

SECTION 02821 - CHAIN-LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Chain-Link Fences.
 - 2. Gates: Swing.
- B. Related Sections include the following:
 - 1. Section 02300 "Earthwork" for site excavation, fill, and backfill where chain-link fences and gates are located.
 - 2. Section 03301 "Cast-in-Place Concrete (Limited Applications)" for concrete [post concrete fill].

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide chain-link fences and gates capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Minimum Post Size and Maximum Spacing for Wind Velocity Pressure: Determine based on mesh size and pattern specified, and on the following minimum design wind pressures and according to CLFMI WLG 2445:
 - a. Wind Speed: 90 mph
 - b. Fence Height: 8 feet; 10 feet, and 12 feet.
 - c. Gate Height: Match height of fence.
 - d. Line Post Group: IA, ASTM F 1043, Schedule 40 steel pipe, or as it is indicated on the plan (construction details).
 - e. Wind Exposure Category: B
 - 2. Determine minimum post size, group, and section according to ASTM F 1043 for framework up to 12 feet high, and post spacing not to exceed 10 feet
- B. Lightning Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Fence and gate posts, rails, and fittings.
 - 2. Chain-link fabric, reinforcements, and attachments.
 - 3. Gates and hardware.
- B. Shop Drawings: Show locations of fences, gates, posts, rails, details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.
- C. Samples for Initial Selection: Manufacturer's color charts or **6-inch** lengths of actual units showing the full range of colors available for components with factory-applied color finishes.
- D. Product Certificates: For each type of chain-link fence, and gate, signed by product manufacturer.
 - 1. Strength test results for framing according to ASTM F 1043.
- E. Qualification Data: For Installer.
- F. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
 - 1. Engineering Responsibility: Preparation of data for chain-link fences and gates, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Include **4 feet** length of fence and gate complying with requirements.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by the Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
 - 2. Approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.
- C. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Chain-Link Fences and Gates: Contractor to provide list of available manufacturers.

2.2 CHAIN-LINK FENCE FABRIC

- A. General: Height indicated on Drawings. Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:
1. Steel Wire Fabric: Metallic or Polymer-coated wire with a diameter of **0.148 inch (3.76 mm)**.
 - a. Mesh Size: **2 inches (50 mm)**.
 - b. Weight of Aluminum Coating: ASTM A 491, Type I, **0.35 oz./sq. ft. (107 g/sq. m)**.
 - c. Weight of Metallic (Zinc) Coating: ASTM A 392, Type II, Class 2, **2 oz./sq. ft. (610 g/sq. m)** with zinc coating applied before weaving.
 - d. Weight of Zn-5-Al-MM Aluminum-Mischmetal Alloy Coating: ASTM F 1345, Type III, Class 2, **1.0 oz./sq. ft. (305 g/sq. m)**.
 - e. Polymer Coating: ASTM D 668, Class [1] [2a] [2b] over metallic-coated steel wire.
 - 1) Color: As selected by Architect from manufacturer's full range, complying with ASTM F 934.
 - f. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.
 2. Aluminum Wire Fabric: ASTM F 1183, with [mill] [caustic-cleaned] [etched] finish, and wire diameter of **0.148 inches (3.76 mm)**.
 - a. Mesh Size: **2 inches (50 mm)**.
 3. Selvage: Knuckled at both selvages.

2.3 INDUSTRIAL FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F 1043 for framing, ASTM F 1083 for Group IC round pipe, and the following:

1. Group: IA, round steel pipe, Schedule 40; IB, aluminum pipe, Alloy 6063; IC, round steel pipe, yield strength 50,000 psi (345 MPa).
2. Fence Height: 8 feet (2.44 m); 10 feet (3.05 m) and 12 feet (3.66 m).
3. Strength Requirement: Heavy industrial according to ASTM F 1043.
4. Post Diameter and Thickness: According to [ASTM F 1043] [ASTM F 1083].
5. Post Size and Thickness: [According to ASTM F 1043.]
 - a. Top Rail: 1.66 inches (42 mm).
 - b. Line Post: 2.375 inches (60 mm) and 2.875" (73 mm).
 - c. End, Corner and Pull Post: 2.875 inches (73 mm), and 4.0 inches (102 mm).
 - d. Swing Gate Post: According to ASTM F 900, 4-inch (102-mm) diameter, 9.11-lb/ft. (13.6-kg/m) weight.
6. Coating for Steel Framing:
 - a. Metallic Coating:
 - 1) Type A, consisting of not less than minimum 2.0-oz./sq. ft. (0.61-kg/sq. m) average zinc coating per ASTM A 123/A 123M or 4.0-oz./sq. ft. (1.22-kg/sq. m) zinc coating per ASTM A 653/A 653M.
 - 2) Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.
 - 3) External, Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil- (0.0076-mm-) thick, zinc pigmented coating.
 - 4) Type C, Zn-5-Al-MM alloy, consisting of not less than 1.8-oz./sq. ft. (0.55-kg/sq. m) coating.
 - 5) Coatings: Any coating above.
 - b. Polymer coating over metallic coating.
7. Aluminum Finish: Mill finish complying with ASTM B 429.

2.4 INDUSTRIAL SWING GATES

- A. General: Comply with ASTM F 900 for double swing gate types.
 1. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1043 and ASTM F 1083 for materials and protective coatings.
 2. Metal Pipe and Tubing: Aluminum. Comply with ASTM B 429 and ASTM F 1043 for materials and protective coatings.
- B. Frames and Bracing: Fabricate members from round, [galvanized steel] [aluminum] tubing with outside dimension and weight according to ASTM F 900 and the following:
 1. Gate Fabric Height: 2 inches (50 mm) less than adjacent fence height.
 2. Leaf Width: As indicated.
 3. Frame Members:

- a. Tubular [Steel] [Aluminum]: 1.66 inches (42 mm) round; 1.90 inches (48 mm) round.

C. Frame Corner Construction:

1. Welded and 5/16-inch- (7.9-mm-) diameter, adjustable truss rods for panels 4 feet (1.22 m) wide or wider.

- D. Hardware: Latches permitting operation from both sides of gate, hinges,[center gate stops] and keepers for each gate leaf more than 4 feet (1.22 m) wide. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.

2.5 FITTINGS

- A. General: Comply with ASTM F 626.

- B. Post and Line Caps: Provide for each post.

1. Line post caps with loop to receive tension wire or top rail.

- C. Rail and Brace Ends: Attach rails securely to each gate, corner, pull, and end post.

- D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: [Pressed-steel or round-steel tubing] [Aluminum Alloy 6063] not less than 6 inches (152 mm) long.
2. Rail Clamps: Line and corner boulevard clamps for connecting [intermediate] [and] [bottom] rails in the fence line-to-line posts.

- E. Tension and Brace Bands: [Pressed steel] [Aluminum Alloy 6063].

- F. Tension Bars: [Steel] [Aluminum] [Fiberglass], length not less than 2 inches (50 mm) shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

- G. Truss Rod Assemblies: [Steel, hot-dip galvanized after threading] [Mill-finished aluminum] rod and turnbuckle or other means of adjustment.

- H. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
 - a. Hot-Dip Galvanized Steel: [0.106-inch- (2.69-mm-)] [0.148-inch- (3.76-mm-)] diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.
 - b. Aluminum: ASTM B 211 (ASTM B 211M); Alloy 1350-H19; [0.148-inch- (3.76-mm-)] [0.192-inch- (4.88-mm-)] diameter, mill-finished wire.

- I. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. (366 g /sq. m) zinc.
2. Aluminum: Mill finish.

2.6 PRIVACY SLATS

- A. Material: PVC, UV-light stabilized, [flame resistant, 4 ply,] not less than [0.006 inch (0.15 mm)] [0.023 inch (0.58 mm)] thick; [attached to not less than 0.0475-inch- (1.21-mm-) diameter, twisted galvanized wire; hedge-type lattice;] sized to fit mesh specified for direction indicated.
- B. Material: Polyethylene tubular slats, not less than 0.023 inch (0.58 mm) thick, manufactured for chain-link fences from virgin polyethylene containing UV inhibitor, sized to fit mesh specified for direction indicated; with [vandal-resistant fasteners and lock strips] [fins for increased privacy factor].
- C. Material: Fiber-glass-reinforced plastic, UV-light stabilized, not less than 0.06 inch (1.5 mm) thick, sized to fit mesh specified for direction indicated[; with vandal-resistant fasteners and lock strips].
- D. Material: Aluminum, not less than 0.01 inch (0.25 mm) thick, sized to fit mesh specified for direction indicated.
- E. Material: Redwood, 5/16 inch (7.9 mm) thick, sized to fit mesh specified for direction indicated.
- F. Color: As selected by Architect from manufacturer's full range.

2.7 CAST-IN-PLACE CONCRETE

- A. Materials: Portland cement complying with ASTM C 150, Type I aggregates complying with ASTM C 33, and potable water for ready-mixed concrete complying with ASTM C 94/C 94M
 - 1. Concrete Mixes: Normal-weight concrete air entrained with not less than 3000-psi compressive strength (28 days), 3-inch slump, and 1-inch maximum size aggregate.
- B. Materials: Dry-packaged concrete mix complying with ASTM C 387 for normal-weight concrete mixed with potable water according to manufacturer's written instructions.

2.8 GROUT AND ANCHORING CEMENT

- A. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, non-corrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance.
 - 1. Do not begin installation before final grading is completed, unless otherwise permitted by the Architect.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts.

3.3 INSTALLATION, GENERAL

- A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.
 - 1. Install fencing on established boundary lines inside property line.

3.4 CHAIN-LINK FENCE INSTALLATION

- A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Exposed Concrete: Extend **2 inches** above grade; shape and smooth to shed water.
 - b. Concealed Concrete: Top **2 inches** below grade as indicated on Drawings to allow covering with surface material.
 - c. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
- C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.
- D. Line Posts: Space line posts uniformly at **10 feet**

- E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts.
 - 1. Locate horizontal braces at mid height of fabric **5 feet** or higher, on fences with top rail and at 2/3 fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- F. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- G. Bottom Rails: Install, spanning between posts.
- H. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave **1 inch** between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than **15 inches** o.c.
- J. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at 1 end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
 - 1. Maximum Spacing: Tie fabric to line posts at **12 inches** o.c. and to braces at **24 inches** o.c.
- K. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.5 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 ADJUSTING

- A. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

3.7 GROUNDING AND BONDING

- A. Fence Grounding: Install at maximum intervals of **1000 feet (300 m)**, except as follows:

1. Fences within **100 Feet (30 m)** of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of **500 feet (150 m)**.
 - a. Gates and Other Fence Openings: Ground fence on each side of opening.
 - 1) Bond metal gates to gate posts.
 - 2) Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least **18 inches (460 mm)** below finished grade.
 - B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of **150 feet (45 m)** on each side of crossing.
 - C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2, unless otherwise indicated.
 - D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is **6 inches (150 mm)** below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location, including the following:
 1. Each Barbed Wire Strand. Make grounding connections to barbed wire with wire-to-wire connectors designed for this purpose.
 2. Each Barbed Tape Coil: Make grounding connections to barbed tape with connectors designed for this purpose.
 - E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
 - F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 - G. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor complying with NFPA 780.

3.8 FIELD QUALITY CONTROL

- A. Grounding-Resistance Testing: Engage a qualified independent testing and inspecting agency to perform field quality-control testing.
 1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of

reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.

2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
3. Report: Prepare test reports certified by a testing agency of grounding resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.9 ADJUSTING

- A. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

END OF SECTION 02821