

MAXSTOP

Welded Wire Security Fence

NUCLEAR POWER PLANTS

SECURITY FENCE, DELAY BARRIERS, AND GATE SPECIFICATIONS

Section 080108NP

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SECTION 080108NP

NUCLEAR POWER PLANTS SECURITY FENCE, DELAY BARRIERS, AND GATE SPECIFICATIONS

PART 1 GENERAL

1.1 SCOPE OF WORK:

- A. Summary: This section covers the work necessary to complete the, Welded Mesh Fence, Delay Barrier and Gate Installation.
- B. References to chain link fence is for information purposes only and are requirements to follow should repairs or replacements of existing fences become necessary.
- C. General: Like items of materials provided hereafter shall be the end products of one manufacturer in order to achieve standardization for appearance, maintenance and replacement. Major components shall be manufactured in the U.S.A.
- D. Delivery, Storage and Handling: Deliver material to the site in an undamaged condition. Carefully store material off the ground to provide proper protection against oxidation caused by ground moisture. Material stored on the site for more than 30 day shall be placed under cover.

1.2 REFERENCE ASTM DOCUMENTS:

- A. A 121-99 Standard Specification for Metallic-Coated Carbon Steel Barbed Wire (galvanized)
- B. A 123/A 123M-02 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products (including those fabricated from rolled, pressed, and forged steel shapes, plates, bars, and strip and welded wire mesh)
- C. A 153/A 153M-05 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- D. A 392-07 Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
- E. A 491-07 Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
- F. A 570 Hot Rolled Sheet and Strip, Structural Quality
- G. A 780-01 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- H. A 824-01 Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use with Chain Link Fence
- I. B 117-07 Standard Practice for Operating Salt Spray (Fog) Apparatus
- J. C 94/C 94M-07 Standard Specification for Ready-Mixed Concrete
- K. A 90/A 90M-07 Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
- L. F 567-07 Standard Practice for Installation of Chain-Link Fence
- M. F 626-96a Standard Specification for Fence Fittings

- N. F 668-07 Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric
- O. F 900-05 Standard Specification for Industrial and Commercial Swing Gates
- P. F 934-96 Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials
- Q. F 1043-06 Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework
- R. F 1910-98 Standard Specification for Long Barbed Tape Obstacles
- S. F 1911-05 Standard Practice for Installation of Barbed Tape
- T. F 1916-98 Standard Specifications for Selecting Chain Link Barrier Systems with Coated Chain Link Fence Fabric and Round Posts for Detention Applications (For grounding reference and chain link replacements or modifications)
- U. F 2354/F 2453M-05 Standard Specification for Welded Wire Mesh Fence Fabric (Metallic-Coated or Polymer Coated) for Meshes of 6 in.2 [3871 mm²] or Less, in Panels or Rolls, with Uniform Meshes

1.3 FEDERAL SPECIFICATIONS (FS):

- A. ACE 02821A UFGS Army Corps of Engineers Unified Guide Specification
- B. NAVFAC 02821N UFGS Navy Unified Guide Specification

1.4 MATERIALS: (CONFORMING TO ASTM F 1916 WHEN APPLICABLE)

- A. Submittals: Shall show application to the project
- B. Product Data: Manufacturers' catalog cuts, with printed specifications, and installation instructions. Manufacturer shall provide certification of compliance with material specifications.
- C. Samples:
 - 1. One square foot of fence fabric
 - 2. One each size of post tops and extension arms
 - 3. One 6.0 in. (152 mm) long segment sample of each barbed tape specified
 - 4. One 12 in. (305 mm) long sample of each pipe size accompanied by affidavit of compliance
- D. General:
 - 1. Manufacturers:
 - a. C.E. Shepherd, Houston, TX. 1-800-324-9473.
 - b. Allied Tube and Conduit (Barbed tape Division), Hebron, OH. 1-800-285-4066
 - c. Allied Tube and Conduit, Chicago, IL. 1-800-882-5543.
 - d. Tymetal Corporation (Gates and Operators), Greenwich, N.Y. 1-800-328-4283.
 - 2. The use of manufacturers' name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired. Products from other manufacturers shall be considered in accordance with the general conditions.

3. Material shall be new and products of recognized, reputable, manufacturers having a minimum of 5 years experience. Used, re-rolled, or re-galvanized materials are not acceptable.
4. All fence fabric herein specified shall be hot-dip galvanized and shall have a minimum zinc coating of two (2) ounces per square foot of surface, unless otherwise specified.
5. Steel pipe and other framework shall be hot-dip galvanized in accordance with ASTM F 1043 1C Type B-D.

Color options are green, black and brown. Polymer powder coatings are applied, after welding, to zinc-coated (galvanized) wire mesh.

6. Repairs to existing fence systems are not covered under this contract and will require change orders to complete additional work.

PART 2 PRODUCTS

2.1 FABRIC: (OPTIONS)

A. Steel Fabric:

Chain Link Fabric: existing on the site requiring repairs or modification is either woven from 11 or 9 gauge in a 2 in. (51 mm) diamond mesh pattern. Chain link fence fabric shall be of high-grade commercial quality with a minimum breaking strength of 850-lb/ft. (3780N) and 1250 lb/ft respectively. Fabric and coating shall meet the requirements of ASTM A 392, Class 2 or aluminum coated in accordance with ASTM A 491. The fence fabric may be fabricated into a single piece to the height specified or as specified herein. Selvage: Top side twisted: bottom side knuckled.

Improve performance by replacing all chain link fence systems with welded mesh.

1. Welded Mesh Fence Fabric:
 - a. Mesh height as indicated on the drawings. If panel height exceeds 8 ft. (2.4 m), panel width shall not exceed 8 ft. plus additional width at the vertical edge of the panel equivalent to the mesh opening dimensions. The 1.5 in. x 4 in. x 11 gauge (38 mm x 102 mm x 3mm) welded mesh fabric can be fabricated in rolls up to 10 ft. (3 m) maximum height. For fence heights exceeding 10 ft. (3 m) two pieces of fabric are required, one above the other.
 - b. Wire shall conform to ASTM F 2354, having a nominal tensile strength of 73,000 psi (503MPa).
 - c. After welding the fabric is hot-dip galvanized or zinc-5% aluminum-mischmetal coated in accordance with ASTM A 123 or ASTM F 2453.
2. Panels: Welded Mesh Security Fabric is generally fabricated in panels. Single mesh panels are fabricated to a height of 20 ft. Panel widths are 7 ft. or 8 ft., plus additional width at the vertical edge of the panel equivalent to the mesh opening dimensions to be used for the overlap connection at the line-post.
3. The following fabric options are available as single panels or installed in combination of panels to accommodate the Design Basis Threat requirements.

- a. Panel Options (Examples):
- 1) Protected Area:
 - (i) Single Panel: Cut and Climb Resistant fabric 0.5 in. x 3 in. x 8 gauge or 0.5 in. x 2 in. x 10 gauge.
 - (ii) Combinations of Panels: Cut and Climb Resistant installed as either the upper or lower panels of 2 in. x 2 in. x 8 gauge and 0.5 in. x 2 in. x 10 gauge.
 - (iii) Fence height: 10 to 12 ft.
 - 2) Shooting Zone:
 - (i) Single Panel:
 - (a) Fences nearest to facility shall be 2 in. x 2 in. x 8 gauge.
 - (b) Fences leading to the shooting zone shall be 1.5 in. x 4 in. x 8 gauge.
 - (c) Fence heights: 10 to 12 ft.
- Shooting zone fence systems are generally 10 – 12 feet in height. Larger mesh openings are required to minimize bullet deflection. Custom designed mesh panels can be fabricated to accommodate a variety of mesh openings. Fence configurations will vary according to the anticipated threat. Consult with the welded mesh manufacturer for alternative designs.
- 3) Delay and Denial Barrier:
 - (i) Single Panels: 2 in. x 2 in. x 8 or 9 gauge (51mm x 51 mm x 4 mm or 3.8 mm) topped with a number of 24 in. (610 mm), 30 in. (762 mm), 36 in. (878 mm), and 60 in. (1,524 mm) diameter security coils.
 - 4) Safety Fence:
 - (i) Single Roll: 3 in. x 3 in. x 9 gauge (76 mm x 76 mm x 3.8 mm) 6 or 7 ft. (1.3 m or 2.1 m) in height.

2.2 FRAMEWORK SPECIFICATIONS:

- A. General: Framework shall conform to the following unless otherwise specified:
1. ACE 02821A UFGS Army Corps of Engineers Unified Guide Specification
 2. NAVFAC 02821N UFGS Navy Unified Guide Specification
- B. Tubular Post: shall conform to ASTM F 1043 Group 1A(A) and 1C(B). Minimum coatings shall be in accordance with ASTM F 1043 Group 1C Exterior Type B and Interior Type D (SS 40).
- C. Performance: All tubular framework shall meet the following requirements. The product of the yield strength and section modulus shall not be less than that for pipe conforming to ASTM F 1043. Post rails and braces shall demonstrate the ability to withstand testing in accordance with ASTM B 117 as follows:
1. Exterior: 1000 hours with maximum of 5% red rust
 2. Interior: 650 hours with a maximum of 5% red rust

- D. Repairs: Zinc-rich paint will be used for repairing surfaces damaged by field welding. Touch up welded areas with zinc-rich paint conforming to ASTM A 780.
- E. Size & Weight: Grade B Post in accordance with ASTM F 1043 Group 1C

Use	Size	O.D.		Wall Thickness		Wt/Ft.	
Rails	1-5/8 in.	1.660 in.	42 mm	0.110 in.	2.8 mm	1.82#	2.71 kg/m
Post	2 in.	1.900 in.	48 mm	0.120 in.	3.0 mm	2.28#	3.39 kg/m
Post	2-1/2 in.	2.375 in.	60 mm	0.130 in.	3.3 mm	3.12#	4.64 kg/m
Post	3 in.	2.875 in.	73 mm	0.160 in.	4.1 mm	4.64#	6.91 kg/m
Post	3-1/2 in.	3.500 in.	89 mm	0.160 in.	4.1 mm	5.71#	8.50 kg/m
Post	4 in.	4.000 in.	102 mm	0.160 in.	4.1 mm	6.56#	9.76 kg/m
Post	4-1/2 in.	4.500 in.	114 mm	0.237 in.	6.0 mm	10.80#	16.07 kg/m
Post	8-5/8 in.	5.000 in.	127 mm	0.322 in.	8.2 mm	28.58#	42.55 kg/m

Consult with the pipe manufacturer for information regarding post sleeves for increased strength.

PART 3 DELAY BARRIERS

Refer to Post Chart for metric conversions.

Note 1: It is not necessary to increase terminal post size when using welded mesh fence fabric.

Note 2: Levels of Security Drawings typically represent type and number of fence systems required.

3.1 6 OR 7 FT. SAFETY INNER FENCE FRAMEWORK

- A. Line and Terminal Post: Grade (B) Pipe 2.375 O.D.
- B. Top and Bottom Railing: Grade (B) Pipe 1.660 O.D.
- C. Fence Fabric (Options):
 1. 1.5 in. x 4 in. x 11 gauge (38 mm x 102 mm x 3 mm) Welded Mesh, available in rolls, or
 2. 3 in. x 3 in. (76.2 mm x 76.2 mm) x 9 gauge Welded Mesh, available in rolls
- D. Barbed Tape: Select in accordance with Section 4.4

3.2 10 FT. INNER SECURITY FENCE FRAMEWORK AND FABRIC

- A. Line Post and Terminal Post: Grade (B) Pipe 2.875 O.D.
- B. Top, Intermediate, and Bottom Railing: Grade (B) Pipe 1.660 O.D.
- C. Fence Fabric (Options):
 1. 0.5 in. x 3 in. x 8 gauge (12.7 mm x 4 mm) Cut and Climb Resistant, or
 2. 2 in. x 2 in. x 8 gauge (51 mm x 51 mm x 4 mm) Welded Mesh

3.3 12 FT. INNER SECURITY FENCE FRAMEWORK AND FABRIC

- A. Line Post and Terminal Post: Grade (B) Pipe 4.000 O.D.
- B. Top, Intermediate, and Bottom Railing: Grade (B) Pipe 1.660 O.D.
- C. Fence Fabric (Options):
 - 1. 0.5 in. x 3 in. x 8 gauge (12.7 mm x 4 mm) Cut and Climb Resistant, or
 - 2. 2 in. x 2 in. x 8 gauge (51 mm x 51 mm x 4 mm) Welded Mesh

3.4 BLAST MITIGATING FENCE SYSTEMS

Blast mitigating fences and barriers are designed according to the existing terrain, setback, available space and the amount of delay specified in accordance with the anticipated threat.

Consult with the welded mesh manufacturer for design information specific to particular applications. Welded mesh gabions are also available for blast mitigation.

3.5 SLOPES

Circumstances encountered when constructing fence systems on slopes: angle of slope (affects the length of post), fence height, soil conditions, installation methods, accessibility, fabric type, level of security, and wind loads. Some security applications will also be affected by the burial of a portion of fence fabric.

PART 4 POST HOLE DIAMETERS AND SETTING DEPTH:

- 4.1 FABRIC HEIGHT 6.0 FT. TO 18.0 FT.:** Minimum posthole diameters for 2.375 in. are typically 10.0 in.; 2.875 in. are typically 12.0 in.; 4.0 in. are typically 16.0 in.; and 6.625 in. are typically 24.0 in., unless otherwise specified.

Exposed Height of Fabric		Line Post		Terminal		Setting Depth	
6 Feet	1.8 m	2.375 in.	60 mm	2.875 in.	73 mm	30 in.	762 mm
7 Feet	2.1 m	2.375 in.	60 mm	2.875 in.	73 mm	33 in.	838 mm
8 Feet	2.4 m	2.375 in.	60 mm	2.875 in.	73 mm	36 in.	914 mm
9 Feet	2.7 m	2.875 in.	73 mm	4.000 in.	102 mm	39 in.	991 mm
10 Feet	3.0 m	2.875 in.	73 mm	4.000 in.	102 mm	42 in.	1067 mm
11 Feet	3.4 m	2.875 in.	73 mm	4.000 in.	102 mm	45 in.	1143 mm
12 Feet	3.6 m	2.875 in.	73 mm	4.000 in.	102 mm	48 in.	1219 mm
13 Feet	4.0 m	2.875 in.	73 mm	4.000 in.	102 mm	51 in.	1295 mm
14 Feet	4.3 m	3.500 in.	89 mm	4.000 in.	102 mm	54 in.	1372 mm
15 Feet	4.6 m	3.500 in.	89 mm	4.000 in.	102 mm	57 in.	1447 mm
16 Feet	4.9 m	4.000 in.	102 mm	6.525 in.	168 mm	60 in.	1524 mm
17 Feet	5.2 m	4.000 in.	168 mm	6.525 in.	168 mm	63 in.	1600 mm
18 Feet	5.5 m	4.000 in.	168 mm	6.525 in.	168 mm	66 in.	1676 mm

Post Sizes are based on 70 MPH wind velocity for 9-gauge 2 in. fabric. Refer to ASTM F 1916 for nominal wind loads. Larger diameter terminal posts are only required when chain link is specified as the fence fabric.

4.2 FITTINGS AND ACCESSORIES:

- A. General: All fittings and accessories shall be pressed steel, malleable steel or cast iron manufactured in accordance with the RR-F-191/4D specifications, and ASTM F 626. All fittings shall be hot-dip galvanized in accordance with ASTM A 123. All hardware shall be hot-dip zinc coated in accordance with ASTM A153.
- B. Post Tops: Post tops shall be pressed steel, or malleable iron, designed as a weather tight closure cap for tubular post. Provide one cap for each exposed tubular post end, unless equal protection is afforded by combination post top cap and barbed wire supporting arm where barbed wire or barbed tape is required.
- C. Tension (Stretcher) Bar: No tension bars required for welded fabrics if mesh openings are smaller than 1.0 in. (25.4 mm). When tension bars are used the bars shall be of a length equal to the full height of fabric with a minimum cross-section of 3/16 in. x 3/4 in. (5 mm x 19 mm). Provide one tension bar for each gate post and terminal post and two for each corner and pull post where chain link is installed. For welded mesh installations, the tension bars are pre-drilled at the specified spacing interval and bolted to the tension band.
- D. Tension (Stretcher) Bar Bands: Bar bands shall be heavy-pressed steel 3/4 in. x 1/10 in. (19 mm x 3 mm) nominal to secure tension bars to tubular terminal posts. Space bar bands not more than 14 in. (356 mm) on center.
- E. Braces: Post braces, when called for on the drawings or in these specifications, shall be of the same material as the rails and shall extend from the terminal post to the first adjacent line post. Braces shall be securely fastened to the posts by heavy pressed steel and malleable fittings. Securely truss from line post to base of terminal post with a 3/8 in. (9.5 mm) truss rod equipped with a galvanized turnbuckle. Where tension wires are installed at the top and bottom of the fence, place the single horizontal brace one foot below the top of the terminal post and extended to the adjacent line post. Follow trussing instructions above.
- F. Fittings: Malleable steel, cast iron, or pressed steel. Fittings to include stretcher bars and bands, clips, truss rods, brace rod, fabric bands, boulevards, and hardware.

4.3 EXTENSION ARMS:

- A. Extension Arm (45° Single Arms): Each post shall be equipped with one 14 in. extension arm with slits at evenly spaced intervals for three strands of barbed wire. Extension arms shall have a tight press-fit or should be tack welded or secured to the post with self-tapping 3/16 in. (8 mm) minimum diameter screw. Extension arms shall be a solid one-piece construction, non-breakaway type. Barbed tape support wire shall be barbed wire, tension wire, or cables.
- B. Barbed Wire: Barbed wire shall conform to ASTM A 121, Class 3 and shall be hot-dip galvanized steel consisting of two strands 12.5 gauge twisted line wire with 14 gauge four point barbs located 5 in. on center.
- C. Tension Wire: Tension wire shall be 7 gauge smooth, zinc or aluminum coated.
- D. Cable: Cable shall be 3/16 in. (8 mm) diameter stainless steel.

4.4 BARBED TAPE: (CONFORMING TO ASTM F 1910)

- A. Wire Reinforced 24 in., 30 in., 36 in., and 60 in. Concertina: Material properties and other technical data available in Standard Specification ASTM F 1910.

The barbed tape shall be permanently cold-clenched over an austenitic stainless steel core wire. The wire shall have a diameter of .098 in. (2.5 mm) with a medium tensile strength of approximately 140 ksi (937 Mpa). The barbed tape shall have a minimum 230° wrap about the core wire.

Adjacent alternate loops shall be clipped together around the circumference to obtain the concertina effect. Clip spacing of the extended coil will vary according to the specified diameter. Clips shall be capable of withstanding a minimum pull load of 200#. Each coil shall contain either 31 loops or 51 loops and cover 20 ft. and 25 ft. ± 1 ft. (7.1 m and 7.6 m ± 3 m). Twistable wire ties for securing the barbed tape shall be minimum 16 gauge stainless steel.

4.5 GATES GENERAL: (REFER TO POST CHART FOR METRIC CONVERSION)

Note: This section provides for the repair or replacement of existing gates, if necessary.

- A. GATE POST: Gates referred to are swing or slide, complete with latches, stops, keepers, hinges or rollers and roller tracks.
 - 1. Single width of gate up to 6 ft. 0 in. (1.8 m) wide: Grade (B) Pipe 2.875 in. O.D
 - 2. Single width of gate 7 ft. 0 in. to 12 ft. 0 in. (2.1 to 3.7m) wide: Grade (A) Pipe 6.625 in. O.D
 - 3. Single width of gate 13 ft. 0 in. to 18 ft.0 in. (4 to 5.5m) wide: Grade (A) pipe 6.625 in. O.D., 18.98 lb. per lineal foot
 - 4. Single width of gate over 18 ft. 0 in. (9.5m) wide: Grade (A) pipe: 8.625 in. O.D.
- B. GATE FRAMES
 - 1. Swing Gate Frames Height 6 ft. 0 in. to 12 ft. 0 in. (1.8 to 3.7 m): Grade (B) Pipe: 1.90 in. O.D.
 - 2. Swing Gate Frames Height 12 ft. 1 in. to 16 ft. 0 in. (3.7 to 4.9 m): Grade (B) Pipe: 2.375 in. O.D
- C. Gate Construction Conforming to ASTM F 900: Assemble gate frames by welding. Install mid-height horizontal rails and install mid-distance vertical pipe of the same size and weight as frame members. When horizontal or vertical bracing is not required, provide truss rods as cross bracing to prevent sagging or twisting. Refer to drawings regarding construction details.
- D. Gate Fabric: Shall be the same type as used in the fence construction. The fabric shall be attached securely to the gate frame at intervals not exceeding 14 in. (356 mm). Secure fabric to frame with tension bars, tension bands and 9 gauge galvanized steel wire ties.
- E. Gate Hinges, Latches Stops, Keepers and Accessories: Shall be hot dip galvanized with zinc coating of no less than 2 ounces of zinc/ft.² (610 g/m²).
 - 1. Gate Hinges: Shall be adequate for gate size specified, with large bearing surfaces for clamping in position. The hinges shall not twist or turn under the action of the gate. The gates shall be capable of being opened and closed easily by one person. All hinges will be malleable iron, ball-and-socket type. Hinges shall be non-lift-off type, offset to permit 180 degree swing, and of suitable size and weight to support gate. Provide 3 hinges for each leaf over 7 ft. (2.1 m) high.
 - 2. Gate Latches, stops, and keepers shall be provided as appropriate for all gates. Latches shall have a plunger-bar or center drop rod of full gate height arranged to engage the center stop. Latches

shall be arranged for locking with specified locking hardware. Center stops shall consist of a device arranged to be set in concrete and to engage a plunger-bar of the latch for double gates.

3. Keeper: Provide keeper for all manually operated vehicle gates, which automatically engages the Gate leaf, holding it in the OPEN position until manually released.
4. Locking devices shall be constructed so that the center drop rod or plunger bar cannot be raised when locked. No stop is required for single gates. Keepers shall consist of a mechanical device for securing the free end of the Gate when in the full open position. Gates and posts shall be modified as required to receive hardware, including locking and operating mechanisms as herein specified.

F. Gate Modifications: Key access ports shall be installed where directed.

PART 5 WORKMANSHIP:

The contractor's work shall be of the highest quality, consistent with generally accepted practices of the trade and in accordance with this specification.

5.1 SECURITY FENCE INSTALLATION:

- A. Site Preparation for Fence Installation: Prior to the installation of any security fence, all necessary clearing and grading on both sides of the fence shall be performed by the Contractor. Grading shall be done in such a manner as to provide a straight, flat surface in order to construct a fence line with no gaps greater than 2 in. (51 mm) between the bottom of the fence fabric and the ground, grade beams or above ground pre-cast / cast-in-place concrete barriers. Dirt fill used to establish the finished fence line shall be thoroughly compacted.
- B. General: Installation of fencing shall meet the requirements of ASTM F 1916 and ASTM F 567 as modified herein. Skilled mechanics, experienced in this type of construction, shall erect the fencing in straight lines between angle points, in accordance with the manufacturer's recommendations and these Specifications. All security fences and gateposts shall be grounded as specified herein.
- C. Post Holes: Post holes shall be in accordance with this specification and the drawings. Set posts plumb and to depths shown on drawings and as specified. Vacuum all posts holes to the desired diameter and depth. Facility engineers will stipulate which holes might be bored instead of vacuumed. The contractor shall locate all above and below ground utilities that might cause a hazard to workers and their equipment. The contractor shall bear all responsibility for insufficient or incorrect information relating to utilities.
- D. Concrete: Concrete shall conform to ASTM C 94 and shall be thoroughly worked into post holes so as to leave no voids. Allow concrete to cure a minimum of one week (7 days) before installing fence fabric or fittings. The top surface of posthole concrete shall have a crown watershed finish unless the sub-grade for the buried fabric becomes the top of the footing
 1. Setting Posts in Rock: Drill holes into solid rock or concrete 1/2 in. (13 mm) wider than pipe diameter; 18 in. (457 mm) deep for end, pull, corner and gate posts; and 12 in. (305 mm) deep for line posts. Set posts into holes and fill angular space with non-shrink grout.
- E. Post Spacing: Space posts equal distance in the fence line to a maximum of 10 ft. (3 m) on center. Provide corner or terminal posts for any change in direction of 15 degrees or more and for any abrupt change in grade, with bracing in both directions. Due to certain site or soil conditions, some fence installations will require posts installed on concrete barrier a minimum of 8 in. (203 mm) in depth or attached with brackets to the side of the barrier.

- F. Terminal Posts: Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Terminal posts shall be used at beginning and end of each continuous length of fence and where abrupt changes in vertical or horizontal alignment of 15 degrees or more occur.
1. Chain Link Installations: Terminal posts shall be installed at intervals not to exceed 500 ft. (152 m). Where fence runs are greater than 500 ft. (152 m), space terminal posts evenly between corners and ends throughout the run.
 2. Welded Mesh: No terminal post required.
- G. Rails, Braces, Tension Bars and Truss Rods: Install rails, braces, tension bars and truss rods as called for on the drawings and in these specifications. All rails, braces, tension bars and truss rods shall be installed on the side of the fence least accessible. For example, rails on the perimeter security fence shall be installed on the side away from the intruder.
1. Rails: The intermediate and bottom rails shall be connected to the line and terminal post using boulevards or bands and rail ends. Attachment bolts for bands shall be 5/16 in. x 1-1/2 in. (8 mm x 38 mm) carriage bolts and nuts. The boulevard bolts shall be 3/8 in. (10 mm) diameter for security application and 5/16 in. (8 mm) diameter for Nuisance and Safety Fences. One expansion sleeves shall be installed at intervals of 500 ft. (152.4m) where top rails are continuous.
- H. Fence Fabric: Fasten chain link and welded mesh fabric to end posts with tension (stretcher) bar and bar bands at spacing interval specified. Chain link fabric shall be installed such that it will pass the fabric tension test in accordance with ASTM F 1916. No fabric testing required for the welded mesh supplied in rolls or panels
1. Roll Fence Fabric: Fabric shall be secured to all rails and line posts with 9 gauge minimum, galvanized steel wire spaced 12 in. (305 mm) on center. Tie down wire shall be hooked to the fabric and pulled across the secure side of the rail or line post and attached to the fabric on the opposite side of the post. Both ends are twisted a minimum of two turns pulling the fabric in close contact with the rail or line post. To prevent untwisting of the ties by hand, remove any excess wire ends.

Pre-formed 9 gauge ties twisted with power tools are acceptable. Twisted ends of ties are located to the side or bent downward on line post and to the side on rails.
 2. Wire Tie Twist shall be on secure side of fence. Secure fabric to the terminal and gateposts for the full length of the fabric by using stretcher bars and bar bands. The bar band shall be placed 14 in. (356 mm) maximum.

Use stretcher bars and bar bands to fasten the welded mesh to the terminal posts for the full height of the fabric. Stretcher bars are pre-drilled prior to assembling to the terminal post.
- I. Barbed Wire and Razor Ribbon (Installed in accordance with ASTM F 1911)
1. Outrigger: Install outriggers (extension arms) as recommended by the manufacturer and in accordance with this specification. Securely anchor support arms to posts in such a manner that will prevent easy removal with hand tools.
 2. Terminal posts that are taller than line post at gate locations etc., and posts at the intersection of fences of different heights shall be fitted with an arm made from minimum 1-7/8 in. (48.3 mm)

pipe and welded in place. The angle and length of the fitted arm shall be the same as the other standard extension arms.

Locate all arms at the same angle and height making sure end and corner arms provide a solid anchor for terminating the barbed wire, tension wire or cable. Arms installed at the same angle will permit the uniform continuation of the barbed tape in any direction.

3. Install support wire, barbed tape and all necessary accessories as shown on the drawings and described herein. Attach barbed tape in such a manner that any movement of the tape by the wind will not cause any difficulties with the sensors mounted to the barbed tape or fence.
4. Barbed tape, Barbed Wire, Tension Wire or Cable: shall be stretched tight through the outer slot of each extension arm and secured in place. Only two attaching points are required to secure the barbed tape in place.
5. Contractor: If the contractor is unable to verify installation experience, then the contractor shall contract with the manufacturer to have a manufacturer's representative with a minimum of five years experience on the construction site. This shall be arranged prior to the start of installation. Manufacturer's representative will instruct the contractor's personnel in the proper installation procedure.
6. Installation of Security Coils: Barbed tape Coils installed on the top of the fence shall be as shown on the drawing. The Concertina coils installed on the top of the 14 inch extension arm shall be secured to the single strand of support wire and to the top of the fence.
7. Barbed tape coils are secured to the supporting wire and top and side of the fence fabric by using 16 gauge (1.6 mm) stainless steel twistable wire ties. Follow ASTM F 1911 Standard Installation Practice.

J. TEMPORARY FENCE INSTALLATION:

1. The contractor shall be responsible for removal of all temporary fencing / barriers and the restoration of the site.
2. Salvage of construction material shall be defined as removing, transportation and handling of all fence materials. The facility shall provide a location on site for expendable items. Salvageable items will be returned to the contractor for disposition.

5.2 SECURITY FENCE LEVELS 1 THROUGH 4

A. Fence Levels 1 and 2:

1. Follow the installation instructions section 5.1 and drawings SL-1 and SL-2.
2. An on-site engineer shall determine that buried fabric will not interfere with underground raceways or other utilities belonging to the facility.

B. Fence Level 3:

1. Follow the installation instructions section 5.1 and drawing SL-3.
2. Distances between the delay barriers and the outer fence are determined by available space. Space between the fences and delay barriers should equal those shown on the drawing. Limited construction space requires design changes that will afford the same level of protection. Alternative design criterion is available from the welded mesh manufacturer.

C. Fence Level 4:

1. Follow the installation instructions section 5.1 and drawing SL-4.
2. Should construction space be less than 125 ft (38 m) in width, the fence heights and overall general configurations will change to accommodate the available space. Alternative design criterion is available from the welded mesh manufacturer.

D. Slope Installations:

1. Follow the installation instructions section 5.1 and consult with the welded mesh manufacturer regarding additional information.
2. Level of security will be determined in accordance with the anticipated threat against the area.
3. Follow the special considerations in section 3.4.

E. Removable Fence Sections:

1. Security Fences incorporating removable sections are intended for limited traffic over railroad tracks, roadways, and the like. Removable sections are constructed as independent units capable of removal by forklift. Each removable section will emulate the permanent fence and require the same delay rating.

PART 6 GROUNDING:

- A. Work to be performed by a certified electrician and in accordance with ASTM F 1916.
- B. Fences crossing power lines of 600 volts or more shall be grounded at or near the point of crossing and at distances not exceeding 150 ft. (46 m) on each side of crossing. Grounding electrodes along the fence line shall be installed at 300 ft. (91 m) intervals, unless electronic detection is an integral part of the fence. If electronic detection is an integral part of the fence, then grounding electrodes are installed at 150 ft. (46 m) intervals. Bonding jumpers shall attach the rows of barbed tape to each grounding conductor. Bonding jumpers shall not be less than AWG No. 6 copper.
- C. Grounding electrodes shall be a minimum 3/4 in. (19 mm) diameter x 8 ft. (2.4 m) long copper clad rod, driven into the earth until the top is 12 in. (305 mm) below grade. Attach a No. 2 AWG bare stranded copper conductor by exothermically welding to the ground rods and extend underground in the immediate vicinity of the fence post.
- D. Secure conductors to post with 5/16 in. (8 mm) minimum self-tapping galvanized or stainless steel bolts and approved copper compression terminal ends or clamps.
- E. Gate Locations: Where gates separate the continuous fence line, a #2 AWG bare stranded copper conductor shall run from on side of the gate underground, to the gate post or nearest line post on the opposite side of road or walkway. One 3/4 in. (19 mm) diameter copper clad electrode is sufficient for each gate. Braided bonding jumpers shall bond gates to post on the hinge side.
- F. After completion of grounding connections, perform a ground resistance test in the presence of the contractor's representative. The ground resistance shall not exceed 25 OHMS under normal dry conditions. Where resistance requirements cannot be attained, install additional rods not closer than 6 ft. (1.8 m) apart. Install no more than two additional rods at each location.

END OF SECTION