

**SECTION 02950
FENCE**

PART 1 GENERAL

1.01 - Section Includes

- A. Chain Link Fence
- B. Field Fence

1.02 - Description of Work

- A. Chain Link Fence.

The Work under this Section shall include all labor, material, equipment and all else necessary for full compliance with the Contract Documents for chain link fence installations.

- B. Field Fence.

This Work includes the furnishing of all labor, material and equipment and all else necessary for full compliance with the Contract Documents for field fence.

1.03 - Submittals

- A. Submit shop drawings of the fence, gates and accessories together with the erection drawings.
- B. When requested, samples of fabric and other materials shall be submitted to the Engineer for testing purposes.

PART 2 PRODUCTS

2.01 - Chain Link Fence

- A. Fence Fabric: (Galvanized): Fabric shall be either zinc or aluminum coated fabric, with salvage knuckled top and bottom, and made from No. 9 wires. Zinc coated fabric shall meet requirements of ASTM A392 Class 2 coating and aluminum coated fabric shall meet requirements of ASTM A491.
- B. Fence Fabric: (PVC Coated)
 - 1. Fabric shall be woven in 2-inch mesh from 9-gauge steel wire conforming to the "Standard Specification for Polyvinyl Chloride (PVC) – Coated Steel Chain-Link Fence Fabric". The height of the fence fabric shall be 6 feet unless otherwise indicated on the Contract Drawings.
 - 2. The 9-gauge diameter vinyl fabric woven in a 2-inch mesh shall have a minimum coating thickness of 20 mils bonded to high quality galvanized steel wire having a minimum tensile strength of 100,000 psi with a minimum zinc weight of .3 oz per square foot of uncoated wire surface in accordance with ASTM A116.
 - 3. The vinyl coating shall be bonded over the galvanized steel wire to insure a dense and impervious bonded coating having a smooth and lustrous surface in accordance with RR-F-191/1C, Type IV. The wire shall be galvanized and vinyl-bonded before weaving and shall be free and flexible at all joints. Ungalvanized wire and non-bonded extruded vinyl coatings are unacceptable. Fabric shall be imprint branded with the manufacturer's name, tensile strength, gauge and country of origin.
 - 4. Plasticized PVC coating shall be stabilized and colorfast to withstand 1500 hour WEATHER-O-METER tests ASTM D1499, E 42, Type E. The vinyl-bonded galvanized steel fabric shall be insulated for 12,000 volts, shall be a self-extinguishing character, and shall have a minimum hardness of Durometer A90 ± 5.
- C. Framework and Accessories: All framework and accessories, posts and rails shall have a Class II galvanized coating (2.0 oz zinc per square foot) meeting ASTM A392. No used, re-rolled or open seam material will be permitted in posts or rails. All fittings and accessories shall be new.
- D. Bands or Clips: Fabric shall be connected:
 - 1. to line posts with 11 gauge galvanized steel wire clips;

2. to top rail with 11 gauge galvanized steel wire;
 3. to terminal, corner and gate-posts with ¼-inch by ¾-inch tension bars tied with 11-gauge, 1-inch wide steel bands and 3/8-inch diameter bolts and nuts;
 4. to tension wire with 11-gauge galvanized steel hog rings.
- E. Posts: Posts shall be made of galvanized steel pipe of the sizes and weights given below or of other approved equivalent section.
1. Line posts shall have a 2½-inch diameter and weight 3.65 lb per lineal foot.
 2. End, corner and pull posts shall have a 3-inch diameter and weight 5.79 lb per lineal foot.
 3. Gate Post for single-swing gates up to 18 ft shall be 6.625-inch diameter and weigh 18.97 lb per lineal foot.
 4. Gateposts for double-swing gate openings 15-32 feet shall be 6.625-inch diameter and weigh 18.97 lb per lineal foot.
- F. Caps: Steel Pipe Posts shall be capped with caps of the manufacturer's standard material, as approved. Line post tops shall be heavy galvanized malleable iron or solid aluminum, fitting over top and outside of post and provided with means of passing top rail.
- G. Top/Bottom Rails: Top/bottom rails shall have a 1-5/8-inch diameter and weigh 2.27 lb per lineal foot furnished in random lengths averaging at least 20 feet. The pipe shall be jointed with extra long, pressed steel, hot dipped galvanized sleeves to provide a rigid connection that permits expansion and contraction. The top/bottom rails shall be connected to the end posts with beveled edged galvanized steel bands and rail ends.
- H. Top/Bottom Tension Rod: Top/Bottom Tension rods shall be 0.375-inch (3/8-inch) diameter aluminum 6061 T6, attached by 0.25-inch diameter hook and bolt assembly to top/bottom rail 14 inches on center, typical.
- I. Fittings: Fittings shall be aluminum forgings, malleable iron, or pressed steel.
- J. Tension Wire:
1. A 7-gauge, high carbon galvanized coiled spring steel tension wire shall be attached to the bottom of the fabric, with galvanized steel hog rings, 24 inches on centers, to prevent swing of the fabric, and shall meet requirements of ASTM A641, hard grade, with a Class 3 zinc coating or an aluminum coating of not less than 0.25 oz per square foot.
 2. Tie wires for chain link fence shall be the size and type recommended by the manufacturer, but not smaller than No. 9 diameter for post ties or No. 12 diameter for rail and brace ties. Equivalent steel clips or aluminum wire or clips may be used if approved by the Engineer.
- K. Bracing: All terminal posts shall be braced by means of galvanized 1-5/8-inch outside diameter horizontal compression member securely attached to terminal in first line posts with malleable iron fittings and beveled edge banks, and truss-braced from first line post to bottom of terminal with ½-inch rod and turnbuckle. Corner and angle point posts shall be so braced in each direction.
- L. Bases: Concrete bases for posts shall be 3000 psi concrete.
- M. Vinyl-clad components shall be as noted in the Contract Documents.

2.02 - Fabrication of Chain Link Fence

- A. Galvanizing: All material used in the fence construction, except woven wire hereinbefore specified and aluminum shall be galvanized with a heavy coating (not less than 2 oz per square foot of surface) of pure zinc spelter using the hot-dip process. The surface area of tubular steel shall be the area of both inside and outside surfaces.
- B. PVC Coating: PVC coating shall be as specified in paragraph 2.01.B.

2.03 - Field Fence

- A. Fabric
1. The fabric used in field fence shall meet requirements of ASTM A116, Class 3 coating, or ASTM A584. Fabric may be furnished in lengths greater than 20 rods. For Type 47 fence, the fabric design is ASTM Design Number 1047-6-11; and for Type 39 fence, the fabric

- design is ASTM Design Number 939-6-11. When the type is not designated, ASTM Design Number 1047-6-11 fabric shall be furnished. Stay wires shall be attached to each line wire with not less than one and one-quarter wraps.
2. The steel rod used for splicing fence material shall be galvanized as determined by visual inspection.
- B. Barbed Wire: Barbed wire shall meet requirements of ASTM A121 for 950 lb force minimum strand breaking strength and 4 barbs at nominal 5 inches on center. The zinc coating shall be at least 0.80 oz per square foot.
- C. Brace Wire and Tie Wire.
1. Wire used for wire braces and wire ties shall be galvanized wire meeting requirements of ASTM A116, Class 3 coating, or an aluminum coated steel wire with a coating of not less than 0.25 oz per square foot.
 2. Unless otherwise designated, the size of wire for the respective use shall not be smaller than the following diameters:
 - a. Brace wire: No. 9.
 - b. Tie wires or clips for fastening field fence to steel posts: No. 12.
- D. Staples: Staples used to attach fence to wood posts shall be plain, No. 9, 1-3/4-inch long wire staples, unless otherwise specified in the Contract Documents and shall be subject to prior approval of the Engineer.
- E. Wood Posts
1. Wood fence posts shall be pine posts meeting the requirements of Iowa DOT Standard Specification for Road Construction, Section 4164, with pressure preservative treatment meeting the requirements of Section 4161. They shall be of the size and length designated in the Contract Documents. Unless otherwise specified, posts shall be round stock of the following sizes and lengths for the respective uses
 - a. Line posts, 4-inch top: 7-ft length
 - b. End, corner, gate, pull, angle, and brace posts, 6-inch top: 8-ft length
 2. When driving of line posts is contemplated, the tip of the post may have a blunt point. This point shall be near the centerline of the post and shall be made before treatment.
- F. Braces for Field Fence: Braces for field fence shall be steel angle or other approved bracing systems. Braces shall weigh not less than 1.94 lb per lineal foot. Angles shall be not less than 2 inches by 1½ inches by 3/16 inches. All braces shall be as shown in the Contract Documents and shall have ends flattened to fit squarely against the posts with brace approximately horizontal. Braces shall be coated as required for steel line posts.
- G. Steel Line Posts for Field Fence: Steel posts of T-section or other approved sections shall be used as line posts with wood posts, as shown in the Contract Documents. They shall not be used for corner, brace, pull, end, or gate posts. Only one type of steel post may be used in any installation 1,000 feet or less in length. Posts shall be equipped with lugs or other approved means to prevent the fence fabric from moving vertically. Posts, exclusive of anchor plate, shall weigh not less than 1.3 lb per lineal foot. Each post shall be provided with a steel anchor plate of adequate size, firmly attached. After the anchor plate is attached, the finished post shall be completely painted with a prime coat and an enamel finish coat, with no limitation on color or tip identification except as provided for 1,000-ft installations. This paint shall be thoroughly dry before posts are bundled for shipment. Unless otherwise specified, steel line posts shall be 7 feet in length.

PART 3 EXECUTION

3.01 - Erection of Chain Link Fence

- A. The fences and gates shall be erected in accordance with the recommendations of the manufacturer. Unless otherwise shown on the Contract Drawings, posts shall be set in concrete at least 1 foot in diameter and 3'-6" below grade. The posts shall be embedded at least 2'-6" but

not more than 3 feet in the concrete base. The top of the post bases shall be crowned to shed water and provide a neat appearance.

- B. Fabric shall be connected: to line posts every 14 inches; to top and bottom tension rods every 14 inches; to terminal and corner posts every 14 inches; to tension wire every 24 inches.
- C. Clear the line of the new fence to be constructed by removal of existing trees, branches, shrubs, brush, existing fence structure, sign posts and other obstructions as specified under "Site Clearing" – Section 02110.
- D. The fence shall follow the contours of the ground as nearly as is practical and be set 2-3 inches above finished ground level.
- E. Line posts shall be spaced equidistant in the fence line, not more than 10 feet apart. All posts shall be set plumb and true in concrete bases, as shown on the Contract Drawings.
- F. In areas of solid rock, the posts shall extend into the rock a minimum of 12 inches. The Engineer shall determine the depth of burial of the posts. Where posts are drilled into rock, cement grout shall be substituted for concrete.
- G. Chain link fence that crosses beneath any primary electrical power transmission line, other than a secondary feeder line for individual customer service, shall be properly grounded. The fence shall be grounded at the point of transmission line crossing and at a distance of 25-50 feet in each direction from the crossing. The grounding installation shall be as detailed in the Contract Documents.
- H. Chain link fence erected adjacent to and within 50 feet of a primary power line shall be grounded by placing ground rods at not more than 500-foot intervals.
- I. Each applicable straight section of fence shall have at least one ground. The Engineer may require the installation of an additional ground at the terminus of a section of fence or at other locations near areas of pedestrian traffic. Ground rod shall be connected to the fence as shown in the contract documents.

3.02 - Erection of Field Fence

- A. Setting Brace Post Assembly.
 - 1. Each angle, corner, and end post shall be set with one brace or more in each fence line. All posts shall be set as shown in the Contract Documents and at locations designated by the Engineer. Angle posts will be required where vertical alignment of fence changes 30 degrees or more. Corner posts will be required where horizontal alignment of fence changes by 10 degrees or more. End posts will be required where it is intended to terminate the lines of fence by cutting the fence fabric. Brace posts shall be located so that the horizontal brace will make contact with both posts while posts are in the vertical position.
 - 2. The annular space around end, corner, angle, and brace posts shall be backfilled by tamping a well graded crushed stone or a PCC mix approved by the Engineer. At the time backfill is placed, it shall contain sufficient moisture to be readily and thoroughly compacted by tamping.
 - 3. Braces shall be installed as shown in the Contract Documents and shall be placed so that they will not hold water on top of the brace. When the brace is in position, brace wire shall be applied from the brace post just below the horizontal brace downward to the angle, corner, or end post approximately 3 inches from the ground. Each diagonal brace wire shall consist of two strands of No. 9 wire making one complete turn around each post and returning to the other post, resulting in four strands of wire between posts. When the ends are secured by means approved by the Engineer, tension shall be applied by twisting the four wires together. The number of metal brace panels required for a brace post assembly is determined by the distance between any combination of end post, gate post, angle post, or pull post assembly. For the above purpose, the brace post adjacent to a corner post or an angle post is considered the end post. One metal brace panel is required for distances of 165 feet or less, and two metal brace panels are required for distances of more than 165 feet.

B. Setting Pull Posts.

1. Pull posts, for the purpose of tightening fence wire by mechanical means, are required at intervals not greater than 960 feet in straight lines of fence not intercepted by any brace posts. Two pull posts shall be set with one horizontal brace and diagonal tension wire braces in both directions between posts.
2. Setting of posts shall comply with provisions in Paragraph 3.02.A.

C. Setting Line Posts.

1. In each run of fence between brace posts and pull posts, line posts shall be set at the interval designated in the contract documents. Every third line post shall be a round, wood post not smaller than 4-inch top diameter. The two intermediate posts shall be steel posts. In any run of fence 1,000 feet or less, all steel line posts shall be of the same type.
2. Steel line posts shall be set by driving. Care shall be used to not damage steel posts in driving. Wood line posts shall be set in bored holes not smaller than 9 inches in diameter or by driving in a manner which will not damage the post. Soil removed from bored holes shall be thoroughly tamped back into the hole.

D. Stretching Fence Fabric.

1. Fabric shall be cut and tied off at all end posts and brace posts adjacent to corner and angle posts. Each line wire of the fabric shall be passed around the post and secured by not less than four wraps tight around itself. Tension in the fabric shall be applied by mechanical means and shall be held until the end of each line wire has been tightened around the post and securely wrapped on itself. The fabric at the corner post assembly shall be hand tensioned from the brace post around the corner post to the other brace post.
2. For pull post assemblies the fence fabric shall be extended past the first post and attached to the second post. Each line wire of the fabric shall be cut and wrapped around the post and secured by not less than four wraps tight around itself.
3. Unless otherwise required, fence shall be placed on the side of the posts closest to the roadway to be protected. At each wood post, each line wire shall be securely attached to the post by a staple driven to not kink the wire. At each steel post, each line wire shall be secured to the post by a wire tie or clip wrapped around the wire on each side of the post, holding the wire tightly to the post and preventing slipping up or down the post.

E. Stretching Barbed Wire.

1. Each strand of barbed wire shall be secured at end posts and the brace post adjacent to corner and angle posts by being wrapped around the post and not less than four wraps tight around itself. Tension shall be applied to each individual strand of barbed wire, and the end of the strand shall be securely stretched and attached to the post before the tension is released.
2. At each wood post, each strand shall be attached by a staple driven to hold the wire tightly against the wood without kinking the wire. At each steel post, each strand of barbed wire shall be firmly held by a wire tie or clip which will be wrapped around the strand on each side of the post, preventing slipping either up or down the post.

F. Splices.

Splices in fence fabric shall be made by attaching the fabric to angle, brace, or pull posts according to Paragraph 3.02.D, by looping each line wire around a galvanized, ½-inch rod at least 2 inches longer than the fabric width; and wrapping the line wire on itself four turns, or by using a crimped connector which develops a strength of at least 85 percent of the wire strength. Splices in barbed wire shall be made at corner or pull posts according to Paragraph 3.02.E or with a telephone type splice with each end making four complete turns around the other strand or by using a crimped connector recommended for barbed wire and which develops a strength of at least 85 percent of the wire strength.

G. Gates.

Gates shall be mounted so that they swing fully and do not sag or drag on the ground. They shall be provided with galvanized, welded chain long enough to completely encircle the post

and the end frame of the gate. Metal of the chain shall be not less than 5/16 inch in diameter with links large enough to admit a padlock. Gates shall also be provided with an adequate stop and latch to prevent the gate from opening to a point that would damage the gate. The leaves of double swing gates shall match in top and bottom elevation.

H. Channel Crossing Fence.

1. Channel crossing fence, of the type specified in the Contract Documents, will be required when a stream or ravine is to be crossed and it is impractical to fit the line fence to the existing ground line and when more than two additional barbed wires are required below the normal line fence to adequately close the opening. Channel crossing fence shall be constructed in general conformance with, and at locations indicated in the Contract Documents, and to the limits as required by the Engineer at the Site.
2. Posts shall be set and the barbed wire shall be stretched and secured as specified in Paragraph 3.02.E.
3. The maximum spacing of barbed wire shall be 6 inches.
4. For Type A channel crossing fence, extra length wood posts and additional field fence materials shall be used to close the opening satisfactorily. For Type B channel crossing fence, a floodgate, constructed as shown in the Contract Documents shall be required in addition to extra length wood posts and additional field fence materials needed to close the opening satisfactorily.

END OF SECTION 02950