-inch thick x 6 inches wide. Board lengths of 16 feet are preferred so as to stagger the unions when placed on posts on 8-foot centers. Plastic coated rail fence shall be a minimum of 4 inches wide.

**Nails** – Each board shall be attached to the post with a minimum of two 12d (3 ¼-inch) stainless steel nails. For better holding power, use ring-shank or screw-shank instead of common nails. Two 3-inch powder coated decking screws may be used instead of nails.

**EXHIBIT 5: Chain Link Fence for *Critical Confinement/Exclusion***

Chain link fences are suitable for applications where a high level of confinement or exclusion is needed, such as near roads and on property lines, or adjacent to hazardous areas.

***Chain Link Wire Fabric*** – Shall be a minimum 5 feet high, 9-gauge wire with a minimum tensile strength of 1,290 lbs. Chain link fence fabric shall conform to the requirements of ASTM A 392, “Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric,” 2-inch woven mesh, and 9-gauge galvanized steel wire. Zinc coating shall be Class 2 (i.e., 2 ounces of zinc coating per square foot).

***Steel Pipes*** – Posts and fence framework shall conform to the requirements of ASTM F 669, “Specification for Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence,” Group 1A (Schedule 40); ASTM F 1043 “Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework,” Group 1A; and ASTM F 1083, “Standard Specification for Pipe, Steel, Hot Dipped Zinc Coated (Galvanized) Welded, for Fence Structures,” as applicable. Coatings shall be Type A galvanized for both internal and external surfaces.

1. ***Top rail and gate frames*** – Shall be a minimum 1 5/8-inch Outside Diameter standard (Schedule 40) steel pipe;
2. ***Line posts*** – Shall be a minimum 2-inch Outside Diameter standard (Schedule 40) steel pipe, be of sufficient length to support the height of the fence, and be set in concrete to a minimum depth of 12 inches;
3. ***Corner, gate, and end posts*** – Shall be a minimum 2 3/8-inch Outside Diameter standard (Schedule 40) steel pipe, be of sufficient length to support the height of the fence, and be set in concrete to a minimum depth of 12 inches and a width at least 3 times the diameter of the pipe.

***Fittings and Gates*** – Fence fittings shall conform to the requirements of ASTM F 626, “Standard Specifications for Fence Fittings.” Fittings shall be galvanized steel. Wire ties and clips shall be 9-gauge. Gates, gate posts and gate accessories shall conform to the requirements of ASTM F 900, “Standard Specification for Industrial and Commercial Swing Gates.” Coatings shall be the same as selected for adjoining fence framework.

***Installation*** – Unless otherwise specified by the manufacturer, line posts shall be set at intervals not exceeding 10 feet, as measured from center to center of each post. All posts shall be capped immediately after installation. Chain link fabric is generally installed on the outside of the fence post. The fabric shall not be attached to posts until at least 3 days after the posts are set in concrete wall, or at least 5 days after posts are set in the ground with concrete backfill. The fabric shall be stretched taut and securely fastened, using 9-gauge tie clips, to posts at intervals not exceeding 15 inches and to top rails or tension wires at intervals not exceeding 2 feet. Care shall be taken to equalize the tension on each side of each post. Gate frames shall be fabricated and hung so that they sag no more than 1% of the gate width.

**EXHIBIT 6: Electric High Tensile for Critical Confinement/Exclusion Fences and Non-Critical Confinement/Exclusion (or Divisional) Fences**

Electric high tensile fencing is suitable for applications where a high level of confinement is needed, such as near roads and on property lines. It may also be used for interior or divisional fences to divide large pasture acreage into manageable units, to divide the paddocks of intensive grazing systems, or for other non-critical applications.

**Wire** – All wire shall be ASTM Class 3 galvanized, 12 ½ gauge minimum and at least 180,000 PSI tensile strength and at least 1,300 pounds breaking strength for critical confinement and 17 gauge minimum for non-critical confinement. For optimum strength of fencing, attach the wire to the side of the fence that will receive the greatest pressure from animals. Place wire on the outside of posts on curves and corners. Tension shall be set with in-line wire strainers and/or tension indicator springs at 150 pounds. Tension springs shall be full-strength Class 3 galvanized springs. Tension springs are recommended for use in the top one to two strands in areas where the fence is near trees or where animal pressure will be heavy. Tension springs may also be used for all strands. Wrap and twist wires or use crimping sleeves on end and gate posts. At self-insulating corner posts, wrap and twist a separate wire to form an 18 to 20-inch loop to support fence strands or a wrap-around insulator may be used. Wire clips used to hold wire in batten slots should allow the wire to slide freely. The number of wires and spacing is based on the type of livestock to be confined and the purpose and location of the fence. See Exhibits 1 and 2 for details. In flood prone areas see Exhibit 2 for minimum number of strands and spacing. There is a greater possibility of flood damage if more strands are used.

**Line Posts** – Shall be either wooden or steel, and shall meet the following criteria for type of material, size, and spacing:

1. **Wooden posts** – Shall be well seasoned or kiln-dried to minimize warping. Use untreated durable disease free posts of species such as southern yellow pine, red cedar, black locust or osage-orange with bark removed, or non-durable wood that is preservative pressure treated. Do not use red pine, landscape timbers, or peeler cores. Treated lumber shall be treated with a minimum retention of 0.40 lbs./cubic foot chromated copper arsenate (CCA), type A, B, or C, or equivalent non-CCA treatment. Wooden line posts shall be at least 4 inches in diameter, or 4 inches square. Posts shall be of sufficient length to accommodate the minimum fence height and long enough for a minimum depth of 2 ½ feet in the ground. When set in depressions or low places, line posts shall be anchored in the ground or set at an angle to prevent lifting or longer posts may be needed. Where posts cannot be set to the specified depth, they must be set in concrete to secure them. Set posts in a hole that is at least 12 inches deep, with a diameter that is at least three times the diameter of the post. (For example, a 4-inch diameter post shall have a minimum 12-inch diameter hole filled and set with concrete.) Install a ring of staples 3 inches from the end of the post to be set in concrete to help prevent heaving. Concrete shall be of a Portland type mix and sloped at the top to provide positive drainage away from the post. Fence wire shall not be attached to posts until at least 5 days after setting the posts in concrete. Other methods for securing posts at less than the required depth may be used with prior approval from NRCS.
2. **Steel Posts** – Shall be studded or punched “T”, “U”, or “Y” shaped with anchor plates, with a minimum weight of 1.25 lbs. per foot (excluding the anchor plate). Posts shall be either galvanized or painted. Galvanized posts shall be hot-dipped with at least 2 ounces of zinc coating per square foot. Painted posts shall be clean of loose scale with one or more coats of weather resistant paint applied. Steel line posts shall be at least 5 feet long, and driven into the ground to the top of the anchor plate. Where extra strength and support for the fence is needed, use a wooden post instead of steel for every third or fourth line post.
3. **Spacing** – Line posts shall be spaced a maximum of 60 feet apart, on center, on smooth, level terrain, or maximum of 90 feet with battens installed at 30 and 60 feet. Reduce the spacing between posts on uneven ground or rolling terrain to maintain spacing of the bottom wire above the ground.

**EXHIBIT 6: Electric High Tensile for Critical Confinement/Exclusion Fences and Non-Critical Confinement/Exclusion (or Divisional) Fences**

4. **Installing curves** – Installing curves in high tensile, woven wire and barbed wire fences is permissible as long as the change in direction from one post to the next does not exceed 20 degrees.

**Post numbers** – 1 post is needed for changes in direction fore each 20 degree interval (i.e. 1 post 20 degrees, 2-posts up to 40 degrees, 3-posts up to 60 degrees, 4-posts up to 80 degrees and 5-posts up to 100 degrees.

**Installing wire and posts** – Posts must be driven 48 inches deep with a 4 inch lean to the outside of the curve. Post spacing along these curves must be no closer than 4 feet. Wire should be attached to the outside of the posts starting with the post where the direction changes.

**Post Sizing** – Posts shall be a minimum of 4 inches in diameter for changes in direction of up to 7 degrees, 5 inch minimum diameter for changes in direction between 7 and 14 degrees and 6 inch minimum diameter for changes between 14 and 20 degrees.

**Checking angles** – To estimate the change in direction in degrees continue along a line projected out from the straight section of fence for 8-feet. Measure the distance from the straight line to the planned fence location. If the distance is 1-foot the change in direction is approximately 7 degrees, 2-feet is approximately 14 degrees and 3-feet is approximately 20 degrees. Refer to **Exhibit 9 Fence Curve Construction** illustration.

**Battens** – If battens are used, distances between line posts can be increased by 30 feet on uniform terrain. Battens shall be poly, fiberglass or other NRCS approved material with UV stabilization. Wires must be attached to the battens using Class 3 galvanized clips. Spacing between battens will be 30 feet maximum. For a single strand fence, use 4-foot (minimum height) wood or insulated steel posts instead of battens.

**Corner, End, Gate and Brace Posts** – Shall meet the following criteria for type of material and size:

1. **Wooden posts** – Shall be well seasoned or kiln-dried to minimize warping. Use untreated durable disease free posts of species such as southern yellow pine, red cedar, black locust or osage-orange with bark removed, or non-durable wood that is preservative pressure treated. Do not use red pine, landscape timbers, or peeler cores. Lumber shall be treated with a minimum retention of 0.40 lbs./cubic foot chromated copper arsenate (CCA), type A, B, or C, or equivalent non-CCA treatment. Corner, end, and gate posts shall be at least 6 inches in diameter, or 6 inches square. Brace posts shall be at least 5 inches in diameter. Posts shall be of sufficient length to accommodate the minimum fence height and long enough for a minimum depth driven in ground of 3 ½ feet or below frost level, whichever is greater. Where posts cannot be set to the specified depth, for security they must be set in concrete. Set posts in a hole that is at least 24 inches deep, with a hole diameter that is at least three times the diameter of the post. (For example, a 6-inch diameter post shall have a minimum 18-inch diameter hole filled with concrete.) Install a ring of staples 3 inches from the end of the post to be set in concrete to help prevent heaving. Portland type concrete mix shall be used and sloped at the top to provide positive drainage away from the post. Fence wire can be attached to posts after concrete has cured for a minimum of 5 days. Prior approval is required on other methods of shallow post installation from NRCS State Grassland Specialist.

2. **Spacing** – Brace posts shall be set a minimum of 2 times the height of the fence from each corner, end, or gate post. Brace assemblies shall be installed as described in the next section of this exhibit.

**Brace Assemblies** –Fences with 2 or more strands of high tensile wire, **single or double span brace assemblies** are required at all corner, ends, gates, and where the fence alignment changes direction by more than 40 degrees (exception for a 2 wire fence, if corner, end and gate posts are buried 4 feet deep and a 6 inch diameter post is used). **Line brace assemblies** shall also be installed at appropriate intervals in a run of fence and at all sharp breaks in grade. A *run* is the distance between a corner, end, or gate post and the next corner, end, or gate post. Types and maximum intervals for bracing are listed below.

**EXHIBIT 6: Electric High Tensile for Critical Confinement/Exclusion Fences and Non-Critical Confinement/Exclusion (or Divisional) Fences**

Horizontal brace rails shall consist of one of the following materials:

1. **Galvanized steel pipe** – Minimum 2 times height of fence, 2-inch diameter, Schedule 40 pipe.
2. **Wooden post** – Minimum 2 times height of fence, 4-inch square or 3 ½-inch diameter round.

**Brace post pins** shall be galvanized pins a minimum of 3/8-inch x 9-inch and 3/8-inch x 4-inch.

**Brace wires** shall consist of 12 ½ gauge or stronger, galvanized, high tensile wire, double wrapped with a 1 ½-inch x 2-inch x 2-foot twist stick. A double wire with a tightener or a double wire crimped together may also be used. Brace wires shall be tightened to secure the brace assemblies.

If a wide stream or gully is to be crossed, the fence section shall be terminated on one bank with a brace assembly and a new section started on the other bank. In flood prone areas see Exhibit 2 for minimum number of strands and spacing. There is a greater possibility of flood damage if more strands are used.

Refer to Pennsylvania Standard Drawings for typical brace assembly designs for the different types of fences located at [http://www.pa.nrcs.usda.gov/technical/Engineering/standard\\_drawings/standard\\_drawings.html](http://www.pa.nrcs.usda.gov/technical/Engineering/standard_drawings/standard_drawings.html)

**Fasteners** – For wood posts, use minimum 9-gauge galvanized wire staples to attach wire to the posts. Staples shall be a minimum of 1 ½ inches long for softwood and a minimum of 1 inch long for hardwood such as black locust. Staples shall be driven diagonally across the wood grain to avoid splitting. Staples shall not be driven into the post so deeply (including line, corner, end, gate and brace post) that the wire will not move when tightened or with expansion and contraction.

For steel line posts, attach wires by wrapping with 12 ½ to 14-gauge galvanized wire or by use of the manufacturer's specially designed clips.

All electrified wires must be properly insulated as specified by the fence manufacturer.

**Electrical Fence Charger** – The electric fence charger must have adequate voltage to effectively electrify the system and maintain output to control the type of animals, based on the manufacturer's recommendations. The charger shall be low impedance, high voltage, and shall include all of the safety features that are required by the manufacturer. Electric fence warning signs shall be placed a minimum of 300' apart where the public has access to the fence.

**Insulators** – If needed, these shall be UV stabilized (plastic) high density polypropylene, high strain end and corner tube insulator, or high strain porcelain corner. Insulators shall be strong enough to support long spans of wire and must allow the wire to slide freely. Insulators shall be used on all posts that are not self-insulating (plastic, fiberglass, etc.).

**Grounding Rods** – Rods shall meet or exceed the requirements of the manufacturer of the electrical fence charger, and shall be installed as per the manufacturer's recommendations. Grounding rods shall be galvanized or copper coated rods. Grounding rods and clamps shall be of similar materials. Fences built with metal posts

set in earth will provide sufficient lightning protection, and do not require additional grounding.

**EXHIBIT 7: Electroplastic Twine (Polywire) and Electrified Ribbon for Non-Critical Confinement/Exclusion (or Divisional) Fences**

Electrified twine and/or ribbon type fencing may be used as interior (cross) fencing to divide large pasture acreage into manageable units, to divide the paddocks of intensive grazing systems or similar applications. Electrified twine (polywire) or ribbon type fencing shall not be used in applications where a high level of confinement is needed.

**Wire** – Shall consist of new materials free of manufacturing or other defects. Polywire shall have a minimum of six stainless steel strands running through the material.

The number of wires and spacing is based on the type of animal to be confined. See Exhibit 2 for details.

**Line Posts** – Shall be manufactured fiberglass, plastic, or other suitable material as approved by NRCS. Posts shall be at least 4 feet long, set deep enough in the ground to withstand livestock. “Step-in” posts designed for this purpose may be used.

Line posts shall be installed on a spacing as specified by the manufacturer to control specific livestock. Closer spacing shall be used as topographic conditions indicate.

**Corner and End Posts** – When posts are needed at the end or corner of a cross fence, they may be untreated durable wood (red cedar or black locust), or pressure treated softwood with a diameter sufficient to anchor the wire. Posts must be long enough to allow them to be set at least 1 ½ feet in the ground.

**Fasteners** – The fence shall be fastened and insulated from line and end posts by using supplies provided by the manufacturer of the fence material.

**Electrical Fence Charger** – The electric fence charger must have adequate voltage to effectively electrify the system and maintain output to control the type of animals, based on the manufacturer’s recommendations. The charger shall be low impedance, high voltage, and shall include all the safety features that are required by the manufacturer. Electric fence warning signs shall be placed a minimum of 300’ apart where the public has access to the fence.

**Grounding Rods** – Rods shall meet or exceed the requirements of the manufacturer of the electrical fence charger, and shall be installed as per the manufacturer’s recommendations. Grounding rods shall be galvanized or copper coated rods. Grounding rods and clamps shall be of similar materials.

**EXHIBIT 8: Summary of Fence Types and Selected Materials <sup>1/</sup>**

Fence Materials and Installation Requirements								
Type of Fence	Wire Quality	Line Post Type	Line Post Size	Line Post Spacing	Corner, End, Gate, and Brace Post Type	Corner, End, and Gate Post Size	Brace Post Size	Brace Intervals
<b>Non-Electric High Tensile Smooth Wire</b>	ASTM Class 3 galvanized, min. 12 ½-gauge, 200,000 PSI, 1,540 lbs. breaking strength	Untreated disease free durable wood (e.g., red cedar, black locust) with bark removed, or Non-durable wood that is preservative pressure treated (0.40 lbs./cu.ft. CCA or equivalent), or Heavy duty steel "T", "U", or "Y" posts, galvanized or painted, with anchor plates.	<u>Wooden posts:</u> min. 4 inches diameter or 4 inches square.  Set in ground to min. depth of 2 ½ feet. (See Note 2 at the end of this Exhibit.)  <u>Steel posts:</u> min. 5 feet long. Drive into the ground to the top of the anchor plate.	Max. 30 feet apart on center if spacers or battens are used at 10-foot intervals.  Otherwise, max. spacing at 16 feet apart, on center.	Untreated disease free durable wood (e.g., red cedar, black locust) with bark removed or Non-durable wood that is preservative pressure treated (0.40 lbs./cu.ft. CCA or equivalent).	Min. 6 inches diameter or 6 inches square.  Set in ground to min. depth of 3 ½ feet or below frost level whichever is greater. (See Note 2 at the end of this Exhibit.)	Min. 5 inches diameter.  Set in ground to min. depth of 3 ½ feet or below frost level whichever is greater. (See Note 2 at the end of this Exhibit.)	<u>Single span braces</u> needed when 2-6 wires are used, exception for a 2 wire fence, if corner, end and gate posts can be installed 4 feet deep, no brace assemblies are needed.  <u>Double span braces</u> needed when more than 6 wire are used.
<b>Woven Wire</b>	ASTM Class 3 galvanized, min. 12 ½-gauge top and bottom wire with 12 ½-gauge wire in between.	Same as above.	Same as above.	Max. 10 feet apart, on center, for standard wire. Max 20 feet apart, on center, if high tensile wire.	Same as above.	Same as above.	Same as above.	<u>Single span braces:</u> Needed at corner, end and gate posts.  <u>Line Braces</u> needed if run is longer than 1,320 feet.

**EXHIBIT 8: Summary of Fence Types and Selected Materials <sup>1/</sup>**

Fence Materials and Installation Requirements								
Type of Fence	Wire Quality	Line Post Type	Line Post Size	Line Post Spacing	Corner, End, Gate, and Brace Post Type	Corner, End, and Gate Post Size	Brace Post Size	Brace Intervals
<b>Barbed Wire</b>	ASTM Class 3 galvanized, double-strand, min. 12 ½ gauge with 4-point barbs spaced no more than 6 inches apart, or 15 ½ gauge for high tensile	Untreated disease free durable wood (e.g., red cedar, black locus) with bark removed, or Non-durable wood that is preservative pressure treated (0.40 lbs./cu.ft. CCA or equivalent), or Heavy duty steel “T”, “U”, or “Y” posts, galvanized or painted, with anchor plates.	<u>Wooden posts:</u> min. 4 inches diameter or 4 inches square. Set in ground to min. depth of 2 ½ feet. (See Note 2 at the end of this Exhibit.) <u>Steel posts:</u> min. 5 feet long. Drive into the ground to the top of the anchor plate.	Max. 16 feet apart, on center.	Untreated disease free durable wood (e.g., red cedar, black locus) with bark removed or Non-durable wood that is preservative pressure treated (0.40 lbs./cu.ft. CCA or equivalent).	Min. 6 inches diameter or 6 inches square. Set in ground to min. depth of 3 ½ feet or below frost level whichever is greater. (See Note 2 at the end of this Exhibit.)	Min. 5 inches diameter. Set in ground to min. depth of 3 ½ feet or below frost level whichever is greater. (See Note 2 at the end of this Exhibit.)	<u>Single span braces:</u> Needed at corner, end and gate posts.  <u>Line Braces</u> needed if run is longer than 1,320 feet.
<b>Wooden Board</b>	Wood rails – use well seasoned or kiln-dried wood to minimize warping. Rails are min. 1-inch thick x 4 inches wide, and at least 8 feet long.  Plastic coated rails are min. 4 inches wide.	Untreated disease free durable wood (e.g., red cedar, black locus) with bark removed, or Non-durable wood that is preservative pressure treated (0.40 lbs./cu.ft. ACQ or Natural Select), or Heavy duty steel “T”, “U”, or “Y” posts, galvanized or painted, with anchor plates.	Wooden posts min. 4 inches diameter or 4 inches square. Length sufficient to support desired height of fence and to be set in the ground a min. of 2 ½ feet deep. (See Note 2 at the end of this Exhibit.)	Max. 8 feet apart, on center.	Untreated disease free durable wood (e.g., red cedar, black locus) with bark removed, or Non-durable wood that is preservative pressure treated (0.40 lbs./cu.ft. ACQ or Natural Select).	Wooden posts min. 6 “ diameter or 6” square. Length sufficient to support desired height and be set in ground to min. depth of 3 ½’ or below frost level whichever is greater. (See Note 2 at the end of this Exhibit.)	Not applicable.	Not applicable.

**EXHIBIT 8: Summary of Fence Types and Selected Materials <sup>1/</sup>**

Fence Materials and Installation Requirements								
Type of Fence	Wire Quality	Line Post Type	Line Post Size	Line Post Spacing	Corner, End, Gate, and Brace Post Type	Corner, End, and Gate Post Size	Brace Post Size	Brace Intervals
<b>Chain Link</b>	Min. 9-gauge galvanized wire with 2 ounces of zinc coating per sq. ft. Minimum tensile strength of 1, 290 lbs., 2-inch woven mesh.	Steel post, galvanized with 2 ounces of zinc coating per sq. ft., or painted	Min. 2-inch Outside Diameter standard (Schedule 40) steel pipe.  Length sufficient to support desired height of fence and be set in concrete a min. of 12 " deep	Max. 10 feet apart on center	Steel post, galvanized with 2 ounces of zinc coating per sq. ft., or painted	Min. 2 3/8-inch Outside Dia-meter standard (Schedule 40) steel pipe.  Length sufficient to support desired height & be set in concrete min. of 12 " deep.	Not applicable.	Not applicable.
<b>Electric High Tensile Smooth Wire</b>	ASTM Class 3 galvanized, min. 12 ½-gauge 180,000 PSI, 1,300 lbs. breaking strength	Untreated disease free durable wood (e.g., red cedar, black locus) with bark removed, or Non-durable wood that is preservative pressure treated (0.40 lbs./cu.ft. CCA or equivalent), or Heavy duty steel "T", "U", or "Y" posts, galvanized or painted, with anchor plates.	Wooden posts: min. 4 " diameter or 4" square.  Set in ground to min. depth of 2 ½ ' . (See Note 2 at the end of this Exhibit.)  Steel posts: min. 5' long. Driven into the ground so that the top of the anchor plate is buried	Max. 60 feet apart, on center, or Max. 90 feet apart, on center, with battens installed at 30 and 60 feet.	Untreated disease free durable wood (e.g., red cedar, black locus) with bark removed, or Non-durable wood that is preservative pressure treated (0.40 lbs./cu.ft. CCA or equivalent).	Min. 8 feet long, min. 6 inches diameter or 6 inches square.  Set in ground to min. depth of 3 ½ feet or below frost level whichever is greater. (See Note 2, below)	Min. 8 feet long, min. 5 inches diameter.  Set in ground to min. depth of 3 ½ feet or below frost level whichever is greater. (See Note 2, below.)	<u>Single span braces</u> needed when 2-6 wires are used, except for a 2 wire fence, if corner, end and gate posts can be installed 4' deep, no brace assemblies are needed.  <u>Double span braces</u> needed when more than 6 wire are used.
<b>Electroplastic Twine (Polywire) and Electrified Ribbon</b>	Polywire: min. 6 stainless steel strands running through the material.	Manufactured fiberglass, plastic, or other suitable material as approved by NRCS.	Min. 4 feet long, set deep enough in the ground to withstand livestock. Can use "step-in" posts.	Use spacing specified by the manufacturer to control livestock.	Untreated durable wood (i.e. red cedar, barkless black locus), or Non-durable wood that is preservative pressure treated	Diameter sufficient to anchor the wire.  Posts must be long enough so to set at least 1 ½' in ground.	Not applicable.	Not applicable.
<b>EXHIBIT 8 NOTES:</b>	1/ This exhibit briefly summarizes some of the major components and installation requirements for each fence type. Refer to Exhibits 1-7 for more detailed criteria. 2/ Where posts cannot be set to the specified depth, they must be set in concrete to secure them. Set posts in a hole that is at least 12 inches deep, with a diameter that is at least three times the diameter of the post. (For example, a 4-inch diameter post shall have a minimum 12-inch diameter hole filled and set with concrete.) Install a ring of staples 3 inches from the end of the post to be set in concrete to help prevent heaving. Concrete shall be of a Portland type mix and sloped at the top to provide positive drainage away from the post.							

**Exhibit 9 Fence Curve Construction**

**Fencing Curves - Minimum Number of Posts Required**

**A.** Minimum 1-post on corner to change fence direction 20 degrees  
**B.** Minimum 2-posts on corner to change fence direction 40 degrees  
**C.** Minimum 3-posts on corner to change fence direction 60 degrees  
**D.** Minimum 4-posts on corner to change fence direction 80 degrees  
**E.** Minimum 5-posts on corner to change fence direction 100 degrees

**Fencing Curves – Determining angle of direction change**

2. Measure to fence

35"  $\approx$  20°  
 24"  $\approx$  14°  
 12"  $\approx$  7°

1. Measure 8 feet from direction change