

Producer Name:
Location:
Farm Name:

Project or Contract:
County:
Tract Number:

Practice Location Map

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Description of work:

NRCS Review Only

Designed By: _____

Date: _____

Checked By: _____

Date: _____

Approved By: _____

Date: _____

**NATURAL RESOURCES CONSERVATION SERVICE
SPECIFICATION GUIDE**

FENCE

(Feet)

**SUSPENSION FENCE
CODE 382**

I. SCOPE

Purpose of this practice is to construct a barrier to animals or people and facilitate management practices and/or accelerated conservation practices.

The work shall consist of furnishing materials and installing standard post and wire fence, special wire fences and combination thereof, at the location(s) shown on the plan map, and if needed, on the drawings or as staked in the field. Fencing includes brace assemblies, gates, cattle guards and other components required to meet site conditions and achieve objectives for practice application.

II. FENCE TYPES

Suspension Fences are a lower cost variation of the standard post and wire fence. Suspension fences are used for interior fences on large pastures with level terrain. They can be barbed or smooth. The fence design allows it to sway in the wind and when contacted by animals. Suspension fences should not be used for sheep, goat, hog or other small ruminants.

III. GENERAL SPECIFICATIONS

Any alterations or additions to the practice design must be approved as a variance by NRCS State Resource Conservationist prior to modifying this specification guide and/or associated drawings or installation requirements. Follow variance procedure outlined in the standard.

Fences installed on state, federal, and tribal owned lands normally require a permit or approval. This permit/approval must be provided to NRCS prior to installation.

Interior fences will be built in accordance with this specification. Boundary fences and public right of ways need to reference Colorado Revised Statutes Title 35, Article 46: Fence Law. Fences that are along county and highway roads should follow CDOT fence policy and the most current copy of the Fence Standards at www.dot.state.co.us.

The NRCS assumes no responsibility for interference with private or public utilities.

State and federally protected plants, animal, cultural resources and historically significant properties shall not be harmed or destroyed during the installation of this practice. All Fish and Wildlife Service consultation documents (i.e. conference reports, biological opinions) will be referenced and planned accordingly into the fence design as applicable to the construction location.

All work shall be done in a manner that minimizes soil and vegetation disturbance and the movement of sediment or other pollutants into streams and water bodies. Any engine oil, lubricants, or other chemical pollutants spilled during construction shall be safely collected and properly disposed.

Most fencing materials must be new. Used materials such as treated railroad ties, power or telephone poles, steel pipe or used well casing may be used with prior certification from NRCS Field Office personnel.

Old posts, wire, and other fence materials shall be completely removed from site.

Any existing structures, including the tie-in to other existing fences, used in constructing the new fence, must be approved by NRCS prior to construction. If the structural integrity of the new fence is dependent on existing practices, certification by NRCS will take into consideration structural integrity and lifespan of the existing structure(s).

Life expectancy of this practice is 20 years. Operation and maintenance of new and existing structures is required.

IV. ANCHOR AND BRACE ASSEMBLIES

Brace assemblies shall be installed at all angles, corners, gates and ends of the fence, and at the base and summit of steep slopes as needed to properly stretch the fence wire.

Fences shall be constructed in straight sections. The distance between brace assemblies shall be set at approx. 1320 feet (1/4 mile) for post and wire fences.

Double span brace assemblies are required for sandy or wet soil conditions and/or areas with heavy animal pressure.

Anchor and line brace assemblies may be wood or steel. Wood braces are typically constructed as horizontal brace assemblies or horizontal brace assemblies with a double diagonal brace.

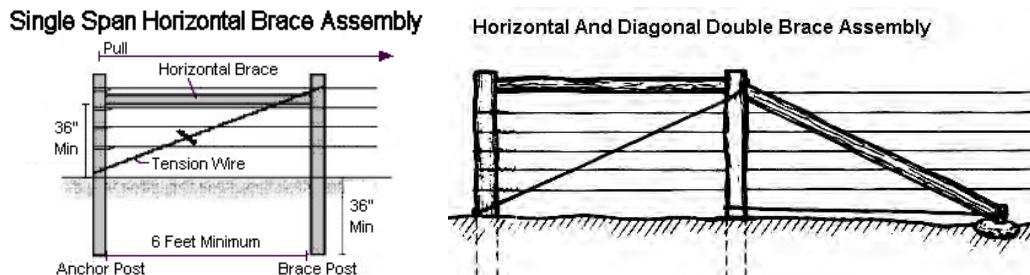
Steel angle iron or steel pipe braces shall be set in concrete. Steel and concrete brace assemblies shall be constructed as single or double span horizontal brace assemblies, or as a diagonal brace assembly. Steel angle iron or pipe shall be galvanized coated or painted. If painted, all rust or lose material shall be removed by wire brushing or other suitable material, treated with a rust inhibitor, primed with metal primer paint and then painted with two coats of high grade weather resistant epoxy or enamel paint.

A. END BRACE ASSEMBLIES

End brace assemblies shall be installed where there is only one direction of pull, such as gates, or where the fence meets a natural barrier. End bracing should be installed on each side of drainages and stream channels where the fence may be damaged due to trapped debris during runoff or flood events.

A diagonal end brace may be used instead of an additional horizontal brace where double span bracing is needed. The diagonal brace shall be doweled, bolted, or welded to the brace post at least 36 inches above the ground.

Figure 1: Example End Braces showing typical H Brace and H Brace with Diagonal Assembly



B. LINE BRACE ASSEMBLIES

Line Brace assemblies are installed where there are two directions of pull on the anchor post(s), such as corners and in-line stretch posts. Line braces are constructed the same as end braces but with the anchor brace post(s) set in both directions of pull.

For a line brace, a single H brace assembly can be used with straight, level sections of fence of $\frac{1}{4}$ mile or less, where the distance and direction of pull are approximately equal on both sides of the line. In a single H brace assembly, each post serves as both an anchor post and a brace post. They are constructed the same as a single span horizontal brace. Tension wires shall be assembled in both directions, unless the assembly is welded.

Figure 2: Examples of typical line brace assemblies

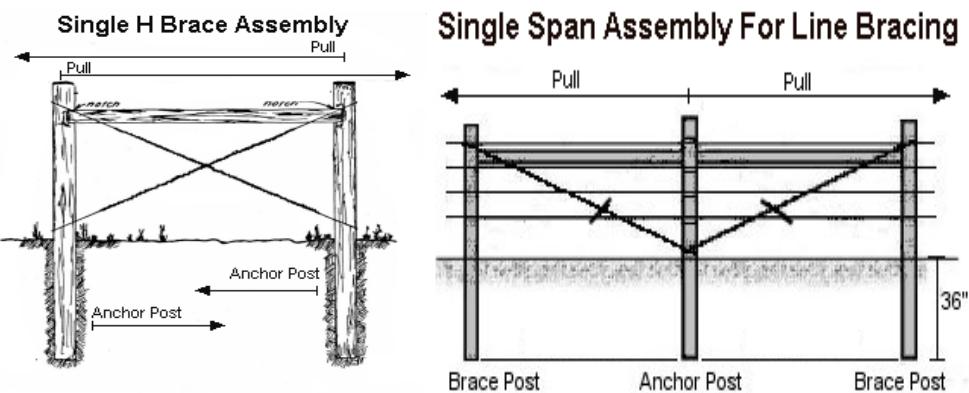


Figure 3: Examples of typical assemblies for corners.

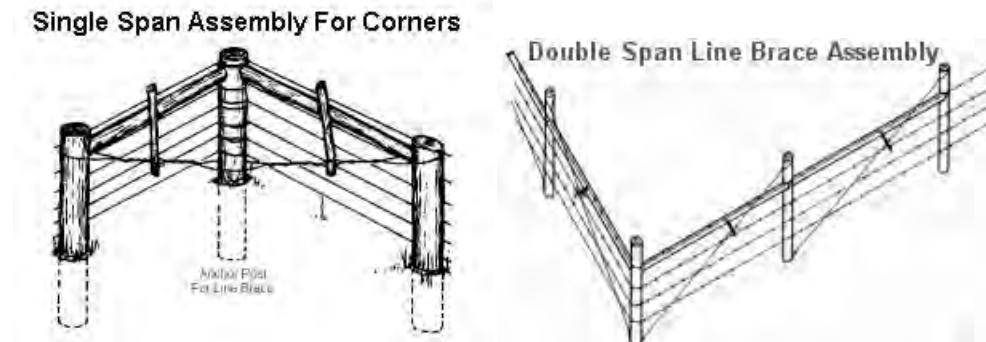
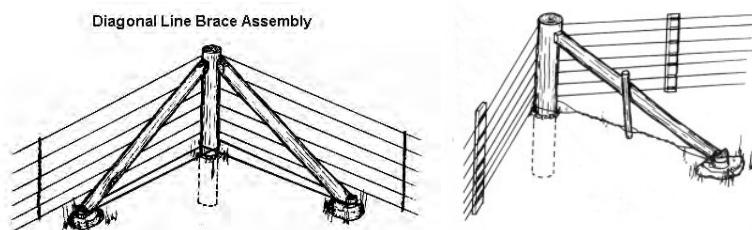


Figure 4: Examples of wood diagonal brace assemblies



Diagonal and single diagonal brace assemblies may be used for bracing angles in the between standard line braces or end braces. The fence wires shall not be tied off to a diagonal brace assembly.

C. Brace Alternatives

The alternative braces examples listed below could be used where it is difficult to dig or drive posts. Refer to *Range Tech Note No. 38* for alternative options for bracing. Include additional specification information in site specific guidance.

- Straddle Jacks
- Square Rock Crib
- Rock Jack
- Wire Fence Cribs

V. ANCHOR AND BRACE POSTS

Wooden Assemblies

All end, corner, and brace posts must have a minimum diameter of 6 inches. Untreated juniper, oak, mesquite, black locust and redwood posts may be used. Pine and other softwoods must be pressure treated. Railroad ties in good condition are suitable for use as anchor and brace posts.

All anchor and brace posts shall be set in ground at least 36 inches. In sandy or loose soil, depth of 42 inches is recommended. Anchor and brace posts shall be long enough to extend approximately 2 inches above the top wire.

Posts shall be set in holes at least 6 inches larger than the diameter of the posts. The hole should be filled with dirt in 4 inch layers and tamped firm. The posts shall be plumb. The top of the dirt fill shall be mounded above the ground level such that water does not pond at the base of the post. If setting a wood post in concrete, use at least (1) 80 lb. bag of concrete for a 12 inch post hole to secure brace assembly.

Horizontal bracing between the corner and brace posts shall be a minimum 6.5 feet long. Standard "H" Brace assemblies should approximately maintain a 2:1 ration of brace length to height of top wire; maximum distance between brace posts shall be 10 feet. Horizontal brace shall be attached to the upper quarter of the anchor and brace post, approximately 35 inches from the ground. The horizontal bracing shall be a post with a minimum diameter of 4 inches.

Wooden diagonal braces shall be a minimum of 10 feet in length and a minimum of 4 inches in diameter. As length increases the minimum diameter needs to increase as well. Lengths 15 feet – 18 feet need to be 6 inches or greater diameter. Lengths greater than 18 inches need to be 8 inches or greater. Brace posts will have to increase in size corresponding to the diagonal brace size. Steel angle iron and pipe may also be used for horizontal or diagonal braces and meet the same diameter and dimensions as above. Steel horizontal braces shall be notched at least 2 inches but not more than 3 inches into wood anchor and brace posts.

Tension wires for all wooden brace assemblies shall be made from two complete loops of 9 gauge or heavier smooth galvanized single wire or two complete loops of 12.5 gauge double strand barbed or smooth wire. Tension wires shall be attached diagonally from approximately 4 inches below the top of the post and 4 inches above the ground, the tension wires shall be twisted together until the brace assembly is rigid.

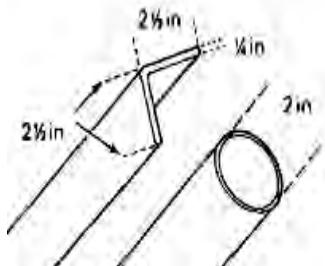
Dowels may be used to attach wooden horizontal and diagonal braces to the wooden anchor and brace posts. The dowels shall be at least 6 inches long, and extend at least 3 inches into each piece. The dowels shall be made of 3/8" or larger steel, or 1" or larger diameter hardwood. Steel rebar can be used. Braces may also be notched into the brace post and secured to the post with 6 inches tempered steel, galvanized, ring shank nail or 6 inches galvanized lag screw.

For wooden diagonal braces, the ground end of the diagonal brace shall be set on a flat rock or concrete. The end of the diagonal brace must be free to move forward when the fence wire is stretched and must not be blocked by a stake or post. The tension wire shall be wrapped from just above the ground of the brace post, to the ground end of the diagonal brace.

Steel and Concrete Anchor Brace Assemblies

Anchor and Brace posts may be made from steel angle iron that is at least 2.5" x 2.5" x 0.25" x 6.5', weight at least 4.1 pounds per foot of length. Anchor and brace posts may also be made from new steel pipe that meets or exceeds the requirements for 2 3/8 inch (OD) or 2 inch (ID) size standard steel pipe (ASTM A120, SCH 40).

Figure 5: Steel pipe and angle iron minimum requirements

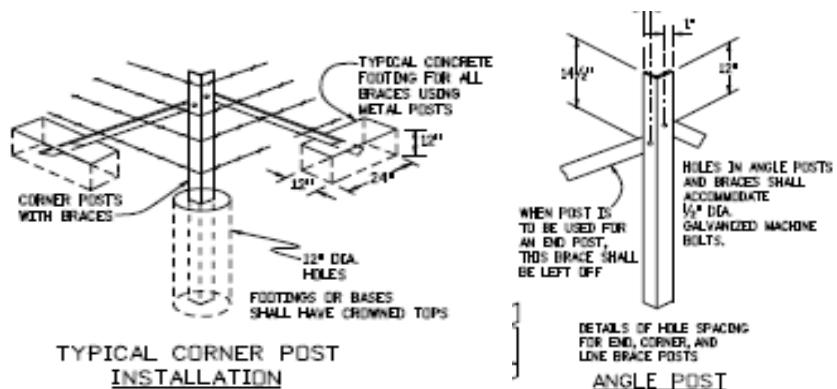


Used steel pipe may be used provided that it is approved prior to construction by NRCS as being of good quality, relatively free of pits and scaling, and meeting specifications.

Steel angle iron and pipe may also be used for horizontal or diagonal braces and meet the same diameter and dimensions as above (in wooden assembly section). Steel horizontal braces shall be welded to steel anchor and brace posts.

The corner post shall be set a minimum of 36 inches deep in a concrete pier 12 inches in diameter; the concrete pier may be either a cylinder or a square. Corner posts set in sandy soils or soils that are "shrink-swell" clays should be set at approximately 42 inches deep. Diagonal braces shall be fastened to the corner with a positive connector such as a clamp or bolt, and shall extend 12 inches into the brace concrete block, which is 12" w x 24" l x 12" d. The bottom of the steel post shall be placed on a rock. The hole shall be filled with concrete in such a way as to allow the concrete to flow around the base of the post. The top of the concrete shall be mounded above the ground level and sloped away from the post to prevent water from ponding around the base of the post.

Figure 6: Typical steel diagonal brace and post attachments



Steel pipe 5 inches in diameter or larger can be set to the same as wooden anchor and brace posts. Steel pipe posts less than 5 inches in diameter and angle iron posts shall be set in a concrete at least 36 inches deep and 12 inches in diameter.

Steel posts that are over 2 inches ID will be capped.

VI. LINE POSTS, STAYS AND FENCE SECTIONS

Line Posts

Line posts shall be set in a straight line between brace assemblies with no more than 12 inches of deviation. Line posts may be wood, steel pipe or manufactured steel "T-posts" or "U-posts".

Wooden line posts will be a minimum of 4 inches top diameter. Wooden line posts shall be set a minimum of 18 inches in the ground, or 24 inches in sandy or wet soils. Untreated western red cedar, black locust, mesquite, western juniper or Osage orange, one seed juniper, Rocky Mountain and Utah juniper, may be used, Pine or other soft wood posts must be pressure treated or treated with a preservative

Manufactured steel "T-posts" or "U-posts" with anchored plates, weighing a minimum of 1.33 pounds per foot of length can be used. The posts shall be studded, embossed, or notched for wire attachment. They shall be galvanized, painted or enameled. "T-posts" or "U-posts" shall be driven into the ground until the top of the anchor plats is below ground level. The steel posts shall be long enough to be driven into the ground above the anchor plate and extend a maximum of 4 inches above the top wire.

Line posts may be made from steel pipe that is a meets or exceeds the requirements for 2 inches nominal size standard steel pipe (Schedule 40). Wire spacing dividers, such as welded loops or other methods, will be necessary. Used steel maybe used provided that it is approved by NRCS prior to construction as being of good quality and relatively free of pits and scaling. Steel pipe shall be set a minimum of 18 inches into the ground, or 24 inches in sandy or wet soils.

Stays

Stays may be made of either galvanized twisted wire or wood. Wood stays shall have a 1.5 inch minimum top diameter. Stays must not touch the ground.

Fence Sections

The maximum line posts spacing between line posts is 100 feet with stays spaced approximately every 15 feet.

VII. FENCE WIRE

Barbed and Smooth Wire

Barbed and smooth wire shall be new, double strand 12.5 gauge or heavier galvanized malleable steel. Both barbed and smooth wire must meet the specification ASTM A121. All wire strength shall have a minimum strand-breaking strength of 950 pounds or 70,000 psi.

Smooth wire can be a single steel wire of 9 gauge or heavier. Wire shall have a minimum tensile strength of 45,000psi.

Fence wires shall be firmly attached to the anchor post on each end of a fence section by double wrapping the wire around the anchor post and tying it off.

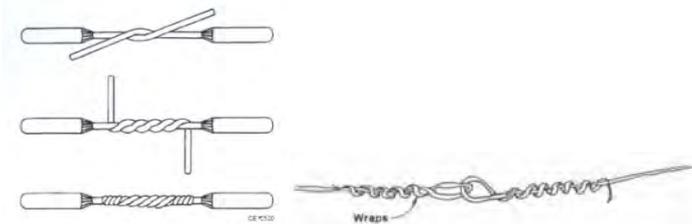
Wires shall be attached to all line posts using staples, tie wires, or manufactured wire fasteners of good quality.

The following minimal criteria will be required:

- Maximum top wire height is 42 inches above ground, or as granted by variance request;
- Minimum bottom wire height 16 inches above ground level and smooth**
- 12 inches spacing between top and second wires;

- Suspension fences are designed to have a whip-like action to turn back livestock. Suspension fence wires shall be tight, with not more than 3 inches of sag between posts. In-line or end-post ratchet strainer devices can be installed to maintain correct wire tension, especially if high-tensile wire is being used.
- Tie wires for attaching fence to posts shall be 16 gauge of heavier galvanized steel;
- Fence wires in suspension fence line sections shall be attached to wooden line posts in a way that the wire can slide back and forth. 20 gauge sheet metal 1 inch x ½ inch fastened on each side of the wire with a sixpenny nail works well.
- Staples shall be 9 gauge galvanized or polished hard wire, minimum 1.5 inches long for treated soft wood, and 1 inch for hardwood posts. Staples shall be driven diagonally to the grain at a slightly downward angle. Staples on line posts will not bind or bend the fence wire and need to allow the wire to contract and expand. Steel "T" or "U" line posts have enough give that wires can be attached normally for suspension fences.
- Where wire splicing is necessary, either the "Western Union" or "loop splice" is acceptable. Commercial wire joiners are also acceptable as long as tension is maintained.

Figure 7: Example of Western Union and Loop Splice



Recommend Wire heights for 4-strand fence:

	Cattle 3-wire**	Cattle**	Sheep**	Cattle and Sheep**
Top wire	42"	40-42"	32"	38"
2 nd wire	30"	28 – 30"	22"	26"
3 rd wire	18"	22"	16"	18"
4 th wire**	n/a	16-18" Smooth	10" Smooth	10" Smooth

Building fence with wildlife considerations assists wildlife movement, as well as maintenance of fence lines. Where jumping animals (e.g. deer, elk) movement occurs, consider using a smooth wire or vinyl coated high-tensile wire for the top wire, or in areas of heavily used crossing area consider covering the existing top wire with PVC/PE pipe.

**In areas where crawling animal (e.g. pronghorn) movement occurs the recommended wire height for the bottom wire is 18 inches from the ground. At known antelope crossing areas fence stays shall not impede movement and bottom wire can be covered with split PE or PVC pipe.

Wildlife Considerations

Spacing, height and type of fence will be planned to include consideration to ungulates, such as pronghorn, deer and elk, as well as sensitive bird species. If there is no wildlife to plan considerations, document area biologist concurrence and include with practice information in the case file.

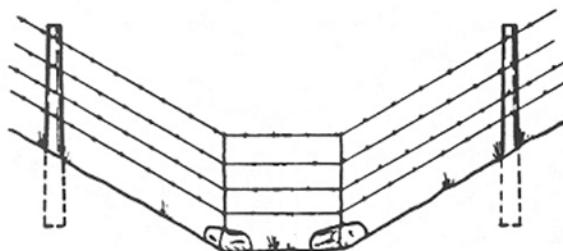
See *Range Technical Note No. 38* and *Range Tech Note 39* for references to plan additional site specific recommendations for wildlife considerations. If not using standards in this spec for wildlife then submit a variance documenting planning for wildlife.

VIII. FENCE ANCHORS

Fence anchors shall be installed when the bottom wire is more than 6 inches above the design height above the ground.

Anchor weights for holding down fence wires crossing drainages or depressions shall weight at least 50 pounds or be equivalent to a 1 cubic foot concrete block. They shall be attached with 9 gauge or heavier smooth wire.

Figure 8: Illustration of fence anchors

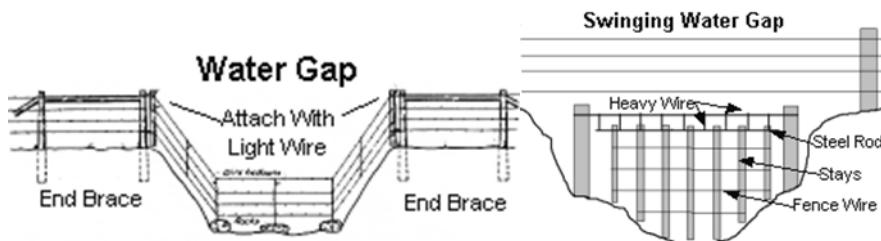


IX. FLOOD GATES, WATER GAPS AND PERENNIAL WATERWAYS

Flood gates may have to be installed in low areas that are subject to flash floods to allow water and water born debris to pass through; otherwise fences may be damaged during heavy run-off.

Water gaps may be needed to control livestock where fences cross streams or drainage. There are two basic types of water gaps. For areas with very little water and only occasional flooding, a breakaway fence will be sufficient. In areas with regular flooding, it may be best to construct flooding gates or panels.

Figure 9: Illustration example of types of water gaps



Depressions less than 16 feet wide can be fenced without braces. Depressions greater than 16 feet need a break-away fence that will leave the rest of the fence undamaged. Water gap shall be assembled as a separate unit to protect the main fence from damage. The ends of the water gap fence wires shall be attached to a separate steel or wooden line post attached to the end brace using light wire or staples that will allow the water gap to break away from the end braces in a flood event. Smooth wire should be used, with the same line post, wire and wires spacing requirements. Depth of posts can be reduced to 12", minimizing damage to the posts if fence breaks away. Water gaps will need to be maintained and replaced after damage.

For deep narrow drainages, a separate fence section can be installed below the main fence. See *Range Tech Note No. 38* for further construction ideas on flood gates and water gaps.

If fencing through a perennial waterway is necessary then a combination of end braces and swinging water gaps may be needed. Fencing over perennial waterways will consider wildlife passage. Ideally, the fence will be a minimum of 12" off the normal water level and should allow free passage by fish and floating birds and provide high visibility for birds in flight. Consider recreational uses when building fences over perennial streams/rivers.

X. GATES AND CATTLE GUARDS

Any commercially available cattle guard approved by the manufacturer for the intended use in the fence may be used.

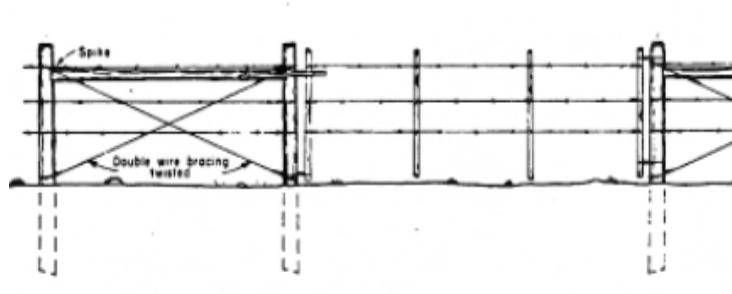
Gates allow access from both sides of the fence and shall be placed in locations that consider existing and planned roads, ease of access for livestock management, intended prescribed grazing strategy to be implemented, and other necessary considerations for the planned area.

Gates shall equal or exceed the quality of the adjoining fence. They shall be adequate width to accommodate the intended purpose. They may be made of wood, aluminum, steel or wire.

Wire gates shall be constructed of equal or better quality wire and stays used in the fence. Wire gate across road shall have stays at least every three feet to ensure they are visible to vehicles.

If a heavy gate is attached to the anchor posts side of the end brace assembly, an additional tension wire running in the opposite direction will be necessary. The tension wire should only be tightened enough to offset the weight of the gate.

Figure 10: Illustration of wire gate



382 – Fence – Suspension Implementation Requirements

IR - 1

The Practice Purpose(s):

Construct a barrier to animals or people and facilitate other management practices or accelerated conservation practices.

Kind of Animal:			
Type of Fence:		Length of Fence:	

Anchors and Brace Assemblies:			
	Type	Materials	Other Requirements (additional information not in specifications or drawings, locations, special considerations specific to project, etc.):

Line Posts and Stays:			
Line Posts		Special Requirements:	
Fence Section Spacing			
Stays:		Number of stays between fence sections:	

Wire Requirements:			
Wire Spacing:		Special Wildlife Requirements:	
Required Fence Markings:	Yes No		

Special Requirements:

Site Preparation and Additional Installation Information

382 – Fence – Suspension Implementation Requirements

IR - 2

OPERATION AND MAINTENANCE

Fences should meet the objectives of the conservation management system in providing an effective barrier. The fence is expected to remain operational for the lifespan of the practice. The expected lifespan of this practice is 20 years. With good maintenance, fences installed to these specifications can longer than the 20 year lifespan.

Typical maintenance requirements include:

- Remove all foreign debris that hinders fence operation
- Immediately repair any damage from vandalism, vehicles, fire or livestock, this includes damage to wires, stays, braces and line posts.
- Maintain gates used for control of livestock and vehicular travel
- Maintain and clean cattle guards as necessary.
- Check and repair/replace flood gaps/water gates after storm events.
- Periodically check fence wire tension and maintain necessary tension.
- Repair any wire breaks that might occur
- Repair/replace stays and maintain spacing requirements.
- Ensure water does not pond around posts.
- Retain and properly discard all broken fencing material and hardware.

Other Requirements:

I have received and reviewed the plans, specifications, drawing, operation and maintenance and any other associated documents. I accept and approve them for installation of this project.

Landowner or Operator Signature

Date

**382 – Fence – Suspension
As-Built Documentation and Practice Certification**

AB - 1

Producer Name		Farm/Tract #:	
Inspection Date:		Follow Up Inspection Date:	

Fence Length:		Measurement Method:	
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Brace Assemblies

Installed at corner, gates, and angles and topography changes:		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Maximum section lengths at approx. every 1320 feet or less:			
Type of Brace:		Materials:	
Length of braces:		Height Above Ground:	
Height of horizontal Brace:		Tension Wire:	
Other Notes:			

Brace Posts

End, Gate and Corner Braces			Line Braces		
Materials:		Materials:			
Treatment Type:		Treatment type:			
Length:		Size:		Length:	
Weight :		Depth Set:		Weight	
Other Notes:					

Line Posts, Stays and Wire Attachment

Line Posts Type:		Treatment Type:	
Post Length:		Size or Weight:	
Depth Set:		Post Spacing (feet):	
Stay Type:		Number of Stays between Posts:	
Tie Wire Gauge:		Staple Size:	
Attached loosely so wire can move:			
Staples driven diagonally with the grain:			
Other Notes:			

Fence Wire

Gauge:		Type:	
Number of Strands:		Fence Markings:	
Wire Spacing:		Wildlife Requirements Met	
Top Smooth:			
Bottom Smooth:		Wire Splicing:	
Other Notes:			

**382 – Fence – Suspension
As-Built Documentation and Practice Certification**

AB - 2

Other:

Gates		Cattle Guards		Water gaps and/or Flood Gates		Other	
Type	Type	Type	Type	Type	Type	Type	Type
Meets Specifications:	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Notes:				

Other As-Built Notes:

If there are items that do not meet the specifications and/or drawings, describe the deficiency:

Deficiency Corrected Date:

Landowner/Operator Completion Certification:

This practice(s) meets applicable NRCS standards, specifications, drawings and installations requirements and represents the above as-built conditions.

Landowner/Operator Signature

Date

Practice Completion and Certification:

The acceptability of this work has been determined by inspections to check compliance with all the provisions of this specification with respect to the drawings and the installations requirements.

I have made an onsite inspection of the site, and have determined that the job as installed does conform to these practice specifications, drawings and installation requirements.

NRCS Signature

Date