SECTION 32 31 17 – ORNAMENTAL WELDED WIRE FENCE 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. Hot dip galvanized, polyester powder finish coated, steel fencing panel, post and accessory system.
2. Gate operator.
3. Grounding and bonding.

B. Related Sections include the following:

1. Division 2 Section "Earthwork" for filling and for grading work.
2. Division 3 Section ["Cast-in-Place Concrete"] ["Cast-in-Place Concrete (Limited Applications)"] for concrete [equipment bases/pads for gate operators, drives, and controls] [post footings].
3. Division 16 Sections for electrical service and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches.

1.3 SUBMITTALS

A. Product Data: Material descriptions, construction details, dimensions of individual components and profiles, and finishes for the following:

1. Fence and gate posts, rails, and fittings.
2. Gates and hardware.
3. Gate operators, including operating instructions.
4. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: Show locations of fence, each gate, posts, rails, and details of gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, elevations, sections, gate swing and other required installation and operational clearances, and details of post anchorage and attachment and bracing.

1. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
2. Wiring Diagrams: Power and control wiring [and communication features] [and access control features]. Differentiate between manufacturer-installed and field-installed wiring and between components provided by gate operator manufacturer and those provided by others.

C. Samples for Initial Selection: Manufacturer's color charts or 6-inch (150-mm) lengths of actual units showing the manufacturer’s standard range of colors available for components with factory-applied color finishes.

D. Samples for Verification: For the following products, in sizes indicated. Prepare Samples from the same material to be used for the Work.

1. Polyester powder coating in 6-inch (150-mm) lengths on shapes for [posts] [rails] [gate framing] [wires] [and on full-sized units for accessories].

E. Product Certificates: Signed by manufacturers of fences and gates certifying that products furnished comply with requirements.

F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

G. Maintenance Data: For the following to include in maintenance manuals specified in Division 1:

1. Finishes.
2. Gate operator.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed 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.

B. Source Limitations for Fences and Gates: Obtain each color, grade, finish, type, and variety of component for fences and gates from one source with resources to provide fences and gates of consistent quality in appearance and physical properties.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. UL Standard: Provide gate operators that comply with UL 325.

E. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators serving as a required means of access.

1.5 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than [two] <Insert number> days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

B. Field Measurements: Verify layout information for 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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. TWINBAR® Fencing System
   a. MFR Manufacturing Corp, Inc..
      1065 Sill Ave
      Aurora, IL 60506
      TEL: 815-552-3333 FAX: 815-552-3315
      Website: www.mfrcorp.com e-mail: info@mfrcorp.com

2.2 FENCE POSTS

A. Posts are made of square or rectangular tubular steel of different sizes depending on the required overall height.

2.3 FENCE PANELS

A. Steel Mesh Fence Panels: Consisting of prefabricated panels of wire mesh formed by vertical rods placed between two horizontal rods. The rods are electro-forge welded at each crossing. The standard panel length is 8'-3". Heights of more than 8' are accomplished by combining panels with a different or equal height. Mesh is galvanized and powder polyester coated after fabrication into panels. [Panel sizes indicated on Drawings] <Insert fence panel sizes below >.

B. Provide fabricated panels of height, mesh size and with post **size** as indicated below:

Type TWINBAR®
Meshsize 2" x 8" (50x200mm) on center
Vertical rods are dia. 1/4"= 4-gauge, (6mm), 2 Horizontal rods are dia. 1/4"= 4-gauge, (6mm)
Panel Width and Post Spacing 8'-3" (2510mm)
Fence Types and Height available

Panel Height	Mesh Size available	Post Type
4'-0" (1230)	2" x 8"(50x200)	2-3/8" x 1-5/8" (60x40)
5'-3" (1630)	2" x 8"(50x200)	2-3/8" x 1-5/8" (60x40)
6'-0" (1830)	2" x 8"(50x200)	2-3/8" x 1-5/8" (60x40)
7'-3" (2230)	2" x 8"(50x200)	2 3/8" x 1-5/8" (60x40)
8'-0" (2430)	2" x 8"(50x200)	3" x 1-5/8" (80x40)
9'-9" (3000)	2" x 8"(50x200)	3" x 1-5/8" (80x40)
13'-1"(4000)	2" x 8"(50x200)	3" x 1-5/8" (80x40)
16'-4" (5000)	2" x 8"(50x200)	4" x 1-5/8" (100/40)
19'-7" (6000)	2" x 8"(50x200)	4" x 1-5/8" (100/40)

2.4 GATES

A. This Section includes the following:

1. Single swing gate.
2. Double swing gate.
3. Single Horizontal slide gate.
4. Double Horizontal slide gate.

B. Metal Tubing framed gates, to match panel system. Steel. galvanized and powder polyester coated after fabrication.

1. Gate Height: ___ feet.

C. Hardware: Latches permitting operation from both sides of gate, hinges, [center gate stops] and, for each gate leaf more than 5 feet (1.5 m) wide, keepers. <Insert other hardware items and accessories.> [Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.]

1. <Insert requirements for padlocks and chains if not Owner furnished.>

D. Slide Gate Track Assembly: Manufacturer's standard track, with framing supports, bracing, and accessories, engineered to support size, weight, width, operation, and design of gate and roller assemblies.

E. Guide Posts and Roller Guards.

2.5 GATE OPERATOR

A. General: Provide factory-assembled automatic gate operation system designed for gate size, type, weight, construction, use, traffic-flow patterns, and operation frequency. Provide operation system for gate specified, of size and capacity and with features, characteristics, and accessories suitable for Project conditions, recommended [and provided]by gate manufacturer complete with electric motor and factory-prewired motor controls, remote-control stations, control devices, power disconnect switch, obstruction detection device, lockable weatherproof enclosures

protecting controls and all operating parts, and accessories required for proper operation. Provide enclosures with corrosion-resistant-protective and decorative finish and two keys per lock. Include wiring from motor controls to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Provide operator designed so motor may be removed without disturbing limit-switch adjustment and without affecting auxiliary emergency operator.
2. Provide operator with UL [approval] [-approved components].
3. Provide electronic components with built-in troubleshooting diagnostic feature.
4. Provide unit designed and wired for both right-hand/left-hand opening, permitting universal installation.

B. Comply with NFPA 70.

C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.

D. Electrohydraulic Operation: Provide unit designed for [gate] [surface] [concrete base/pad] [pedestal] [post] <Insert mounting> mounting; consisting of electric motor, pump, hydraulic actuator to suit gate type, valves, [heater to maintain constant temperature,] and [cold-weather] hydraulic fluid[; with hydraulic locking in both directions].

E. Electromechanical Operation: Provide unit designed for [gate] [surface] [concrete base/pad] [pedestal] [post] <Insert mounting> mounting; consisting of electric motor and factory-prewired motor controls, starter, speed control device, chain-drive assembly, [brake,] clutch or torque limiter, and as follows:

1. Enclosed worm gear reducer, roller chain drive.
2. Enclosed worm gear and chain and sprocket reducers, roller chain drive.
3. V-belt and [worm gear] [chain and sprocket] reducers, roller chain drive.
4. Enclosed worm gear reducer, wheel and rail drive.

F. Operation Cycle Requirements: Design gate operator to operate for not less than the following duty and cycles per hour. One cycle equals one gate opening plus one gate closing.

1. Medium Duty: 10 cycles per hour.
2. Heavy Duty: 25 cycles per hour.
3. Peak Duty: 20 cycles per hour at peak periods.
4. <Insert requirements for duty and cycles per hour or day.>

G. Gate Operation Speed: [Minimum 45 fpm (0.229 m/s)] [Minimum 60 fpm (0.305 m/s)] <Insert speed>.

H. Electric Motors: High-starting torque, [reversible,] [single-direction,] continuous-duty, insulated electric motors, complying with NEMA MG 1, sized to start and operate size and weight of gate considering Project's service conditions without exceeding nameplate ratings or considering service factor.

1. Service Factor: According to NEMA MG 1, unless otherwise indicated.
2. Enclosure: [Totally enclosed, nonventilated or fan-cooled motors, fitted with plugged drain] <Insert another enclosure>.
3. Thermal Protection: Internal [manual] [automatic] reset.
4. Motors Smaller Than 1/2 hp: [Single phase] [Polyphase], <Insert voltage rating,> 60 Hz. [Motor horsepower as recommended by operator manufacturer] [Motor horsepower as indicated on Drawings] <Insert motor horsepower>.
5. Motors 1/2 hp and Larger: Polyphase, <Insert voltage rating,> 60 Hz. [Motor horsepower as recommended by operator manufacturer] [Motor horsepower as indicated on Drawings] <Insert motor horsepower>.

I. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with [NEMA ICS 6, Type 1] [NEMA ICS 6, Type 4] <Insert another type of enclosure> enclosure for [surface] [recessed or flush] [concrete base/pad] [pedestal] [post] <Insert mounting> mounting, and with space for additional optional equipment. Provide the following remote-control device(s):

1. Control Station: Keyed, two-position, switch-operated control station located remotely from gate, with on and off functions. Provide two keys per station.
2. Control Station: Keyed, three-position, switch-operated control station with open and close functions and spring return to off position [with stop button]. Provide two keys per station.
3. Control Station: Momentary-contact, single-button-operated control station with open and close functions.
4. Control Station: Momentary-contact, three-button-operated control station with open, close, and stop positions, [and with key switch to lock out open and close buttons. Provide two keys per station].
5. Card Reader: Functions only when authorized card is presented. Magnetically coded, single-code system activated by coded card [and permitting four different access time periods]. Provide insertion-reader-type, face-

lighted unit fully visible at night.

6. Card Reader: Functions only when authorized card is presented. Easily programmable, multiple-code capability permitting validating or voiding of individual cards [and permitting four different access time periods]. Provide face-lighted unit fully visible at night.

    a. Reader Type: [Touch plate] [Swipe] [Insertion] [Proximity].
    b. Features: [Timed anti-passback] [Limited-time usage] [Capable of monitoring and auditing gate activity].

7. Digital Keypad Entry Unit: Functions only when authorized code is entered. Multiple-code capability of not less than [5] [100] [500] <Insert another number to suit Project> possible individual codes.
8. Digital Keypad Entry Unit: Functions only when authorized code is entered. Easily programmable, multiple-code capability permitting validating or voiding of not less than [100] [2500] [10,000] <Insert another number to suit Project> possible individual codes, consisting of [1 to 6] <Insert number> digits, [and permitting four different access time periods]. Provide face-lighted unit with [metal-keyed] [keyless-membrane] keypad fully visible at night.

    a. Features: [Timed anti-passback] [Limited-time usage] [Capable of monitoring and auditing gate activity].

9. Radio Control: Digital system consisting of code-compatible universal coaxial receiver, [one per gate] [where indicated on Drawings], remote antenna with coaxial cable and mounting brackets, and [one permanently mounted] [four portable] <Insert number and use condition to suit Project> transmitter[s] per receiver designed to operate gates. Provide easily programmable transmitter with multiple-code capability permitting validating or voiding of not less than [1000] [10,000] <Insert another number to suit Project> codes per channel configured for the following functions:

    a. Transmitters: Single-button operated, with open function.
    b. Transmitters: Single-button operated, with open and close functions.
    c. Transmitters: Three-button operated, with open, close, and stop functions.

        1) Provide transmitters featuring [two] [three] [four] <Insert another number to suit Project> independent channel settings controlling separate receivers for operating more than one gate from each transmitter.

10. Telephone Entry System: Hands-free voice-communication system for connection to building telephone system with digital-entry code activation of gate operator [auxiliary keypad entry].

    a. Residential System: Designed to be wired to same line with telephone.
    b. Multiunit System: Designed to be wired to a dedicated telephone line, with capacity to access [20] [100] <Insert number> telephones [and with electronic directory].

11. Vehicle Loop Detector System: System including automatic closing timer with adjustable time delay before closing [timer cut-off switch] and loop detector designed to [open and close gate] [hold gate open until traffic clears] [reverse gate] <Insert function>. Provide electronic detector, with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location shown on Drawings, as recommended in writing by detection system manufacturer for function indicated.

    a. Loop: Wire, in size indicated for field assembly, and sealant; style for [pave-over] [saw-cut] installation.
    b. Loop: Factory preformed in size indicated; style for [pave-over] [saw-cut] installation.

12. Vehicle Presence Detector: System including automatic closing timer with adjustable time delay before closing [timer cut-off switch] and presence detector designed to [open and close gate] [hold gate open until traffic clears] [reverse gate] <Insert functions>. Provide [retroreflective] [emitter/receiver] type detector, with adjustable detection zone pattern and sensitivity, designed to detect the presence or transit of a vehicle in gate pathway by interrupting an infrared beam in zone pattern and to emit a signal activating the gate operator.

J. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:

1. Action: Reverse gate in both opening and closing cycles and hold until clear of obstruction.
2. Action: Stop gate in opening cycle and reverse gate in closing cycle and hold until clear of obstruction.
3. Internal Sensor: Built-in torque or current monitor senses gate is obstructed.
4. Sensor Edge: Contact-pressure-sensitive safety edge, profile, and sensitivity designed for type of gate and component indicated, in locations as follows. Connect to control circuit using [take-up cable reel] [self-coiling cable] [gate edge transmitter and operator receiver system].

a. Along entire gate leaf leading edge.
b. Along entire gate leaf trailing edge.
c. Across entire gate leaf bottom edge.
d. Along entire length of gate posts.
e. Along entire length of gate guide posts.
f. Where indicated on Drawings.
g. <Insert extent and location.>

5. Photoelectric/Infrared Sensor System: Designed to detect an obstruction in partition's path by interruption of an infrared beam in the zone pattern without obstruction contacting gate.

K. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully retracted and fully extended positions.

L. Emergency Release Mechanism: Quick disconnect release of operator drive system of the following type of mechanism, permitting manual operation if operator fails. Design system so control circuit power is disconnected during manual operation.

1. Type: Integral fail-safe release, allowing gate to be pushed open without mechanical devices, keys, cranks, or special knowledge.
2. Type: Mechanical device, key, or crank-activated release.

M. Operating Features: Include the following:

1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features [with capability of monitoring and auditing gate activity]. Provide unit that is isolated from voltage spikes and surges.
2. Fully Systems Compatible: With controlling circuit board capable of accepting any type of input from external devices.
3. Master/Slave Capability: Control stations designed and wired for gate pair operation.
4. Automatic Closing Timer: With adjustable time delay before closing [and timer cut-off switch].
5. Open Override Circuit: Designed to override closing commands.
6. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
7. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.
8. Clock Timer: [24-hour] [Seven-day] <Insert time period> programmable for regular events.

N. Accessories: Include the following:

1. Mounting kit [including pedestal].
2. Audio Warning Module: Provide ADA-compliant audible alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving.
3. Visual Warning Module: Provide ADA-compliant visible [constant-] [strobe-]light alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving.
4. Battery Backup System: Battery-powered drive and access control system, independent of primary drive system, opening gate if power fails. <Insert additional requirements.>
5. External electric-powered lock with delay timer allowing time for lock to release before gate operates.

a. Type: [Solenoid] [Magnetic] for swing gate.
b. Type: [Solenoid] [Magnetic] for slide gate.

6. [Fire] [Postal] box.
7. Fire [strobe] [siren] sensor.
8. Intercom System: <Insert requirements.>
9. Instructional, Safety, and Warning Labels and Signs: [According to UL 325] [Manufacturer's standard for components and features specified] [As indicated on Drawings] <Insert requirements>.

2.6 CAST-IN-PLACE CONCRETE

A. General: Comply with ACI 301 for cast-in-place concrete.

B. Materials: Portland cement complying with ASTM C 150 <Insert type if required>, aggregates complying with ASTM C 33, and potable water [for ready-mixed concrete complying with ASTM C 94]. [Measure, batch, and mix Project-site-mixed concrete according to ASTM C 94.]

1. Concrete Mixes: Normal-weight concrete [air entrained] with not less than 3000-psi (20.7- MPa) compressive strength (28 days), 3-inch (75-mm) slump, and 1-inch (25-mm) maximum size aggregate.

C. Materials: Dry-packaged concrete mix complying with ASTM C 387 for normal-weight concrete mixed with potable water according to manufacturer's written instructions.

2.7 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, 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.

2.8 FENCE GROUNDING

A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.

1. Material Above Finished Grade: [Copper] [Aluminum].
2. Material On or Below Finished Grade: Copper.
3. Bonding Jumpers: Braided copper tape, 1 inch (25 mm) wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.

B. Connectors and Ground Rods: Listed in UL 467.

1. Connectors for Below-Grade Use: Exothermic welded type.
2. Ground Rods: Copper-clad steel.

a. Size: 5/8 inch by 96 inches (16 by 2400 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for [a verified survey of property lines and legal 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 Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

A. Install fencing on established boundary lines inside property line.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.

C. Post Setting: Hand-excavate holes for post foundations in firm, undisturbed or compacted soil. Set posts in concrete footing. Protect portion of posts aboveground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Using mechanical devices to set posts is not permitted. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during placement and finishing operations until concrete is sufficiently cured.

1. Dimensions and Profile: As indicated on Drawings.

2. Dimensions and Profile: 12” diameter for terminal posts, 10” diameter for intermediate posts. Concrete to be 6” deeper than post length in ground.
3. Exposed Concrete Footings: Extend concrete 2 inches (50 mm) above grade, smooth, and shape to shed water.
4. Concealed Concrete Footings: Stop footings [2 inches (50 mm)] <Insert dimension> below grade [as indicated on Drawings] to allow covering with surface material.
5. 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,] [anchoring cement,] mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
6. Posts Set into Concrete in Voids: Form or core drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with [nonshrink, nonmetallic grout,] [anchoring cement,] mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.

7. Mounting Plate Installation: Bolt mounting plates attached to each post to slab or structure as indicated, using expansion bolts.

3.4 FENCE INSTALLATION

A. Terminal Posts: Locate terminal end, corner, and gate posts at changes in horizontal or vertical alignment of [15 degrees or more] [30 degrees or more] [as indicated on Drawings] <Insert requirement>.

B. Line Posts: Space line posts uniformly at 8 feet 3 inches o.c.

C. Mesh Panels: Apply panels to [outside] [inside] of enclosing posts. Leave [1 inch (25.4 mm)] [2 inches (50 mm)] between finish grade or surface and bottom of panel, unless otherwise indicated. Anchor panel to posts with pre-assembled mounting brackets [lock bar]. All post-panel connections are utilizing a patented nylon setting to reduce rattling noise caused by wind, vibrations or other sources

D. Fasteners: install nuts on the side of the fence opposite the panel side. [Peen ends of bolts or score threads to prevent removal of nuts.]

3.5 GATE INSTALLATION

A. General: Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. 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 GATE OPERATOR INSTALLATION

A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.

B. Excavation for [Support Posts] [Pedestals] [Concrete Bases/Pads]: Hand-excavate holes for bases/pads, in firm, undisturbed or compacted soil to dimensions and depths and at locations as required by gate operator component manufacturer's written instructions and as indicated on Drawings.

C. Concrete Bases/Pads: Cast-in-place or precast concrete, made of not less than 3000-psi (20.7-MPa) compressive strength (28 days), [depth not less than 12 inches (300 mm)] <Insert depth 6 to 12 inches (150 to 300 mm) below frost line or detail on Drawings>, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.

D. Vehicle Loop Detector System: [Cut grooves in pavement and] bury and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.

E. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

3.7 GROUNDING AND BONDING

A. Fence Grounding: Install at maximum intervals of [1500 feet (450 m)] <Insert a lesser distance where grounding resistance is high> except as follows:

1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of [750 feet (225 m)] <Insert a lesser distance where grounding resistance is unusually high>.

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 ground 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.

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. Ground-Resistance Testing Agency: [Owner will engage] [Engage] a qualified independent testing agency to perform field quality-control testing.

B. Ground-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure ground 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 ground resistance. Perform tests by two-point method according to IEEE 81.

C. Desired Maximum Grounding Resistance Value: 25 ohms.

D. Excessive Ground Resistance: If resistance to ground exceeds desired value, notify Architect promptly. Include

recommendations to reduce ground resistance and proposal to accomplish recommended work.

E. Report: Prepare test reports, certified by testing agency, of ground 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 from 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.

B. Automatic Gate Operator: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices, [alarms,] and limit switches.

1. Electrohydraulic Operator: Purge operating system, adjust pressure and fluid levels, and check for leaks.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Test controls[, alarms,] and safeties. Remove damaged and malfunctioning units, replace with new units, and retest.

C. Lubricate hardware[, gate operator,] and other moving parts.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain gates.

1. Test and adjust [operators,] [controls,] [alarms,] [safety devices,] hardware, and other operable components. Replace damaged or malfunctioning operable components.
2. Train Owner's personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
3. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
4. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
5. Schedule training with Owner[, through Architect,] with at least seven days' advance notice.

END OF SECTION 02821