

WISCONSIN CONSTRUCTION SPECIFICATION

10. Fences

PART I: STANDARD BARBED WIRE FENCE (SBWF)

1. SCOPE

The work shall consist of furnishing all materials required and installation of the fence at the locations shown on the plans. Part I of this specification applies to standard barbed wire fence (SBWF). Refer to Wisconsin NRCS Field Office Technical Guide, Section IV, Standard 382, Fence, Table 1 for minimum fence height, number of wires, and wire spacing.

Standard barbed wire fences (SBWF) shall have a minimum of three strands of barbed wire (interior fence only).

2. MATERIALS

A. Wire.

Wire shall conform to the requirements of ASTM A 121, Standard Specification for Metallic-Coated Carbon Steel Barbed Wire with Class 3 galvanizing meeting ASTM 641, [Standard Specification for Zinc-Coated \(Galvanized\) Carbon Steel Wire](#). The wire will be new and consist of 2 twisted strands of 12.5-gauge steel wire with Class 3 galvanizing or 2 twisted strands of 15.5-gauge high tensile wire with Class 3 galvanizing. The barbs shall be minimum 2 point on 5-inch centers.

B. Fasteners.

- (1) Staples shall be 9-gauge, Class 3 galvanized steel or heavier with a minimum length of 1.75 inches for softwoods and a minimum length of 1 inch for close-grained hardwoods.
- (2) Manufacturer's clips or 14-gauge wire may be used to fasten wires to steel posts.

C. Posts.

(1) Wood.

All wooden posts and brace members (except red and white cedar, tamarack, osage orange or black locust) shall be treated by a method listed in Table 1, and ensure that complete penetration of the sapwood is obtained. All bark shall be removed from the cedar, tamarack, osage orange, and black locust. At least one-half the diameter of cedar shall be heartwood. The quality of treated wood shall provide sufficient strength and last for the expected life of the fence.

Unless otherwise specified, minimum preservation retention values shall be as listed in Table 1.

**Table 1
Preservative Treatment Method and Minimum Retention**

Treatment Method	Retention (lbs./ft. ³)
Creosote Solution	8.00
Copper Naphthenate	0.055
Pentachlorophenol	0.40
Ammoniacal Copper Arsenate (ACA)	0.40
Chromated Copper Arsenate (CCA), Type A, B, or C	0.40
Micronized Copper Azole (MCA)	0.15
Micronized Copper Quaternary (MCQ)	0.34
Alkaline Copper Quaternary (ACQ or AC2)	0.40

All corner, end, pull, and gate assembly posts shall be wooden with a minimum top diameter of 5 inches.

Wooden line posts shall have a minimum 4-inch diameter.

(2) Steel.

Steel line posts shall have the standard “T” section, and nominal dimensions of 1 $\frac{3}{8}$ inches by 1 $\frac{3}{8}$ inches by $\frac{1}{8}$ inch with anchor plate. The posts shall be rolled from high carbon steel, weigh at least 1.25 pounds per foot of length, and shall be painted with a weather resistant paint for steel, enameled and baked, or hot dip galvanized. The posts shall be studded to aid in wire attachment. Steel fence posts shall conform to the requirements of ASTM A 702, Steel Fence Posts and Assemblies, Hot Wrought.

(3) Other.

Other materials may be used for corner, end, gate assembly, line posts, and brace members if they are of equal or greater strength and quality of above. They must be preapproved by the technician.

3. INSTALLATION

A. Post Installation and Spacings.

Post spacing for line posts shall not exceed 16 feet for standard barbed wire fence and 25 feet for high tensile barbed wire fence.

B. Corner, End, Pull, and Gate Assemblies.

One of the following braces will be used:

- (1) A floating diagonal brace or H-brace is required on corners or ends.
- (2) H-bracing is required at all pull assemblies and must be installed every 660 feet maximum.

Wood horizontal or diagonal brace member shall be a minimum of 4 inches in diameter and a minimum of 7 feet in length, and 9 feet for diagonal braces. A tension wire composed of two complete loops of 9-gauge smooth wire, 12-gauge double strand wire, or a single loop of 12.5-gauge high tensile smooth wire shall be used for H-braces. One end of the tension member shall be at the height of the horizontal brace member and the other end shall be 4 inches above the ground line on the other post.

If the posts are to be set or driven to a 3-foot depth or more below the ground line, a single H-brace assembly may be used. Otherwise, a double H-brace assembly shall be used.

A corner assembly shall be used wherever the horizontal alignment changes more than 15 degrees and/or where vertical alignment changes more than 15 degrees.

C. Line Post.

Wooden line posts shall be set or driven a minimum of 24 inches below the ground line. Steel line posts shall be set or driven a minimum of 18 inches below the ground line. If posts are not driven, the backfill around the post shall be well compacted.

D. Fastening.

The top wire shall be at least 2 inches below the top of a wooden post, and 1 inch below the top of a steel post. The tension on the high tensile barbed wire should be 200 to 250 pounds on each wire. Tension will be applied with an in-line stretcher on each strand. To gauge tension, install a tension spring on at least one strand of wire. All wires shall be attached to each line post.

Staples shall be driven diagonally to the wood's grain and at a slight downward angle, (upward if pull is up) to avoid splitting the post and loosening of the staples. Space should be left between the inside crown of the staple and post to permit free movement of high tensile barbed wire. Barbed staples shall be used for wooden posts.

Wires shall be attached to steel posts using manufacturer's clips or by two turns of 14-gauge galvanized wire.

Wire shall be spliced by means of a Western Union splice or by suitable splice sleeves applied with a tool designed for the purpose. The Western Union splice shall have not less than 8 wraps at each end about the other. All wraps shall be tightly wound and closely spaced.

PART II: HIGH TENSILE PERMANENT ELECTRIC WIRE FENCE (HTPEWF) AND HIGH TENSILE NON-ELECTRIC WIRE FENCE (HTNEWF)

1. SCOPE

The work shall consist of furnishing all materials required and installation of the fence at the locations shown on the plans. Part II of this specification applies to high tensile permanent electric wire fence (HTPEWF) and high tensile non-electric wire fence (HTNEWF). Refer to Wisconsin NRCS Field Office Technical Guide, Section IV, Standard 382, Fence, Table 1 for minimum fence height, number of wires, and wire spacing.

High tensile non-electric wire fence (HTNEWF) shall have a minimum of four strands of high tensile smooth wire (interior fence only). The minimum number of wires is dependent on the use of the fence.

High tensile electric wire fence shall have a minimum of one strand of high tensile smooth wire (interior fence only). The minimum number of wires is dependent on the use of the fence.

Barbed wire shall not be used on electric fences because of the safety hazard created by the high capacity energizers needed to charge the heavy gauge wire.

2. MATERIALS

A. Wire.

The wire will be new, smooth, and meet or exceed the following:

- Gauge – 12.5
- Tensile Strength – 140,000 psi (minimum)
- Galvanizing – Class 3
- Breaking Strength – 900 lbs. (minimum)
- ASTM A 854, Metallic-Coated Steel Smooth High-Tensile Fence and Trellis Wire
- ASTM A 854, Metallic-Coated Steel Smooth High-Tensile Wire Core with UV-Resistant, White, Electrically Conductive Polymer Coating.

B. Fasteners.

- (1) Staples shall be of 9-gauge galvanized steel or heavier with a minimum length of 1.75 inches for softwoods and a minimum length of 1 inch for close-grained hardwoods.
- (2) Manufacturer's clips or 14-gauge Class 3 galvanized wire meeting the appropriate ASTM for the fencing material specified may be used to fasten wires to steel, plastic/composite, or fiberglass posts.

C. Posts.

(1) Wood.

All wooden posts and brace members (except red or white cedar, tamarack, osage orange, or black locust) shall be treated by a method listed in the table below to ensure that complete penetration of the sapwood is obtained. All bark shall be removed from the cedar, osage

orange, and black locust. At least half the diameter of cedar shall be heartwood. The quality of treated wood shall provide sufficient strength and last for the expected life of the fence.

Unless otherwise specified, minimum preservative retention values shall be as listed in Table 2.

**Table 2
Preservative Treatment Method and Minimum Retention**

Treatment Method	Retention (lbs./ft.³)
Creosote Solution	8.00
Copper Naphthenate	0.055
Pentachlorophenol	0.40
Ammoniacal Copper Arsenate (ACA)	0.40
Chromated Copper Arsenate (CCA), Type A, B, or C	0.40
Micronized Copper Azole (MCA)	0.15
Micronized Copper Quaternary (MCQ)	0.34
Alkaline Copper Quaternary (ACQ or AC2)	0.40

All corner, end, and gate assembly posts shall be wooden with a minimum top diameter of 5 inches. Assembly posts shall be a minimum of 8 feet long for single H-brace assemblies.

Wooden line posts shall have a minimum 4-inch diameter (2 ½-inch for osage orange).

(2) Plastic/Composite.

Plastic/composite line posts shall be at least 1 inch in diameter, have a manufacturer’s warranty, and be durable for the life of the fence. All plastic/composite posts shall be UV protected for the life of the fence. Fence posts that are damaged or failing shall be replaced according to the Operation and Maintenance plan developed with the fence design.

(3) Steel.

Steel line posts shall have the standard “T” section, nominal dimensions of 1⅜ inches by 1⅜ inches by ⅛ inch with anchor plate. The posts shall be rolled from high carbon steel, weigh at least 1.25 pounds per foot of length and shall be painted with a weather resistant paint for steel, enameled and baked, or hot dip galvanized. The posts shall be studded to aid in wire attachment. Steel fence posts shall conform to the requirements of ASTM A 702, Steel Fence Posts and Assemblies, Hot Wrought.

(4) Fiberglass.

Fiberglass reinforced posts must be at least ⅞-inch diameter, or fiberglass reinforced T-post at least 1-inch cross-section and have a manufacturer’s warranty and be durable for the life of the fence. Fence posts that are damaged or failing shall be replaced according to the Operation and Maintenance plan developed with the fence design.

(5) Other.

Other materials may be used for corner, end, gate assembly, line posts, and brace members if they are of equal or greater strength and quality of above. They must be preapproved by the technician.

3. INSTALLATION

A. Post Installation and Spacings.

Live trees are not acceptable to use as posts.

Post spacing for line posts shall be a maximum of 50 feet for interior electric fence (except for a lane fence when it shall be 70 feet), or 30 feet for perimeter electric fence, except when stays are placed every 33 feet (then, the maximum post spacing shall be 100 feet). On sites where the land slope is less than 5 percent, a 50-foot maximum post spacing may be used for perimeter fence posts. For high tensile non-electric fence, the maximum post spacing shall be 12 feet if the fence is used to restrain animals.

B. Corner, End, and Gate Assemblies.

Brace assemblies are required at all corners, gates, pull, and end assemblies.

One of the following assemblies shall be used for all corners, ends, and gates:

- (1) A floating diagonal brace.
- (2) An H-brace.
- (3) A substantial corner post. Corner posts are to be set or driven to a minimum of 4 feet below the ground line.

All brace members shall be wood and the horizontal member centerline shall be 4 to 9 inches below the top of the post. Other brace material of equal strength may be used with the preapproval of the technician. Floating diagonal braces shall be placed at $\frac{2}{3}$ the height of the fence, measured from the bottom wire up.

Wood horizontal brace members shall be a minimum of 3 inches in diameter and a minimum of 7 feet in length, 9 feet for floating diagonal braces. A tension wire composed of two complete loops of 9-gauge smooth wire, 12-gauge double strand wire, or a single loop of 12.5-gauge high tensile strength smooth wire shall be used. One end of the tension member shall be at the height of the horizontal brace member and the other end shall be 4 inches above the ground line on the other post.

If the posts are set or driven to 3 feet or more below the ground line, a single H-brace assembly or floating diagonal brace may be used. Otherwise a double H-brace assembly shall be used.

A corner assembly shall be used when the horizontal alignment changes more than 30 degrees.

C. Line Post.

Wood, fiberglass, steel, and plastic/composite posts for HTNEWF shall be set or driven a minimum of 24 inches below the ground line for single or multiple wire fences. Wood posts for HTPWF shall be driven a minimum of 24 inches below the ground line for single or multiple wire fences. Fiberglass, steel, and plastic/composite posts for HTPWF shall be set or driven to a minimum of 12 inches below the ground line for a single wire fence and a minimum of 18 inches below the ground line for a multiple wire fence.

If posts are not driven, the backfill around the post shall be well compacted.

In areas where soil depth restricts the post embedment depth, additional anchors or deadman applied against the direction of pull shall be used.

D. Fastening.

The top wire shall be at least 2 inches below the top of the wooden post and 1 inch below the top of all other posts. Tension will be applied with an in-line stretcher or other tightener on each strand to achieve no visible sag. All wires shall be fastened to each line post.

Staples shall be driven diagonally to the wood's grain and at a slight downward angle (upward if pull is up) to avoid splitting the post and loosening of the staples. Space should be left between the inside crown of the staple and post to permit free movement of high tensile wire. Barbed staples shall be used for wood posts.

Wire shall be attached to steel, fiberglass, and plastic/composite posts using manufacturer's clips or two turns of 14-gauge galvanized wire.

The staples, wires, and clips should allow free movement of the high tensile fence wire.

Wire shall be spliced by means of a manufacturer's recommended splice or knot, or by suitable splice sleeves applied with a tool designed for the purpose.

E. Interior Fences.

For 1-wire electric or other temporary interior fences a brace is not required at corners, gates, pull, and end assemblies.

F. Offset Brackets.

Offset brackets made of galvanized high tensile spring wire with insulator of high density polyethylene with ultra-violet stabilizer or porcelain can be attached to standard barbed wire fence or woven wire fence to provide a transmission line and/or to protect a standard fence. Place the offset brackets no further than 60 feet apart and attach to the wires of the standard fence next to the post. Place offset brackets at chest height of the animals to be controlled. Ensure that no wires of any existing fence comes in contact with the electric fence wire, as an electrical short will occur.

4. LIGHTENING PROTECTION

Lightening protection is required for all electrified fences. Follow the fence energizer manufacturer's recommendations.

5. ADDITIONAL SPECIFICATIONS FOR HTPEWF

A. Energizers.

(1) Power Source.

Electronic energizers or power fence controllers shall be installed according to the manufacturer's recommendations and will meet the following minimum specifications:

- High power, low impedance system with solid state circuitry capable of at least 5,000 volt peak output and a short pulse that is less than 300 mAmps in intensity, finished within .0003 of a second and a rate of 35-65 pulses per minute.
- High impact weather resistant cases.
- 110 volt, 220 volt conventional powered electric fence energizers.
- 12-volt battery powered capable of operating three weeks without recharging. If the length of fence requires an energizer of more than 4 joules, a solar charger will be needed on the battery systems.
- Minimum voltage output by livestock species:
 - cattle: 3000v
 - sheep and goats: 4000v
 - hogs and horses: 2000v
- Utilize a safety pace fuse to prevent over pulsing.

(2) Size.

Under normal operating conditions, the energizer should be capable, at a minimum, of producing 1 joule of energy for each mile of wire used. (Joules are units of electrical energy. One joule does about 0.74 ft-lb. of work. Watts x seconds = joules.) If a significant portion of the fence will be exposed to dense vegetation, additional energy requirements may be needed.

B. Grounding.

All electric fences must be properly grounded. The energizer ground wire shall be connected to a galvanized pipe or rod 0.5 inch or larger in diameter. A minimum of 3 feet of ground rod for each joule of energy output shall be installed to properly ground the fence.

Ground rods shall be placed where soil remains moist for best results. Drive a sufficient number of 6- to 8-foot long rods into the soil 10 feet apart to provide the required length of ground rod exposure to the soil. Connect a continuous ground wire from the energizer to each rod. The energizer terminals, ground wire, and ground rods shall be made of the same material (steel to steel, copper to copper) to prevent accelerated corrosion which could cause a loss of electric continuity.

Additional ground rods may be needed for the system to function properly. Follow the manufacturer's recommendations where they exceed the requirements of this standard.

The ground wire(s) of the fence may be connected to the same grounding system as the energizer or a separate grounding system. Where a combined grounding system is used, the design shall meet or exceed the minimum design criteria specified for both the energizer and lightning protector.

Do not use the grounding system for other existing applications, such as power poles, breaker boxes, and milk barns. At least 65 feet shall separate the fence grounding system from any other electrical grounding system.

C. Spike Protector.

A voltage spike protector is recommended for use with 120 and 140-volt energizers. Also, a ground rod shall be installed at the electric company's transformer pole (primary ground) and another ground rod installed at the electrical circuit breaker box (secondary ground), if they do not exist at the time of electric fence construction. Additionally, a surge protector shall be installed between the energizer and power supply.

D. Insulation and Insulated Cable.

Insulation used for positively charged wire(s) must be high-density polyethylene with ultra-violet stabilizer.

All underground wire(s) installations must be double insulated; molded; high tensile strength steel, 12.5-gauge or larger wire. The insulation must be high density polyethylene or polypropylene with ultra-violet stabilizer.

Insulators for steel and other conductive material posts shall be capable of withstanding at least 10,000 volts of current leakage and shall be made of high-density polyethylene with ultra-violet stabilizer or porcelain.

Insulators for end, corner, and angle braces shall be capable of withstanding at least 10,000 volts of current leakage and shall be made of high-density polyethylene with ultra-violet stabilizer, high-density polypropylene with ultra-violet stabilizer, or porcelain. Red insulators should not be used as they might attract hummingbirds.

Use insulated galvanized wire to cross gates and areas where electrical shocks to humans and livestock should be prevented (e.g., working facilities). For underground burial, use wire designed for burial. Placing buried cable inside plastic pipe helps to decrease the incidence of short-circuiting. Do not use insulated copper wire due to the potential for corrosion at the splice and a lack of tensile strength.

E. Gates.

(1) Electrified Gates.

Electrified gates may be constructed of a single straight wire, galvanized cable, polytape or electrified rope with a spring loaded insulated handle, or an expandable, coiled, high tensile, 12.5-gauge wire attached to an insulated handle. The number of wires shall be determined by the fence objective. The gate shall be constructed so that it is non-electrified when the gate is open. Overhead or underground transmission lines will be used to carry electricity past the gate to the remainder of the fence.

(2) Flood Gates.

An electrified floodgate may be used in lieu of a non-electrified gate if desired. The electrified floodgate is constructed by stretching an electrified wire across the drainage above high water flow level. Attach droppers of 12.5-gauge high tensile fence wire, galvanized cable, or galvanized chains to the electrified wire at a spacing of 6 inches above average normal water level. Connect gate to electric fence with double insulated cable through a cut-off switch and floodgate controller. If flooding is expected for extended periods of time, switch the floodgate off.

6. ADDITIONAL SPECIFICATIONS FOR HTNEWF

A. Grounding for Lightning Protection.

Non-electrical wire fences using wood posts shall be grounded at least every quarter mile. Ground rods should be driven not less than 4 feet into the ground. The rods shall be galvanized steel and a minimum of 0.5 inch in diameter. All line wires of the fence must be grounded.

Part III: TEMPORARY ELECTRIC FENCE (TEF)

1. SCOPE

The work shall consist of furnishing all materials required and installation of the fence at the locations shown on the plans. Part III of this specification applies to Interior Temporary Electric Fence (TEF). Refer to Wisconsin NRCS Field Office Technical Guide, Section IV, Standard 382, Fence, Table 1 for minimum interior electric fence height and number of wires.

2. MATERIALS

All materials provided shall be durable for the intended use and life of the fence. Materials that fail prior to the end of the practice lifespan established by the design shall be replaced with equal or higher quality fencing materials.

A. Wire

Poly-wire, poly-tape, or poly-rope shall have a minimum of 6 strands of stainless steel wire filament and be made with UV stabilized polyethylene. Steel wire filaments shall be 14 gauge or larger. Stainless steel wire filaments shall be a minimum of 19 gauge. Aluminum wire shall not be used.

A minimum of two reels of poly-wire are needed for sub-dividing pastures. In strip-grazing systems with a “back fence”, 3 reels are more convenient. Poly-wire is typically sold on reels containing 660 or 1320 feet of fence.

Energized netting may be used for livestock that will not be controlled by a single strand interior electric temporary fence. Energized netting shall be constructed of UV stabilized polyethylene.

B. Fasteners

Manufacturer’s clips may be used to fasten wires to plastic/composite, or fiberglass posts.

Insulated gate handles, clips or jumpers may be used to attach the poly-wire fence to the adjoining permanent electric fence.

C. Line Posts

(1) Plastic Step-in Posts

All plastic or plastic coated posts shall be UV protected for the life of the fence. Step-in posts shall be made of durable plastic, plastic covered steel or fiberglass. Plastic posts shall have a steel pin at least 4 inches long. Smaller pins are easier to get into the ground during dry and frozen periods. Step-in posts shall have a manufacturer's warranty and be durable for the life of the fence. Fence posts that are damaged or failing shall be replaced according to the Operation and Maintenance plan developed with the fence design.

(2) Fiberglass Posts

Fiberglass posts shall be at least 3/8 inch in diameter. All fiberglass post shall be UV protected for the life of the fence. Fence posts that are damaged or failing shall be replaced according to the Operation and Maintenance plan developed with the fence design.

(3) Steel Pig-tail Insulated Posts

Steel Pig-tail posts shall be at least 3/8 inch in diameter with a UV protected plastic insulator coating over the entire surface or the post that may be contacted by the poly-tape. Fence posts that are damaged or failing shall be replaced according to the Operation and Maintenance plan developed with the fence design.

3. INSTALLATION

A. Post Installation and Spacing

Post shall be spaced a maximum of 50 feet. Add more posts for uneven terrain.

B. Fastening

Poly-wire shall be attached to fiberglass posts using manufacturer's clips.

Poly-wire shall be attached to Step-in posts by inserting the poly-wire into the clip or loop molded onto the body of the post.

Poly-wire shall be attached to Pig-tail posts by inserting the poly-wire through the open loop on the top of the post.

Electric gate handles should be used to attach temporary poly-wire to electric sources such as an exterior high-tensile electric fence wire. These are typically attached to the end of the poly-wire on the reel. Most reels can be hung on the opposite reach on a high tensile fence wire. Insulated clips or jumpers may also be used to attach the poly-wire to the adjoining electric fence.

C. Fence Height and Number of Wires

Poly-wire fences will typically be installed at a 30 inch height measured from the ground surface. Multiple wires or a different top wire height may be necessary based on the fence design requirements found in Table 1 of the Wisconsin NRCS Field Office Technical Guide, Section IV, Standard 382, Fence.

PART IV: WOVEN WIRE FENCE (WWF)

1. SCOPE

The work shall consist of furnishing all materials required and installation of the fence at the locations shown on the plans. Part III of this specification applies to woven wire fence (WWF). Refer to Wisconsin NRCS Field Office Technical Guide, Section IV, Standard 382, Fence, Table 1 for minimum fence height and wire spacing.

Standard woven wire fence (SWFF) shall consist of low-carbon steel woven wire with a single or multiple strands of either barbed wire or high tensile smooth wire with a minimum spacing of 2 to 6 inches starting at the top of the woven wire.

High tensile woven wire fence (HTWWF) shall consist of fixed knot or hinge joint high tensile woven wire with a single or multi strands of smooth high tensile wire, or high tensile barbed wire, 2 to 6 inches above the top of the woven wire. HTWWF may be electrified (see power requirements for electric fence). The bottom of the fence should be placed 7 inches above ground with a barbed wire along the ground.

Specialty high tensile woven wire fence (SHTWWF) shall consist of 49- to 96-inch high woven wire with a single strand of smooth high tensile wire, or high tensile barbed wire, 2 to 6 inches above the top of the woven wire. This type of fence is intended for deer, elk, and exotic animals.

2. MATERIALS

A. Wire.

SWFF shall be made from low-carbon steel wire with Class 3 galvanizing meeting ASTM A 641, [Standard Specification for Zinc-Coated \(Galvanized\) Carbon Steel Wire](#), and conform to the requirements of ASTM A 116, Metallic-Coated, Steel Woven Wire Fence Fabric. The woven wire shall have the top and bottom strands 10-gauge or heavier. The intermediate and stay wires shall be 14.5-gauge or heavier. The stay wires shall be spaced a maximum of 12 inches apart.

HTWWF and SHTWWF will be made from high tensile steel wire with Class 3 galvanizing meeting ASTM A 641, [Standard Specification for Zinc-Coated \(Galvanized\) Carbon Steel Wire](#), and conform to the requirements of ASTM A 116, Metallic-Coated, Steel Woven Wire Fence Fabric. The top and bottom strands of the woven wire shall be 12.5-gauge or heavier. The intermediate and stay wires shall be 14.5-gauge or heavier. The stay wires shall be spaced a maximum of 12 inches apart for non-electric woven wire, and 24 inches when the wire is electrified.

Barbed wire used with SWFF and HTWWF shall meet the requirements of Part I of this specification, Standard Barbed Wire Fence (SBWF).

High tensile wire used with SWFF, HTWWF, or SHWWF will be smooth and meet or exceed the following:

- Tensile Strength – 140,000 psi (minimum)
- Galvanizing – Class 3

- Gauge – 12.5
- Breaking Strength – 900 lbs. (minimum)

B. Fasteners.

- (1) Staples shall be 9-gauge, Class 3 galvanized steel or heavier with a minimum length of 1.75 inches for softwoods and a minimum of 1 inch for close-grained hardwoods.
- (2) Manufacturer’s clips or 14-gauge, Class 3 galvanized wire may be used to fasten wires to steel posts.

C. Posts.

- (1) Wood.

All wooden posts and brace members (except red or white cedar, tamarack, osage orange, or black locust) shall be treated by a method listed in the table below, and ensure that complete penetration of the sapwood is obtained. All bark shall be removed from the cedar, tamarack, osage orange, and black locust. At least one-half the diameter of cedar shall be heartwood. Quality of treated wood shall provide sufficient strength and last for the expected life of the fence.

Unless otherwise specified in the construction plan, minimum preservative retention values shall be as listed in Table 3.

**Table 3
Preservative Treatment Method and Minimum Retention**

Treatment Method	Retention (lbs./ft.³)
Creosote Solution	8.00
Copper Naphthenate	0.055
Pentachlorophenol	0.40
Ammoniacal Copper Arsenate (ACA)	0.40
Chromated Copper Arsenate (CCA), Type A, B, or C	0.40
Micronized Copper Azole (MCA)	0.15
Micronized Copper Quaternary (MCQ)	0.34
Alkaline Copper Quaternary (ACQ or AC2)	0.40

Corner, end, pull and gate assembly posts for HTWWF and SWWF shall be wooden with a minimum top diameter of 5 inches. Assembly posts shall be a minimum 7 feet long for single H-brace assemblies and for double H-brace assemblies. For SHTWWF, the length will depend upon the height of the fence and shall be as specified in the construction plan.

Bend assembly posts shall have a minimum top diameter of 4 inches and will be a minimum 7 feet long.

Wooden line posts shall have a minimum top diameter of 4 inches and shall be a minimum length of 7 feet. Fence posts for SHTWWF must be a minimum 5 inches in diameter.

(2) Plastic/Composite.

Plastic/composite line posts shall have a manufacturer's warranty, and be durable for the life of the fence. All plastic/composite line posts shall be UV protected for the life of the fence. Fence posts that are damaged or failing shall be replaced according to the Operation and Maintenance plan developed with the fence design.

Plastic/composite line posts for SHTWWF and HTWWF shall be at least 1 $\frac{1}{8}$ inches in diameter. Plastic/composite line posts cannot be used with SWWF.

(3) Steel.

Steel line posts shall have the standard "T" section, and nominal dimensions of 1 $\frac{3}{8}$ inches by 1 $\frac{3}{8}$ inches by $\frac{1}{8}$ inch with anchor plate. The posts shall be rolled from high carbon steel, weigh at least 1.25 pounds per foot of length, and shall be painted with a weather resistant paint for steel, enameled and baked, or hot dip galvanized. The posts shall be studded to aid in wire attachment. Steel line posts shall be a minimum length of 5 feet. Steel fence posts shall conform to the requirements of ASTM A 702, Steel Fence Posts and Assemblies, Hot Wrought.

(4) Fiberglass.

Solid fiberglass reinforced posts must be at least 2 inches in diameter, have a manufacturer's warranty, and be durable for the life of the fence. Fence posts that are damaged or failing shall be replaced according to the Operation and Maintenance plan developed with the fence design.

(5) Other.

Other materials may be used for corner, end, gate assembly, line posts, and brace members if they are of equal or greater strength and quality than above. They must be preapproved by the technician.

3. INSTALLATION

A. Post Installation and Spacings.

Post spacing for line posts shall not exceed 16 feet for SWWF and SHTWWF and 25 feet for HTWWF. Corner posts shall be set or driven 3 feet below the ground line unless a restrictive layer prevents installation to the required depth.

B. Corner, End, Pull, and Gate Brace Assemblies.

Brace assemblies are required at all corners, gates, pulls and ends.

One of the following assemblies for all corners, ends, pulls and gates shall be used:

- (1) A floating diagonal brace.
- (2) If the posts are to be set or driven to 3 feet below the ground line, a single H-brace assembly may be used.
- (3) If the posts are to be set or driven to less than 3 feet below the ground line, a double H-brace assembly shall be used.

All brace members shall be wood and the horizontal member centerline shall be 4 to 9 inches below the top of the post. Other brace material of equal strength may be used with the preapproval of the technician.

The horizontal brace member shall be a minimum 4 inches in diameter and a minimum 7 feet in length. A tension wire composed of 2 complete loops of 9-gauge smooth wire, or a single loop of 12.5-gauge high tensile smooth wire shall be used. One end of the tension wire shall be at the height of the horizontal cross brace member and the other end of the tension wire shall be 4 inches above the ground line on the other post.

A corner assembly or bend assembly shall be used when the horizontal alignment changes more than 15 degrees and a pull assembly shall be used when vertical alignment changes more than 15 degrees. A bend assembly will be used only when it will not affect the integrity of the fence. Post spacing for a bend assembly can be determined by placing 3 stakes, each spaced 14 feet apart, along the fence line. A string then is stretched between the first and third stake. A measurement then is taken from the second stake and the string. The spacing of the posts is determined in Table 4.

**Table 4
Post Spacing**

Distance Between String and Stake	Post Spacing
0 to 4 inches	14 feet
5 to 7 inches	12 feet
8 to 10 inches	10 feet
11 to 15 inches	8 feet
16 or more inches	6 feet

These bend assembly posts will be wood and set with a 6-inch lean from vertical to the outside of the curve, and set or driven 36 inches below ground line.

Pull assemblies for SWWF shall be installed at intervals not to exceed 660 feet. The continuity of the wire shall be interrupted at the pull assembly.

HTWWF and SHTWWF will not require the installation of pull assemblies.

C. Line Post.

Wooden and plastic/composite line posts shall be set or driven a minimum of 24 inches below the ground line. If soil depth is less than 24 inches, use standard “T” steel posts.

Steel line posts shall be set or driven a minimum of 18 inches below ground line.

If posts are not driven, the backfill around the post shall be well compacted.

In areas where soil depth restricts the embedment depth, additional anchors or deadman applied against the direction of the pull shall be used.

D. Fastening.

The top wire shall be at least 2 inches below the top of a wooden post and 1 inch below the top of all other types of post. Tension of the fence should be set such that the sag between posts is no more than 1 inch. The tension crimp should be half the size of an untensioned crimp when stretched. All horizontal wires shall be fastened to each line post.

Wire shall be attached to steel, fiberglass, and plastic/composite posts using manufacturer’s clips or two turns of 14-gauge galvanized wire.

Staples shall be driven diagonally to the wood’s grain and at a slight downward angle (upward if the pull is up) to avoid splitting the post and loosening of the staples. Space should be left between the inside crown of the staple and post to permit free movement of high tensile wire. Barbed staples shall be used for wood posts.

The staples, wires, and clips should allow free movement of the high tensile fence wire.

All wire shall be spliced by means of a crimp or suitable knot, or by suitable splice sleeves applied with a tool designed for the purpose. The splice shall have not less than 8 wraps at each end about the other. All wraps shall be tightly wound and closely spaced.

E. Grounding.

Fences using wood posts shall be grounded for lightening protection at least every quarter mile, with ground rods driven not less than 4 feet into the ground. The rods shall be galvanized steel and a minimum of 0.5 inch in diameter. All line wires of the fence must be grounded. Add 12.5-gauge wire for the lead-out wire.

PART V: CHAIN LINK FENCE (CLF)

1. SCOPE

The work shall consist of furnishing all materials required and installation of the fence at the locations shown on the plans. Part IV of this specification applies to chain link fence (CLF). Refer to Wisconsin NRCS Field Office Technical Guide, Section IV, Standard 382, Fence, Table 1 for minimum fence height and wire spacing.

2. MATERIALS

A. Chain Link Fence Fabric.

Chain link fence fabric shall be 9-gauge wire with a minimum tensile strength of 1,290 pounds. Chain link fence fabric shall conform to the requirements of ASTM A392, "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. Polymer coated chain link fence fabric shall conform to the requirements of ASTM F 668, Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric. Any damage to the coating shall be repaired in accordance with manufacturer's recommendations, or the damaged fencing material shall be replaced.

B. Posts and Fence Framework.

Posts and fence framework shall conform to the requirements of ASTM F 1043 "Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework," Group 1A, for Heavy Industrial Fence. Coatings shall be Type A galvanized for both internal and external surfaces. Any damage to the coating shall be repaired in accordance with manufacturer's recommendations, or the damaged fencing material shall be replaced.

C. Gates, Gateposts, and Gate Accessories.

Gates, gateposts, and gate accessories shall conform to the requirements of ASTM F 900, Standard Specification for Industrial and Commercial Swing Gates. Coating shall be the same as selected for adjoining fence and framework.

D. Top Rail and Gate Frames.

Top rail and gate frames shall be a minimum 1.66 inch outside diameter standard (Schedule 40) steel pipe or Grade B high strength steel.

E. Line Posts.

Line posts shall be a minimum of 1.9 inches outside diameter standard (Schedule 40) steel pipe or Grade B high strength steel and be of sufficient length to support the height of the fence.

F. Corner, Gate, and End Posts.

Corner, gate, and end posts shall be a minimum of 2.375 inches outside diameter standard (Schedule 40) steel pipe or Grade B high strength steel, be of sufficient length to support the height of the fence, and be set in concrete.

G. Fence Fittings.

Fence fittings shall conform to the requirements of ASTM F 626, "Standard Specification for Fence Fittings." Fittings shall be galvanized steel. Wire ties and clips shall be 9-gauge galvanized steel.

3. INSTALLATION

Installation shall be in accordance with the construction plans.

A. Post Installation.

All posts shall be capped immediately after installation. Where posts are installed in highly corrosive soils, the posts shall be vinyl coated in addition to the above requirements and set in concrete poured inside a clay tile or plastic tubing.

B. Braces and Top Rails.

Braces and top rails shall be installed horizontally at the height shown on the drawings or recommended by the manufacturer. Braces and top rails shall be attached to the posts by suitable fittings, as recommended by the manufacturer. A 7-gauge galvanized steel tension wire, meeting the appropriate ASTM for the fencing material specified, tightened by mechanical means, shall be placed approximately 4 inches from the ground level. A similar tension wire shall be placed at the top of the fence if a top rail is not used.

C. Chain Link Fabric.

Chain link fabric is generally installed on the outside of the fence post unless otherwise shown on the drawings. Fencing fabric shall not be stretched until at least 4 days after the posts are grouted into walls or 7 days after the posts are set in the concrete backfill or grouted into concrete walls. 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.

A stretcher bar shall be used at terminal post locations.

D. Barbed Wire.

Barbed wire shall be installed as shown on the drawings and shall be pulled taut and fastened to each post or arm with the tie wires or metal tie clips.

E. Gate Frames.

Gate frames shall be fabricated and hung so they sag no more than 1 percent of the gate width.

PART VI: BOARD FENCE (BF)

1. SCOPE

The work shall consist of furnishing all materials required and installation of the fence at the locations shown on the plans. Part V of this specification applies to board fence (BF). Refer to Wisconsin NRCS Field Office Technical Guide, Section IV, Standard 382, Fence, Table 1 for minimum fence height, number of boards, and board spacing.

A board fence shall have a minimum of three boards.

2. MATERIALS

All materials provided shall be durable for the intended use and life of the fence.

A. Wood

All wood posts, boards (horizontal boards) and brace members (except red or white cedar, tamarack, osage orange, or black locust) shall be treated by a method listed in the table below to ensure that complete penetration of the sapwood is obtained. Boards may be painted with an exterior paint durable for the life of the fence in lieu of preservative treatment. All bark shall be removed from cedar, osage orange, and black locust. At least half the diameter of cedar shall be heartwood. The quality of treated wood shall provide sufficient strength and last for the expected life of the fence.

Unless otherwise specified, minimum preservative retention values shall be as listed in Table 5.

**Table 5
Preservative Treatment Method and Minimum Retention**

Treatment Method	Retention (lbs./ft.3)	BOARDS Retention (lbs./ft.³)
Creosote Solution	8.00	8.0
Copper Naphthenate	0.055	0.055
Pentachlorophenol	0.40	0.40
Ammoniacal Copper Arsenate (ACA)	0.40	0.25
Chromated Copper Arsenate (CCA), Type A, B, or C	0.40	0.25
Micronized Copper Azole (MCA)	0.15	0.06
Micronized Copper Quaternary (MCQ)	0.34	0.15
Alkaline Copper Quaternary (ACQ or AC2)	0.40	0.20

Wood boards shall be well seasoned or kiln-dried to minimize warping.

B. Composite Wood

All composite wood products shall have a manufacturer's warranty for the intended use and life of the fence providing coverage against checking, splitting, splintering, rotting, structural damage from termites, and fungal decay of composite wood.

3. INSTALLATION

A. Posts

Posts shall be spaced to accommodate board lengths. Post spacing for wood fence shall not exceed 8 feet on center. Post spacing, size, and installation for composite wood fences shall meet manufacturer's recommendations for the intended use, and size and number of boards.

Wood posts will have a minimum top diameter of 6 inches for large livestock applications and 4 inches for small livestock. Angular wood posts shall have a minimum top, nominal dimension of 6 inches by 6 inches for large livestock applications and 4 inches by 4 inches for small livestock. Wood line posts will be set or driven a minimum of 36 inches. Gate and corner wood posts will be firmly set or driven in the ground a minimum of 48 inches. Wood posts will be of sufficient length to support the height of the fence and be firmly set or driven in the ground.

B. Boards

Boards for wood fence used for small animals and low pressure areas for large animals shall be a minimum size of 1 inch by 6 inches (nominal). Wood boards used for large animal confinement shall be a minimum size of 2 inches by 6 inches (nominal). Boards for wood fence shall be a minimum of 8 feet in length.

Board size for composite wood fence shall be in accordance with manufacturer's recommendations for the intended use of the fence.

Board length should be twice the post spacing with staggered seams on the posts. The boards shall be placed on the livestock side in corrals and other high pressure areas.

Each wood board shall be attached to each post with a minimum of two 16d hot dipped galvanized steel, stainless steel, copper, silicon bronze, or equivalent proprietary coated nails. For better holding power, use ring-shank, spiral, or screw-shank instead of common nails. Two 3-inch decking screws with like treatments may be used instead of nails. Increase the number of nails or screws by one additional nail or screw per 2 linear inches of board nominal width for board nominal widths exceeding 6 inches.

Each composite wood board shall be attached to each post in accordance with manufacturer's recommendations.