

## CONSERVATION PRACTICE SPECIFICATION

### Fence - 382

Installation of Fence - 382 shall adhere to the North Dakota NRCS conservation practice Standard in the Field Office Technical Guide (FOTG) – Section IV – Conservation Practices.

The General-Purpose Fence is designed to contain or control movements of livestock where heavy concentrations or pressures are not expected (e.g. cross fences, use exclusion, boundary fences).

The Protective Fence is designed for use in areas where a high degree of protection is desired (e.g. livestock waste storage structure).

The size, gauge, amount, weight, or type of materials specified for each fence type shall be regarded as minimums, unless otherwise specified. Post seating depths shall be regarded as minimums. Post spacing and wire spacing shall be regarded as maximums, unless otherwise specified.

All materials used in construction of a fence will be new. Any materials or construction features that exceed these specifications, or equivalents of different design but of equal or greater effectiveness, are acceptable for meeting specifications. Questionable materials or construction features which deviate from the designs shown require prior approval by the State Resource Conservationist.

#### GENERAL-PURPOSE FENCE

##### **General-Purpose Fence (3 or 4-wire barbed, and woven-wire)**

For construction details, see ND Conservation Job Sheet 13, located in FOTG – Section IV – Conservation Practices – Fence - 382.

Barbed wire will **not** be used on power fences either as the energized wire or as a ground wire. Power fence and barbed/woven wire will not be mixed on the same segment of fence.

#### **Materials**

##### A. Barbed wire

1. Standard weight: Double-strand galvanized wire of 12.5 gauge with two-point 14 gauge wire barbs at a spacing of approximately 4 to 6 inches.
2. High-tensile strength (170,000 psi): Double-strand galvanized wire of 14 or 15.5 gauge with two-point 16.5 gauge barbs at a spacing of 4 to 6 inches.

B. Smooth wire

1. Standard weight: Double –strand 12.5 gauge galvanized wire.
2. High-tensile strength (170,000 psi) single strand, Type III galvanized.

C. Woven wire

1. Standard weight: 26 to 34 inches high netting with 11 gauge top and bottom wires, 14.5 gauge intermediate and stay wires, all galvanized. Mesh size can be 6” x 6” or 6” x 12”; 12-inch mesh is recommended for goats to reduce hang-up.
2. High-tensile strength: 42-inch netting with 12.5 gauge high-tensile strength (170,000 psi) line wires, 12.5 gauge medium-tensile strength (125,000 psi) stay wires, all galvanized. Mesh will be 4” x 6” to 7” x 12”.

D. Wood posts: All decay-susceptible wood posts (such as pine) must be treated with proper chemical preservatives for below-ground application (i.e. creosote or pentachlorophenol). Posts made from rot-resistant woods such as red cedar or Rocky Mountain juniper are suitable without treatment.

1. Line posts: 3-inch diameter, 6-foot length, sound, and reasonably straight.
2. Corner, gate, and in-line brace posts: 5-inch diameter, 7-foot length, straight and sound, wood.

E. Steel posts:

1. Line: Length, 5.5 feet; weight, 1.25 pounds per foot (excluding anchor plate); must have knobs, studs, or grooves for holding wire in place; must be equipped with a sturdy anchor plate firmly attached.
2. Corner, gate and in-line brace posts: 2<sup>7</sup>/<sub>8</sub> inch outside diameter, 5.8 lb/ft, 8-feet in length, new or used, of good quality, free of rust and pitting (surface rust which doesn't adversely affect the integrity of the pipe is acceptable). Posts will be permanently capped to prevent rainfall from entering post and tabs welded to the “pull” post to maintain proper wire spacing.

F. Brace material

1. Braces: Straight and sound 4” x 4” x 8’ lumber or 4-inch diameter post of 8-foot length or 2” x 8’ steel pipe. Pipe should be free from rust although superficial rust (i.e. surface rust) which doesn't adversely affect the integrity of the pipe is allowable. Braces will be securely attached to the vertical posts.
2. Wire: either of the following
  - a. Galvanized, double-strand 12.5 gauge
  - b. Galvanized, single-strand 9 gauge

G. Wire fasteners

1. Staples: 9 gauge wire staples, 1.5 inches long for softwoods, 1-inch length for high- density hardwoods.
2. Ties and/or clips: Made especially for the particular style of post used or #12 galvanized wire.

H. Stays: Galvanized, twisted, wire stays shall be long enough to hold each fence wire at specified spacing.

**Construction**

A. Post seating depth: All posts should be set deep enough to gain maximum sturdiness consistent with soil conditions. Set posts to the following depth under normal conditions:

1. Line posts
  - a. Wood: 2 feet
  - b. Steel: 1.5 feet
2. Wood corner, in-line brace, and gate posts will be seated at least 2.5 feet deep.
3. Steel drill stem pipe corner, in-line brace and gate posts will be driven to a minimum depth of 3.5 feet. When not driven, posts will be centered in a hole that is a minimum of 12 inches in diameter, 2.5 feet in depth, completely filled with concrete and crowned (mounded) at post base to prevent water from ponding around post.

B. Line post spacing

1. Barbed-wire fence
  - a. Up to 24 feet without stays.
  - b. 25 to 30 feet with at least one stay. Stays must divide the space between posts about equally.
2. Woven-wire fence: Up to 20 feet.

C. Alignment: Construction should be as straight as possible between corners or turns. Fence construction along curved lines should be in straight segments with in-line bracing at appropriate angles. Sound railroad ties or 5" x 7' posts set at a depth of 2.5 feet are adequate for bracing turns of 15 degrees or less. If angle is greater than 15 degrees then H-brace or diagonal brace is required.

D. Bracing and anchoring: When fencing over uneven terrain, the fence shall be adequately anchored at low spots.

1. In-line brace, end or gate brace assemblies: Install at 1,320-foot intervals or closer, between corners or other major turns. Set two posts a minimum of 8 feet apart with top timber between the two, and diagonal wires from the base of each to the top of other posts. A diagonal style brace may be used in place of the standard H-style brace. Refer to ND Conservation Job Sheet 24.

2. Corner braces: Set brace a minimum of 8 feet from the corner with top timber between the posts, with one diagonal wire wrapped and twisted from the top of the brace post to the bottom of the corner post. A diagonal style brace may be used in place of the standard H-style brace. Refer to ND Conservation Job Sheet 24.
- E. Wire placement: Wire will be double-wrapped and stapled at all corners, in-line brace post assemblies, and gate posts.
1. Barbed wire
    - a. Three-wire: Attach top wire at least 42 inches above ground level at post locations. Attach middle and bottom wires so wire-to-wire and wire-to-ground intervals are all about equal.
    - b. Four or more wire: Same as above, except operator may attach some wires closer together at their discretion, based on types of livestock involved.
  2. Woven wire
    - a. Netting will be supplemented with a barbed wire attached approximately 3 inches above it. Attach bottom wire of netting about 2 inches above ground level at post locations.

### **Power Fence**

For construction details, see ND Conservation Job Sheet 23, located in FOTG – Section IV – Conservation Practices – Fence - 382.

Power fences erected in areas of potential high public use should be properly signed.

### **Wire**

- A. Type: Use smooth, single-strand, 12.5 gauge high-tensile strength (170,000 psi, minimum), type III galvanized or better. ***Barbed wire will not be used on power fence.***
- B. Placement
  1. A single, hot wire may be used in situations where the earth will provide an adequate ground to complete the circuit back to the energizer. This single, hot wire should be located 26 to 32 inches above the ground line.
  2. Two-wire power fences will have the top wire (hot wire) at least 26 inches above ground line and the bottom wire (ground wire) 8 to 12 inches below the top wire. The bottom (ground) wire will be connected either directly to the negative side of the energizer or to the same grounding rod(s) as the energizer. In situations where the earth provides an adequate ground to complete the circuit, both wires may be energized.
  3. Three-wire power fences will have the top wire (hot wire) at least 26 inches above ground line. The remaining two wires will be spaced 8 to 12 inches apart. The middle wire (ground wire) will be connected either directly to the negative side of the energizer or to the same grounding rod(s) as the energizer.

In situations where the earth provides an adequate ground to complete the circuit, all three wires may be energized.

- C. Tension: Tension on each wire shall be sufficient to maintain proper wire spacing between line posts. In-line strainers will be installed on each wire to maintain correct tension on each wire between all brace corners and gate assemblies. Tension springs may be used on each wire to maintain proper tension.

### **Line posts**

#### **A. Material**

1. Fiberglass or other compound type posts will be a composite of polypropylene, marble, wood fiber/"flour", fiberglass, and/or polymer resin that has been treated by thermosetting (heat treatment) and UV protected. Posts will be a minimum of 7/8 inch x 7/8inch T-shape or 7/8-inch diameter round, with notches or holes located for proper wire spacing.
2. Wood posts will have a diameter of 2 inches or larger. Posts must be treated or made from rot-resistant wood. Eucalyptus wood (ironwood) and insul timber posts are not recommended due to excessive breakage.
3. Steel posts will weigh one pound per foot, excluding anchor plate, and have a firmly-attached anchor plate.

#### **B. Placement requirements**

1. Posts will be driven a minimum depth of 16 inches, except in sand where 24 inches may be required.
2. For three-wire power fences, line posts are not to exceed 75-foot centers without stays, or 100-foot centers with stays on 50-foot centers between line posts.
3. For single-wire and two-wire power fences, line posts are not to exceed 100-foot centers. Stays should not be used on two-wire power fences.

### **Corner, Gate, and Brace Assemblies**

#### **A. Materials and design will meet the same requirements as general-purpose fence.**

1. For one, two, or three-wire permanent power fences, the diagonal style corner may be used in place of the standard H-style corner. Refer to ND Conservation Job Sheet 24, located in FOTG – Section IV – Conservation Practices – Fence - 382.
2. In-line brace assemblies will be spaced at intervals no greater than 4,000 feet on level terrain.
3. Over uneven terrain, provide additional bracing as needed between corner, gate, end, and brace assemblies. Use properly anchored posts of adequate size with attached deadmen in low spots. On rises, use wood posts of 4-inch diameter or larger to counteract downward pull.

## **Fence Alignment**

Construction should be as straight as possible between corners or turns. Construction along curved lines should be done in straight segments with in-line bracing at appropriate angles. Sound railroad ties or 5" x 7' posts set at a depth of 2.5 feet are usually adequate for bracing these turns, especially where the angles are wide and the fence segment is short.

## **Fence Fasteners and Insulators**

### **A. Materials**

1. On wood posts and steel posts, use porcelain, ceramic, or high-quality, UV-stabilized polypropylene insulator to which the wire can be attached. Polypropylene insulators shall be of the type that provides adequate spacing from the post to prevent current leakage.
2. Use only manufacturer's recommended insulators at all points where tension from the wire is transferred to corner, gate, end, and brace posts.

### **B. Attachment**

1. Attach wire to porcelain and ceramic insulators with the appropriate manufacturer's clip or use 12 gauge, galvanized wire.
2. Attach wire to fiberglass posts with the specifically designed manufacturer's fastener or "clip" or use 12.5 gauge galvanized wire tied in a loop to attach wire to post. Instead of using "clips" or wire ties, holes may be drilled in fiberglass posts. Holes should be drilled at the proper spacing. The line wire is not to be threaded through pre-drilled holes but will be attached with wire or proper fasteners. High-tensile strength wire is attached to the post using a short length of galvanized wire that is looped around the line wire, threaded through the hole in the post, and wrapped back around the line wire on either side of the post ("Cotter key" style fastener).

C. Stays: Only fiberglass stays will be used. They will be a composite of marble, fiberglass, and polymer resins that have been treated by thermosetting.

D. Energizers: Electronic energizers or power-fence controllers shall be UL (Underwriters Laboratory) listed. Installation shall be according to manufacturer's recommendations. Additional requirements include:

1. High output, low-impedance type
2. Minimum output of 1 joule
3. High-impact, weather-resistant case or otherwise adequately protected from weather.
4. Solid-state circuitry (snap-in circuit panels).
5. Any of the following power requirements;
  - a. 110-volt

- b. 220-volt
- c. 12-volt battery (with or without solar charger)

The minimum accepted fence voltage for livestock control is shown below. Vegetation loads and electrical shorts will reduce the voltage resulting in the need for a higher output energizer. These figures are for guidance purposes only.

- cattle - 1600 volts
- sheep and hair goats - 2000 volts
- hogs, horses and meat goats - 1200 volts

- F. Electrical Grounding: All power fences must be properly grounded as per the energizer manufacturer's recommendation. **Inadequate grounding is the leading cause of power fences' failure to control livestock.**
- G. Insulated cable: To cross gates and other areas where the power fence is located some distance away from the energizer or controller, use insulated cable. Use galvanized wire with two layers of insulation for underground burial or overhead transmission. Where feasible use overhead transmission to reduce the incidence of short-circuiting, which can occur with underground burial. Do not use insulated copper wire due to corrosion factor and lack of tensile strength.

## PROTECTIVE FENCE

For details, see ND Conservation Job Sheet 14, located in FOTG – Section IV – Conservation Practices – Fence - 382. Construct standard protective fences by the same method and design as specified for general-purpose fence except for the following variations:

### Materials

#### A. Line posts

1. Wood: 4-inch diameter, length 6.5 feet.
2. Steel: 6-foot length, weight of 1.25 pounds per foot, excluding anchor plate.

### Construction

#### A. Line post spacing

1. 16 feet; wood at least every third post: applicable for barbed and woven-wire.

#### B. In-line bracing and anchoring

1. Maximum 825-foot interval.

C. Wire

1. Four barbed wires with top wire at least 42 inches above the ground. Lower wires may be spaced at the discretion of the operator, based upon types of livestock to be excluded.
2. Woven wire will have at least one barbed wire attached approximately 3 inches above the top of the woven wire.

**CHAIN-LINK FENCE**

For use as protective fence where high-hazard risks need to be reduced (i.e., around waste storage structures, power generators, etc.).

**Materials**

A. Wire

1. Fabric wire will be a minimum of 12.5 gauge 2-inch mesh, 48 inches high, with zinc coating or equivalent.
2. Barbed wire; See general-purpose fence design section for barbed wire specifications.

B. Posts

1. Line posts: galvanized steel with a minimum outside diameter of 1 5/8" x 5.5'.
2. Corner posts: galvanized steel with a minimum outside diameter of 2 3/8" x 6'.
3. Gate posts: galvanized steel with a minimum diameter and length to support the gate width needed according to the manufacturer's recommendations.

C. Top rail

1. Will be galvanized steel pipe, or equivalent, with a minimum diameter of 1 5/8 inches.

D. Gates

1. Gates will be of the size necessary to allow for equipment access.
2. Gates shall be installed according to manufacturer's recommendations.
3. Gates may be single-swing or double-swing with the appropriate fittings for latches, stops, hinges, keepers, and other needed accessories. All materials will be steel with zinc coating or equivalent.

E. Chain-link fence accessories

1. Caps, rail and brace ends, rail sleeves, wire ties and clips, brace bands, tension bands, tension bars, tension wire, barbed-wire support arms, and other accessories will be of steel and zinc coated as per manufacturer's recommendations. Install lock, latches, or chains where safety is a concern.

## Construction

All chain-link fences will be constructed according to the manufacturer's recommendations and/or completed job sheets.

## FENCE DESIGN FOR SPECIALIZED LIVESTOCK

### Bison

- A. Boundary fences: The specification for a protective four barbed wire fence will be used as the minimum design criteria for a boundary fence. Six-foot length, steel posts will be utilized in place of the standard 5.5-foot length, steel post. Wood posts will be 6.5 feet in length. Top wire should be set at 52 inches in height.

Other designs (i.e. 3 or 4 wire barbed General-purpose) may be used depending upon the level of herd management and proven fencing designs already in use on the unit.

- B. Internal cross fences: The minimum design criteria are a standard three-wire barbed or two-wire power fence. Fences exceeding minimum criteria will be dependent on producer's need and management.

### Elk and White-tailed Deer

Fence design requirements and permits for elk and white-tailed deer are issued through the North Dakota Department of Agriculture's Board of Animal Health. Inquiries should be directed to the Board of Animal Health at 701-328-2654 or <http://www.legis.nd.gov/information/acdata/pdf/48-14-01.pdf>

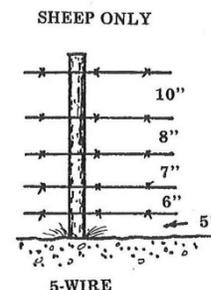
### Horses

To minimize or prevent injury; double-strand, galvanized, barbless wire of 12.5 gauge may be substituted for the barbed wire in a general-purpose or protective fence.

### Sheep

Woven wire has been the customary fence for sheep. However, properly constructed multi-wire (5 wires or more) high tensile smooth wire power fence or barb wire has also proven effective. Power fence may also provide enhanced predator control. Specifications for woven wire fence are shown on ND Conservation Job Sheet 13. Corner and brace assemblies for multi-wire power or barbed wire fence will be constructed as per ND Conservation Job sheet 13. Wire spacing (from ground surface) for power or barb wire:

- 1<sup>st</sup> wire: 4 to 6 inches
- 2<sup>nd</sup> wire: 10 to 12 inches
- 3<sup>rd</sup> wire: 17 to 19 inches
- 4<sup>th</sup> wire: 25 to 27 inches
- 5<sup>th</sup> wire: 35 to 37 inches



Variations to wire spacing may be granted via the variance process. Consult your Area Rangeland Management Specialist.

### **WILDLIFE FRIENDLY FENCE**

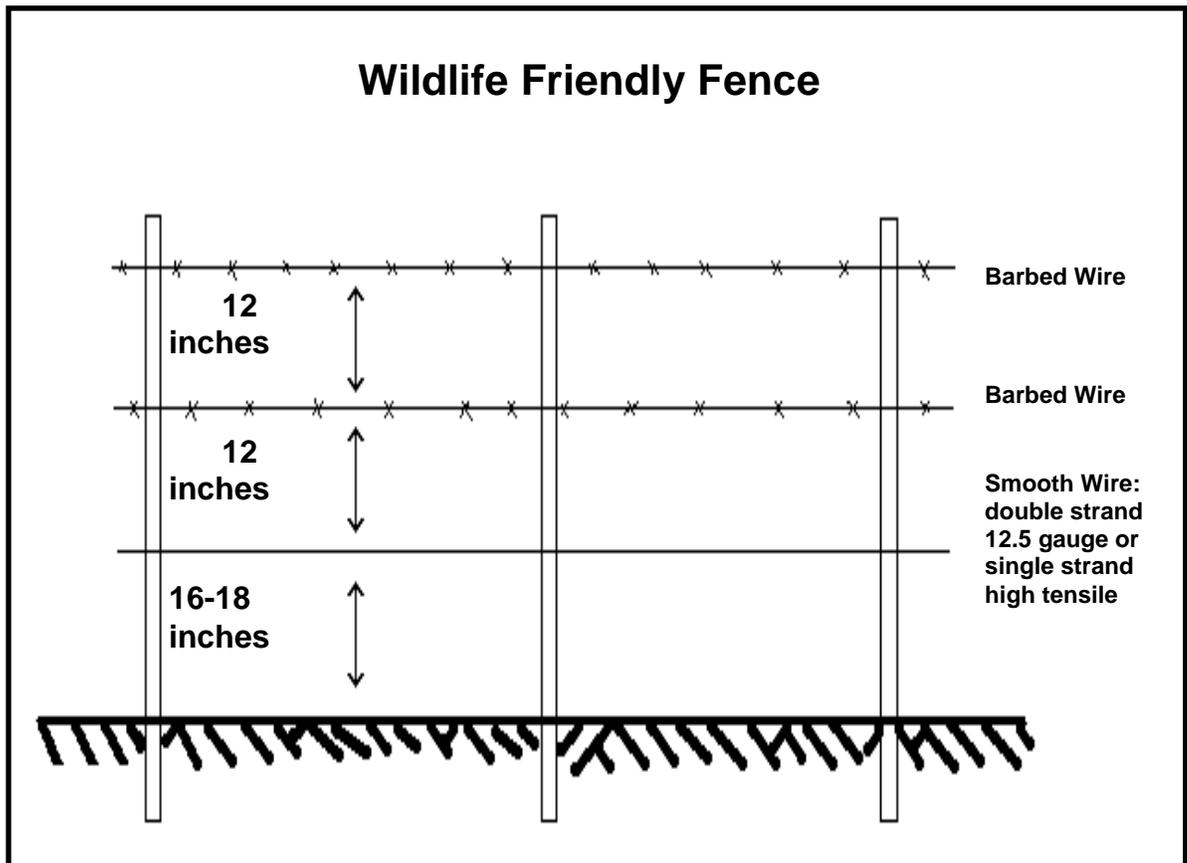
General-purpose fence (barbed wire only, no woven wire)

Top wire for boundary (3 or 4 wire) and cross fences (3 wire only) will be 42 to 46 inches. Wire spacing for the top two line wires will be a minimum of 12 inches apart at the post location. Bottom wire will be smooth wire (double strand 12.5 gauge or single strand high tensile 12.5 gauge) installed a minimum of 16 inches from the ground. For 4 wire fences, the third wire from the top will be spaced equidistance between the bottom and second wire, measured at the post. For wildlife friendly options when installing a 5 or more wire sheep fence, contact your area specialist for guidance.

#### **Power fence**

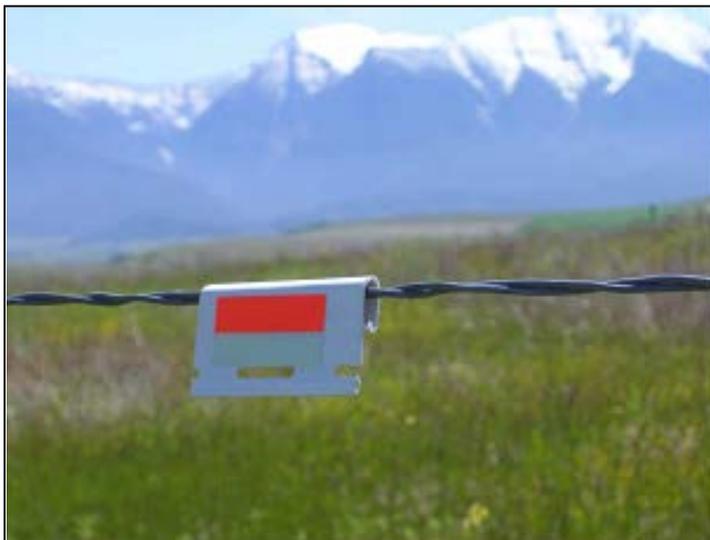
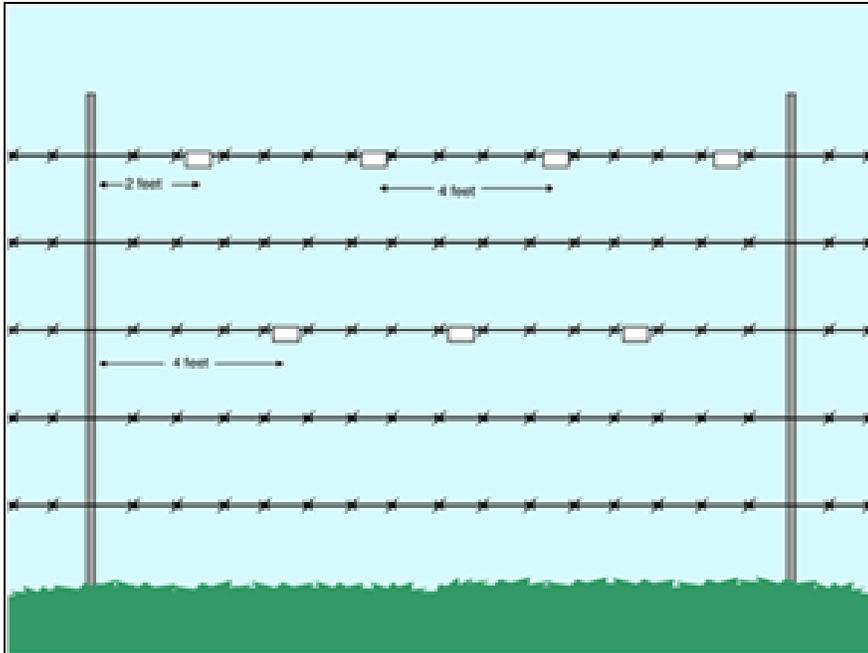
One, two or three wire power fences constructed as per this specification are considered wildlife friendly.

Diagram # 1



### Sage-grouse

Add reflectors to new or existing fence (except electric) within ¼ mile of a known lek (active or inactive), known high use feeding areas, and observed sage grouse fence strike areas. Reflectors will be added to the fence up to ¼ mile in both directions from the previous mentioned areas. For new fence installations, reflectors can be installed on the entire fence. Reflectors will be spaced according to the directions on the following diagram. For existing three and four wire fences, reflectors will be installed on the top two wires; on 5 wire fences, on top and third wires.



For additional information, see:

[http://www.suttoncenter.org/caffeine/uploads/files/research/pdf/fence\\_marking.pdf](http://www.suttoncenter.org/caffeine/uploads/files/research/pdf/fence_marking.pdf)

## LIVESTOCK WINDBREAK FENCE

Planning considerations should include local topography, impacts on water quality, proximity to other structures and/or physical features which may affect snow deposition (i.e. existing shelterbelts), and prevailing seasonal wind direction.

### **Portable Fabricated Windbreak**

Properly constructed portable windbreak fences provide shelter to wintering livestock, permitting the manager to move livestock from traditional wintering areas to more non-traditional locations such as cropland or hayland fields and/or facilitate such winter feeding methods as swath or bale grazing. Livestock wintering locations will be moved at least annually. This can benefit water quality by reducing impacts on sensitive areas, enhance nutrient management, improve soil health and reduce costs associated nutrient management. See ND Conservation Job Sheet 25 for specifications, materials and design criteria.

### **Permanent Fabricated Windbreak**

Properly planned and constructed permanent fabricated windbreaks are designed to modify wind and snow patterns, providing some level of protection for wintering livestock. See ND Conservation Job Sheet 26 or 27 for specifications, materials and design criteria.

## REQUIRED FORMS

- A. ND-CPA-2 Fence Data Sheet. All forms are located in [FOTG – Section IV – Forms](#).

## OPTIONAL DOCUMENTS

- A. Manufacturer’s instructions for power fence energizer.

## PLANNING REQUIREMENTS

- A. Document compliance with NRCS’s cultural resource policy and environmental policy.
- B. Indicate the location of fence on the conservation plan map.
- C. Furnish the operator with the Conservation Job Sheet(s) for each type of fence planned.
  - 1. ND Conservation Job Sheet 13 for General Purpose Fence
  - 2. ND Conservation Job Sheet 14 for Protective Fence
  - 3. ND Conservation Job Sheet 23 for Power Fence
  - 4. ND Conservation Job Sheet 25 for Portable Windbreak Fence
  - 5. ND Conservation Job Sheet 25 or 26 for Permanent Fabricated Windbreak Fence

- D. For chain-link fence, include a copy of the manufacturer's recommended specifications in the case file.

**PERFORMANCE**

- A. Field checks a representative sample or all fencing for conformance to material and construction specifications.
- B. Identify sections of the fence checked.
- C. Determine the length of the fence by chaining or plotting and measuring on an aerial photo. The latter is to be used only when the location can be readily and accurately plotted.
- D. Accept producer-claimed figure when aerial photo measurement is used and difference is minor. Resolve any major difference by chaining.
- E. Complete all data on form ND-CPA-2 Fence Data Sheet.