

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE GENERAL SPECIFICATIONS**

FENCE

(feet)

CODE 382

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Note: There have been no changes to the Figures dated 6/11/99. They are to be used until an updated copy is provided. Metal post caps are recommended but not required for >1/4 inch pipe wall thickness; see pipe posts, D. & F. this section.

APPENDIX A

GENERAL MATERIAL AND INSTALLATION CRITERIA

1. APPLICABLE TO ALL CONVENTIONAL PERMANENT FENCES¹ - Posts.

- A. Wood post preservatives and treatment: Yellow cedar is the only native Alaskan tree approved for untreated use; all other native woods are to be treated. For aspen, balsam poplar, black and white spruce, process use double-diffusion treatment of copper sulfate and sodium chromate (Krieg, 1993). Copper sulfate (CuSO₄) and sodium chromate (Na₂CrO₄) treated posts have been found to have the greatest longevity. Posts should be peeled and treated while green and submersed three days in 8% CuSO₄ solution. Another treatment option is cold soak in pentachlorophenol (Krieg, 1993) refer to note on page 2 of same publication. If the specifications are followed for the appropriate tree species, both of these processes are approved. Chemicals addressed herein are possibly carcinogenic, poisonous, and hazardous. **Mixing in solution can result in toxic gases.** These chemicals should be applied only under the supervision of DEC approved technicians. Check with appropriate DEC representatives before making any chemical recommendation. Posts treated with the following chemicals are to retain the amounts of that chemical as defined in the following:

<u>Treatment for Posts</u>	<u>Retention lb./ft³</u>
Creosote Coal Tar	6.0
Pentachlorophenol	0.6
Acid Copper Chromate	0.5
Amoniacal Copper Arsenate	0.4
Chromated Copper Arsenate (CCA)	0.4

- B. Wood line posts: must be minimum 3 inches top diameter. In rocky soil, posts must be set a minimum depth of 18-20 inches. On all other non-rocky soils, line posts must be set a minimum depth of 24 inches. On undulating or mountainous terrain, position line posts on high and low points to facilitate required wire height.
- C. Metal **T** and **U** line posts. Must be new, painted or galvanized, and weigh a minimum of 1.25 lbs. per one foot of length. In loam, silt and soils of low shrink/swell capacity, posts must be driven so the anchor plate is below grade. In clay and high organic content soils, anchor plates posts must be 2-3 inches below soil surface.
- D. Pipe line posts: 2¼ inches nominal size pipe or larger may be used for line posts. Capping, painting, rust protection or galvanization is recommended for all post but not necessary for posts with >¼ inch pipe wall thickness. All Figures show capped and rust protected examples, inferring that the posts have a <¼ wall thickness. For conventional livestock fence, driven pipe post depths will be the same as described in Figure 1 or 2.
- E. Wood corner posts: must be at least 6 inches top diameter for conventional 44" and 60" fence and set at a minimum depth of 36 inches. For conventional fences, consider using corner design as defined in McKenzie and Currier, 1984.

¹ For Elk and Moose Fence, refer to specifications in Appendix D and Figures 13 and 14.

Appendix A (Cont'd)

- F. Pipe corner posts: corner assemblies with $>1/4$ inch wall thickness do not need to be capped, rust protected or painted. Post depths are to be the same as described in Figure 1 or 2.
 - G. Bracing at corners and gates: braces and/or end assemblies are required at all corners and at all gates.
 - H. When fence turning point changes more than 20° , sufficient bracing will be required to support line posts and maintain fence in a plumb position.
 - I. Wood brace assemblies shall be minimum of $2\frac{1}{4}$ inches normal size diameter and length of horizontal brace shall be a minimum of 6 feet.
 - J. In permafrost or freezing soil conditions, fence posts will not be set in concrete because of frost heave action.
 - K. Soils susceptible to annual freezing - posts shall extend 1 foot into the non-freezing zone of the soil. The length of posts will be allowed to vary, depending on depth to frozen soil.
 - L. In rocky areas or shallow to bedrock soils, steel posts or special type construction may be needed.
 - M. When designing a fence for construction across permafrost areas, contact the State Range Specialist and State Engineer for specifications.
2. Wire.
- A. Refer to Table 1 for top wire height and wire gauge specifications.
 - B. Wire spacing for conventional fence from ground to top wire for five wire fence is 5, 12, 30, and 44 inches; four-wire is to be 16, 24, 32 and 44 inches; three-wire fence is 16, 24 and 36 to 38 inches. Electrified two-wire spacing will need to be designed for the specific class and kind of livestock.
3. Staples or Wire Clips.
- A. Must be galvanized and similar to strength of fence wire.
 - B. Staples will be used for wood posts. Use at least 9 gauge galvanized staples, at least $1\frac{1}{2}$ inches long for softwoods and at least 1 inch long for hardwoods. Drive staple(s) diagonally to grain of the wood to prevent splitting. Leave adequate space between staple and post so wire can slip back and forth. Use 12.5 ga. wire ties for pipe posts. For woven wire, staple or tie off at least the top three wires and the bottom wire. Staple or tie off along the post every 1 to $1\frac{1}{2}$ feet.
4. Pull-Post Spacing.
- A. For non-electric fences between pull posts or pull post assemblies - Pull post may be the length of wire spool (normally 1320 feet) on straight pulls in flat topography. See Figure 12 for pull post criteria.
5. Let Down Fences.
- A. Refer to Figure 15 for let down gate design. Refer to Figures 16 and 17 for general design. Let down fence material construction will be in accordance with standard cattle fences except for the following:
 - a. Line posts - minimum 4-inch diameter, treated or cedar standard post. Maximum spacing will be 50 feet.

Appendix A (Cont'd)

- b. Stays - extend 3 inches above top wire. Minimum dimension will be 2 to 2 ½ inches diameter. Galvanized wire or staples will be used to fasten stays to line posts. Maximum spacing will be 10 feet. End stays will be 2 ½ inch diameter galvanized pipe, connected to corner or line brace by galvanized chain positioned 4 to 8 inches from top and bottom of each end stay.
- c. Additional construction considerations; connect end stays to corners or line braces for maximum support. Because this fence will stretch with use, compensate for stretch during construction. Stays interfering with line post will be repositioned. An adequate right of way should be prepared to facilitate easy lay down and reinstallation.

Refer to Table 1 for specifications.

Table 1 Footnotes (Table 1 continued)

FENCE SPECIFICATIONS

- 1/ Malleable - Foreign and US manufactured 13.5 to 12.5 gauge and heavier Type III galvanization malleable steel barbed wire must equal or exceed 950 pounds-force (lb.) breaking strength. If lab test is needed, three wire samples of the lot under consideration will be tested. The average strength of the samples shall be the basis for acceptance. Any single sample of the three tested, having less than 900 pounds, shall disqualify the lot. Woven wire (or net wire) shall have at least: 11 gauge top and bottom strands; 14.5 gauge intermediate and stay wires and vertical stay wire spacing shall be 12 inches or less. Horizontal spacing between wires may vary according to manufacturer.
- 2/ High tensile wire must have a 170,000 PSI minimum strength (approximately 1800 lb breaking strength for 12.5 gauge), or greater, for 3 or more wire fences. Must have 130,000 PSI minimum strength or greater for 1 or 2 wire fences; and minimum of Type III galvanization which has 0.80 ounces of zinc per square inch of wire surface.
- 3/ At least 32 inches of woven wire (or net wire) having at least: 11 gauge top and bottom strands; 14.5 gauge intermediate and stay wires; stay wires spacing 12 inches or less.
- 4/ Required number of twisted wire stays or other suitable stay material must be installed in such a fashion so that they are spaced evenly between line posts and other stays. To determine total number of stays needed, take the distance between line posts and divide by stay spacing to determine n . Then calculate $n - 1$ to determine the total number of stays needed for the span between posts. To calculate total number of stays for the fence, determine the number of spans and multiply by stays/ span. Number in this column designates distance (ft) between posts and stays and other stays.
- 5/ To be used for multi-pasture short duration rotations only. For electric fence, a designated training facility is recommended.
- 6/ Line posts and stays will be set at significant high and low points over undulating terrain to maintain proper wire height. Post and stay spacing in high grazing pressure areas will be adjusted as necessary to create a suitable livestock barrier.
- 7/ When cattle are grazed with sheep add one barbed wire above seventh wire. For 32-inch woven wire, use 2 strands of barbed wire spaced 6 inches above woven wire and 6 inches between barbed wires.
- 8/ Fencing in areas receiving >72 inches total snowfall, or coastal areas receiving >48 inches total snowfall, the minimum post spacing will be 16.5 feet.
- 9/ These applications also apply to drop fences that are constructed in high snowfall areas.
- 10/ Information in this column defines suitability for the fence to be used as either a perimeter (boundary) or cross fence or both. The following letters p and x denote perimeter fence and cross fence respectively. When both letters **p** and **x** occur concurrently, the fence will be suitable for both perimeter and cross fence.
- 11/ For reindeer, any fence specified in the above (cattle & horses) is suitable to be used as cross fencing. For perimeter fence applications, use only those fences specified under reindeer in this table that are constructed so that the top wire is a minimum of 60 inches in height.
- 12/ Nylon monofilament with a >4.0 mm. diameter and a breaking strength of 800 – 900 pounds may be substituted for smooth wire for horse applications.
- 13/ For horses use a minimum top wire height of 44 inches.
- 14/ The application of any high tensile wire is marginally acceptable for horses and will be approved but it is not recommended.
- 15/ Electric fence applications or combinations of electric with conventional wire, for these animals will be designed by the cooperator, manufacturer and DC and be reviewed and approved by appropriate State Office personnel.
- 16/ For bison cross fence specifications, refer to cattle and horse conventional barbed wire 12.5 gauge malleable or high tensile wire or to 3 strand electric, smooth high tensile 12.5 gauge wire in this table.
- 17/ For this table, for rows in this column with multiple wire heights, e.g., 32" + 12"; add the two together (44") for height of top wire placement. The first identified height, e.g., 32" is top of woven wire; the second identified height is space to be occupied by strands of smooth or barbed wire.
- 18/ Stay is to equal minimum strength of heavy duty steel T post and extend from top wire into the ground. If wood stays are used, they are to be treated with preservatives according to Appendix A.1.A of this specification.

APPENDIX B
GENERAL MATERIAL AND INSTALLATION CRITERIA
APPLICABLE TO PERMANENT ELECTRIC FENCES ONLY

ENERGIZERS AND COMPONENTS

1. Energizers for permanent electric fencing must be:
 - A. High voltage/low impedance, short pulse that can produce at least 4000 volts output with all livestock containment fences charged (on) when under maximum anticipated load.
 - B. Recommend one digital read out voltmeter to be accompanied with energizer.
2. A minimum of 18 feet of galvanized steel (1/2-inch minimum) grounds must be installed near the energizer. Locate 5 ground rods in water accumulated area and in deep soil area, 6 foot long rods spaced at least 10 feet apart.

If energizer terminals can accept copper wire, copper ground rods, copper clamp, and copper wire may be used. Avoid mixing dissimilar metals to prevent electrolysis.

An additional set of four 6-foot ground rods for arresting the lightning is required. These should not be closer than 65 feet from the ground rod set at the energizer. Install one additional 6 feet galvanized (1/2 inch minimum) ground rod for each one mile of fence, located in moist area or preferred site between end of fence and energizer. For large energizer systems (14 or more joules), use a minimum of 3 additional feet of ground rods per joule of energizer output capacity.
3. For 120 volt or 240 volt energizers, install a voltage spike protector and inspect or install a ground rod at electric company's transformer pole (primary ground) and another ground rod at electrical circuit breaker box (secondary ground). Both primary and secondary grounds must have less than 10 ohms resistance.
4. A lightning arrestor or lightning choke is required (See Figure 10).

WIRE

1. Top wire should be about 66% the shoulder height of the grazing animal. Other wire(s) located below this height should be spaced so grazing animal receives facial shock. Constructed fence must not allow the animal's head to penetrate the fence without being shocked.
2. Wires attached to line post must be allowed to slip and be locked to stay post, if applicable.
3. For splicing high tensile strength wire, use only the equivalent of micro press crimping sleeves or figure eight knots. All electrical connections (both ground and positive) must use the equivalent of micro press crimping sleeves or taps.
4. When tying end posts with high tensile strength wire, use only thread through method or crimping sleeves.

Appendix B (Cont'd)

5. Fences constructed in sand, loamy sand, or shallow rocky soils are not to use all positive wire system because of poor conductivity and reduced shock effectiveness.

POSTS

1. Fiberglass sucker rod must be at least 1 inch in diameter.
2. Fiberglass T-post and stays must be new and at least 1 inch cross-section.
3. Pull posts or pull post assemblies for electric permanent fence shall be spaced no more than ½ miles apart on undulating terrain. On flat terrain, spacing may be increased to end of spool (not to exceed 4000 feet).

ELECTRICAL ACCESSORIES

1. Insulation used for positive charged wire(s) must be high-density polyethylene or polypropylene with ultraviolet (UV) stabilizer, capable of withstanding a minimum of 10,000 volts or more current leakage.
2. All underground wire(s) installations must be insulated, molded, high tensile strength steel, 12.5 gauge or larger wire. The insulation must be high-density polyethylene or polypropylene with ultraviolet (UV) stabilizer and capable of withstanding a minimum of 10,000 volts or more current leakage.
3. Insulators for steel and other conductive material posts must be high-density polyethylene or polypropylene with ultraviolet (UV) stabilizer, porcelain, or other insulators that withstands 10,000 volts or more current leakage.
4. Insulators for end, corner, and angle braces must be high-density polyethylene or polypropylene with ultraviolet (UV) stabilizer or porcelain (Do not use insulated tubing for brace assembly).

APPENDIX C

GENERAL MATERIAL AND INSTALLATION CRITERIA APPLICABLE TO TEMPORARY ELECTRIC FENCES ONLY

1. Temporary electric fence shall be constructed with the intent of being left in place for only a short time period. It shall not be constructed as an equivalent of a permanent fence. Therefore, the criteria for a temporary electric fence requires materials, design, and construction that will accomplish the intended purpose and last for the time period planned with no more maintenance than desired.
2. The number of wires and spacing will be designed to accomplish the desired result of the fence (See permanent electric fence guidance for number of wires and spacing). Temporary net fence is available and can be used to prevent concentrated livestock use or crowding.
3. Portable or temporary electric fence systems include materials such as: polyethylene wire and tape with woven steel or aluminum wire, aluminum wire, plastic and fiberglass post, reels to roll up wire, and portable battery operated energizers. Polyethylene and polypropylene wire and insulators must include ultraviolet (UV) stabilizers. Temporary fences may be attached to permanent fences to further subdivide pastures. Follow manufacturer's directions for construction, use, and operation.

APPENDIX D

WOVEN AND SMOOTH WIRE NON-ELECTRIC ELK AND MOOSE FENCE

NOTE: **HTEN** as used in this Appendix refers to High Tensile Strength Wire

<u>POSTS</u>	<u>DIMENSIONS</u>	<u>INSTALLATION</u>
End or corner (with bracing)	6 inch diameter x 12-16 feet long	Minimum 4' depth, driven or handset.
Corner or direction change (No bracing)	6 inch diameter x 12-16 feet long	Min 4' depth, driven or handset space; 4' min Lean 5° to outside of bend. Single post 20° bend; 2 posts 60° bend; 4 posts 80-90°
Line post	5 inch diameter x 10-16 feet long	Minimum 3' depth, driven or handset on all rises and depressions and 30 feet max spacing with wire spacers (battens) between line posts. 20 feet max spacing if no battens.
Battens or Droppers	10 – 12 feet	Install at midpoint (see Table 1).
<u>BRACING</u>		
Brace Posts	5 inch diameter x 11-17 feet long	Minimum 4 feet depth, driven or handset.
Brace Rail	4 inch diameter x 10-16 feet long wood or 2 inch galvanized steel pipe	Double Brace Assembly needed except for very short runs. Install horizontal brace rail at two-thirds the height for lower fences, one-half to two-thirds the height for higher fences. Diagonal brace rail at same height on end or corner post.
Brace Pins	Galvanized 3/8 inch diameter steel rod, 10" and 4" long	Pin brace rail to post at both ends.
Brace Wire	HTEN galvanized 12.5 gauge Type III	Horizontal brace - double wrap, staple ends to post, tighten with twitch stick. (See Fig. 14). Diagonal brace - thread through bottom of end post and brace on top of floating foot.
Brace Rod	Galvanized ½ diameter steel rod	

WIRE (also see Figure 14.)

TYPE:	HTEN Class 3 Galvanized Woven Fence Wire, 47" and 75", 12.5 gauge HTEN Class 3 galvanized smooth wire.
TENSION:	HTEN Woven - stretch to flatten wire tension crimps halfway about 5') per 20 rods of 330 feet); or HTEN smooth - 250 lbs.

Appendix D (Cont'd)

STRAINERS: **HTEN** Woven - wire type fence stretcher. Smooth - use an in-line strainer.

TENSION INDICATOR: For smooth wires, in-line tension spring, specified tension per unit length change.

SPACING: Woven: variable; smooth wires: 9 inches for first two wires above woven and varies for additional strands.

FASTENING: Appropriate wire knots or crimping sleeves for splicing and end connections are to be used for splicing or connecting wire. When attaching wire to wooden posts, the top 3 horizontal wires as well as the bottom horizontal wire will be stapled. Additional staples will be placed along the remaining wire and post approximately 1 to 1 ½ feet apart. When attaching wire to drill stem or pipe posts, use 12.5 ga galvanized ties or wire and tie off at the same location previously described.

Source: NRAES, Cooperative Extension. 1987.

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