

SECTION 32 31 21

DECORATIVE METAL SECURITY FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Crash Rated Metallic coated steel security fences.
 - 2. Swing gates.
 - 3. Horizontal slide gates.
 - 4. Gate operators, including controls.

1.2 ACTION SUBMITTALS

- A. Product Data: Technical data including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Submit plans, elevations, sections, gate locations, post spacing, and mounting attachment details, and grounding details.
 - 1. Provide full site plans and enlarged site plans indicating the crash rating and all product options for all fence sections, gates and related items. Clearly identify all crash rated sections of fence to comply with verification of locations with Architect and Owner.
 - 2. Indicate clear compliance with all crash rated sections to rating indicated; provide detailing and crash rating certifications for all fencing units.
 - 3. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 - 4. Wiring Diagrams: Include diagrams for power, signal, and control wiring.
- C. Samples: Provide sample 12 inches (300 mm) in length for linear materials.

1.3 INFORMATIONAL SUBMITTALS

- A. Provide crash rating certifications for all rated fencing units verifying compliance with all performance requirements indicated in this Section.
- B. Field quality control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Submit data for gate operators to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at site.
- B. The entire anti-ram barrier system, and all associated panels, I-beam posts, bollards, gates, accessories, fittings, and fasteners shall be obtained from a single source.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Aesthetic Matching: The crash rated security fence of this Section must be a close aesthetic match to the non crash rated fencing specified in Section 32 31 19 Decorative Metal Fences and Gates. The manufacturer's representative shall be consulted prior to bidding for complete information and requirements to achieve that match.
- B. Wind Loading:
 - 1. Fence Height: As indicated on the Drawings.
 - 2. Wind Exposure Category: C unless otherwise indicated on the Drawings.
 - 3. Design Wind Speed: 140 mph (225 kph).
- C. Lightning Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.
- A. Vehicle Crash Rating General: Provide crash rated sections of fencing as indicated on the Drawings. The Contractor shall confirm all areas of crash rated fencing with the Architect and Owner prior to engaging submittals or procurement for the Work of this Section.
- B. Vehicle Crash Testing: Comply with requirements of ASTM F 2656.
 - 1. Impact Category: M.
 - 2. Impact Velocity: 50 mph
 - 3. Penetration Rating: P1.

2.2 METALLIC COATED STEEL SECURITY FENCES

- A. Metallic Coated Steel Security Fences:
 - 1. Crash Rated Security Fence Basis of Design: Provide the total anti-ram cable barrier system of Stalwart IS Engineered design by Ameristar, Gauntlet Pickets outward facing for anti-climb, based on Impasse II Decorative Line. The system shall include all components (i.e., cables, supports, panels, I-beam posts, and hardware) required. Subject to compliance with requirements, and aesthetic equivalence determined by the Architect, products by one of the following may also be acceptable:
 - a. BetaFence USA LLC.
 - b. Builders Fence Company, Inc.
 - c. Fortress Building Products

- d. Master Halco.
 - e. Xcel Fence.
- B. Security Fence Description:
- 1. Material: Galvanized steel.
 - 2. Height: as indicated on the Drawings.
 - 3. Clearance above: as indicated on the Drawings.
- C. Steel material for cable-supporting framework (i.e., corrugated pales, rails and I-beam posts) shall be galvanized prior to forming and shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa). The steel shall be hot-dip galvanized to meet the requirements of ASTM A653/A653M with a minimum zinc coating weight of 0.90 oz/ft² (276 g/m²), Coating Designation G-90.
- D. Steel material for cable-anchoring bollard posts shall conform to the requirements of ASTM A500/A500M, with a minimum yield strength of 46,000 psi (315 MPa).
- E. Cable material shall be Independent Wire-Rope Core (IWRC) wire rope conforming to Federal Specification RR-W-410E, 6 x 36 Warrington Seale, preformed, right regular lay, medium lubrication, Extra Improved Plow Steel (EIPS), with a breaking strength of 103,400 pounds (51.7 tons). Cable diameter shall be 1 inch.
- F. Posts: I beam and other posts shall be sized to meet Performance Requirements including but not limited to crash ratings, match sizes as indicated on the Drawing and be uniform in size throughout the installation and sizes of non-crash rated decorative metal fencing. Where required by design infill posts with concrete to meet rating certifications.
- 1. Posts at Swing Gate Openings: Square tubes 3 inches by 3 inches (76 mm by 76 mm) formed from 0.108 inch (2.74 mm) nominal thickness, metallic coated steel sheet or formed from 0.105 inch (2.66 mm) nominal thickness steel sheet and hot dip galvanized after fabrication.
 - 2. Posts at Horizontal Slide Gate Openings up to 12 Feet (3.7 m): Square steel tubing 3 inches by 3 inches (76 mm by 76 mm) with 3/16 inch (4.76 mm) wall thickness, hot dip galvanized.
 - 3. Posts at Horizontal Slide Gate Openings Wider Than 12 Feet (3.7 m): Square steel tubing 4 inches by 4 inches (102 mm by 102 mm) with wall thickness, hot dip galvanized.
- G. Post Caps: Manufacturer's standard for the product line.
- H. Rails: Rails shall be sized to meet Performance Requirements. The cross-sectional shape of the rails shall conform to the manufacturer's Stalwart II rail design a nominal 2" x 2" x 11 Ga. Tamperproof fasteners shall be used to fasten each fence panel to post bracket and rail to post connections. Posts shall conform to the manufacturer's Stalwart II I-Beam design with a nominal 3" x 2.75" x 12 Ga. Provide 6 rails.
- I. Pickets: Material for fence panel pickets shall be 1" square x 14 Ga. tubing. The fence panel rails shall conform to the manufacturer's ForeRunner™ double wall design with outside cross-section dimensions of 1.75" square and a minimum thickness of 14 Ga.

Picket holes in the ForeRunner rail shall be spaced 4.715" o.c. Picket retaining rods shall be 0.125" diameter galvanized steel. High quality PVC grommets shall be supplied to seal all picket-to-rail intersections.

1. Picket Style: Invincible Pickets outward facing for anti-climb

J. Fasteners: Stainless steel carriage bolts with tamperproof nuts.

K. Metallic Coated Steel Sheet: Galvanized steel sheet or aluminum zinc, alloy coated steel sheet.

L. Interior surface of tubes formed from uncoated steel sheet shall be hot dip zinc coated same as exterior.

M. Galvanizing: For components indicated to be galvanized, hot dip galvanize to comply with ASTM A 123/A 123M. For hardware items, hot dip galvanize to comply with ASTM A 153/A 153M.

N. Finish: Powder coating.

2.3 SWING GATES

A. Gate Configuration: As indicated.

B. Gate Frame Height: Indicated on Drawings.

C. Gate Opening Width: Indicated on Drawings.

D. Automated vehicular gates shall comply with ASTM F 2200, Class IV.

E. Galvanized Steel Frames and Bracing: Fabricate members from square tubes 2 inches by 2 inches minimum to meet performance requirements formed from 0.108 inch (2.74 mm) nominal thickness, metallic coated steel sheet or formed from 0.105 inch (2.66 mm) nominal thickness steel sheet and hot dip galvanized after fabrication.

F. Frame Corner Construction: Welded and 5/16 inch (7.9 mm) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider.

G. Additional Rails: Provide as indicated, complying with requirements for fence rails.

H. Infill: Comply with requirements for adjacent fence.

I. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 feet (1.52 m) wide. Provide cane bolts for pairs of gates. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.

1. Refer to Door Hardware Section 08 71 00 for additional hardware requirements. Prepare fence and gate components in factory to receive all hardware.

J. Spring Hinges: BHMA A156.17, Grade 1, suitable for exterior use.

1. Function: 320 - Gate spring pivot hinge. Adjustable tension.

- 2. Material: Malleable iron; galvanized.
- K. Hinges: BHMA A156.1, Grade 1, suitable for exterior use.
 - 1. Function: 39 - Full surface, triple weight, antifriction bearing.
 - 2. Material: Wrought steel, forged steel, cast steel, or malleable iron; galvanized.
- L. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from 1/2 inch (12.7 mm) diameter, round steel bars, hot dip galvanized after fabrication. Finish to match gates. Provide galvanized steel pipe strikes to receive cane bolts in both open and closed positions.
- M. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.
- N. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A 123/A 123M. For hardware items, hot-dip galvanize to comply with ASTM A 153/A 153M.
- O. Steel Finish: Primed with High performance coating.

2.4 HORIZONTAL SLIDE GATES

- A. High Security Gate Configuration: As indicated.
 - 1. Type: Overhead slide.
 - 2. Type: Cantilever slide, with internal roller assemblies.
 - 3. Configuration to match Security Fence.
- B. Gate Frame Height: Indicated on Drawings.
- C. Gate Opening Width: Indicated on Drawings.
- D. Automated vehicular gates shall comply with ASTM F 2200, Class IV.
- E. Steel Frames and Bracing: Fabricate members from square tubing. Hot dip galvanize frames after fabrication.
 - 1. Frame Members: Steel tubing 2 inches by 2 inches (51 mm by 51 mm) with 1/8 inch (3.2 mm) wall thickness.
 - 2. Bracing Members: Steel tubing 2 inches by 2 inches (51 mm by 51 mm) with 1/8 inch (3.2 mm) minimum wall thickness.
- F. Frame Corner Construction:
 - 1. Welded frame with panels assembled with bolted or riveted corner fittings and 5/16 inch (7.9 mm) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider.
- G. Additional Rails: Provide rails indicated, complying with requirements for fence rails.
- H. Infill: Comply with requirements for adjacent fence.

- I. Hardware: Latches permitting operation from both sides of gate, locking devices hangers roller assemblies and stops fabricated from. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.
- J. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.
- K. Galvanizing: For items other than hardware that are indicated to be galvanized, hot dip galvanize to comply with ASTM A 123/A 123M. For hardware items, hot dip galvanize to comply with ASTM A 153/A 153M.
- L. Metallic Coated Steel Finish: High performance coating.
- M. Steel Finish: High performance coating.
- N. Basis of Design TransPort IS by Ameristar.

2.5 COATING MATERIALS

- A. Epoxy Zinc Rich Primer for Uncoated Steel: Universal epoxy primer compatible with coating specified to be applied over it.
- B. Topcoat: polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm).

2.6 GATE OPERATORS

- A. Gate Operators:
 - 1. Horizontal Slide Gate Operator Basis of Design: Provide SlideDriver 15 by High Security. Subject to compliance with requirements, products by one of the following may also be acceptable:
 - a. Amazing Gates of America LLC.
 - b. AutoGate, Inc.
 - c. CAME Americas Automation LLC.
 - d. Chamberlain Group, Inc. (The).
 - e. DoorKing, Inc.
 - f. Eagle Access Control Systems, Inc.
 - g. Tymetal Corp.
 - h. US Automatic Inc.
 - i. Viking Access Systems.
- B. Provide factory assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for Project conditions, with remote control stations, safety devices, and weatherproof enclosures; coordinate electrical requirements 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.

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.
- C. Comply with NFPA 70.
- D. UL Standard: Manufacturer and label gate operators to comply with UL 325.
- E. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators on gates that must provide emergency access.
- F. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1 and the following:
1. Voltage: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
 2. Horsepower: Not less than 1 HP.
 3. Enclosure: Totally enclosed.
 4. Duty: Continuous duty at ambient temperature of 105 degrees F (40 degrees C) and at altitude of 3300 feet (1005 m) above sea level.
 5. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
 6. Phase: One.
- G. Gate Operators: Concrete base mounted:
1. Hydraulic Slide Gate Operators:
 - a. Duty: Heavy duty, commercial/industrial.
 - b. Gate Speed: Minimum 60 feet (18.2 m) per minute.
 - c. Maximum Gate Weight: 1,500 lbs.
 - d. Frequency of Use: Continuous duty.
 - e. Operating Type: Wheel and rail drive with manual release.
 - f. Hydraulic Fluid: Of viscosity required for gate operation at ambient temperature range for Project.
 - g. Locking: Hydraulic in both directions.
 - h. Heater: Track and roller heater with thermostatic control.
- A. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with NEMA ICS 6, Type 4 enclosure for concrete base pedestal mounting, and with space for additional optional equipment. Provide the following remote control device(s):
1. Control Station: Keyed, three position switch with open, stop, and close function; located remotely from gate. Provide two keys per station.
 2. Card Reader: Functions only when authorized card is presented. Programmable, multiple code system, permitting four different access periods; face lighted unit fully visible at night.
 - a. Reader Type: Proximity.
 - b. Features: Capable of monitoring and auditing gate activity.

- B. Vehicle Loop Detector: System includes automatic closing timer with adjustable time delay, timer cutoff switch, and loop detector designed to open and close gate and hold gate open until traffic clears. System includes 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. System includes number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement, as recommended in writing by detection system manufacturer for function indicated, at location indicated on Drawings.
- C. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function:
 - 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 self coiling cable or 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.
 - 5. Photoelectric/Infrared Sensor System: Designed to detect an obstruction in gate's path when infrared beam in the zone pattern is interrupted.
- D. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully retracted and fully extended positions.
- E. Emergency Release Mechanism: Quick disconnect release of operator drive system of the following type, 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.
- F. Operating Features:
 - 1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features with capability for monitoring and auditing gate activity. Provide unit that is isolated from voltage spikes and surges.
 - 2. System Integration: 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 cutoff 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 programmable for regular events.

G. Accessories:

1. Warning Module: Audio Visual, strobe light alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving; compliant with the United States Access Board's ADA-ABA Accessibility Guidelines.
2. Battery Backup System: Battery-powered drive and access control system, independent of primary drive system.
 - a. Fail Safe: Gate opens and remains open until power is restored.
 - b. Fail Secure: Gate cycles on battery power, then fail safe when battery is discharged.
3. External electric powered magnetic lock with delay timer allowing time for lock to release before gate operates.
4. Fire box.
5. Fire strobe sensor.
6. Instructional, Safety, and Warning Labels and Signs: According to UL 325.
7. Equipment Bases/Pads: Precast concrete, depth not less than 12 inches (305 mm), dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.

2.7 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Concrete: Normal weight, air entrained, ready mix concrete complying with requirements in Section 03 30 00 with a minimum 28 day compressive strength of 3000 psi (20 MPa), 3 inch (75 mm) slump, and 1 inch (25 mm) maximum aggregate size.
- C. Nonshrink Grout: Factory packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M and specifically recommended by manufacturer for exterior applications.

2.8 GROUNDING MATERIALS

- A. Comply with requirements of Section 26 05 26.
- B. Grounding Conductors: Size as indicated on Drawings. Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.

1. Material above Finished Grade: Aluminum.
 2. Material on or below Finished Grade: Copper.
 3. Bonding Jumpers: Braided copper tape, 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- C. Grounding Connectors and Grounding Rods: Comply with UL 467.
1. Connectors for Below Grade Use: Exothermic welded type.
 2. Grounding Rods: Copper clad steel.
 - a. Size: 5/8 inches by 96 inches (16 by 2440 mm).

2.9 STEEL FINISHES

- A. Surface Preparation: Clean surfaces according to SSPC-SP 5/NACE No. 1 White Metal Blast Cleaning. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.
- B. Primer Application: Apply zinc rich epoxy primer immediately after cleaning, to provide a minimum dry film thickness of 2 mils (0.05 mm) per applied coat, to surfaces that are exposed after assembly and installation, and to concealed surfaces.
- C. High Performance Coating: Apply intermediate and polyurethane topcoats to prime coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1 Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel, for shop painting. Apply at spreading rates recommended by coating manufacturer.
1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation after correcting unsatisfactory conditions.

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.

1. Construction layout and field engineering are specified in Section 01 73 00.

3.3 INSTALLATION

- A. Install fences according to manufacturer's written instructions.
- B. Install fences by setting posts as indicated and fastening rails and other components to posts. Peen threads of bolts after assembly to prevent removal.
- C. Post Excavation: Drill or hand excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than 24 inches (600 mm) plus 3 inches (75 mm) for each foot (300 mm) or fraction of a foot (300 mm) that fence height exceeds 4 feet (1.2 m).
- D. 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 and sleeves and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Exposed Concrete: Extend 2 inches (51 mm) above grade. Finish and slope top surface to drain water away from post.
 - b. Concealed Concrete: Top 2 inches (51 mm) below grade in landscaped areas to allow covering with surface material. Slope top surface of concrete to drain water away from post.
 3. Posts Set in Concrete: Extend post to within 6 inches (150 mm) of specified excavation depth, but not closer than 3 inches (75 mm) to bottom of concrete.
 4. Posts Set into Concrete in Sleeves: Use galvanized steel pipe sleeves with inside diameter at least 3/4 inch (20 mm) larger than outside diagonal dimension of post, preset and anchored into concrete for installing posts.
 - a. Extend posts at least 5 inches (125 mm) into sleeve.
 - b. After posts have been inserted in sleeves, fill annular space between post and sleeve with nonshrink grout, mixed and placed to comply with grout manufacturer's written instructions; shape and smooth to shed water. Finish and slope top surface of grout to drain water away from post.
 5. Posts Set into Voids in Concrete: Form or core drill holes not less than 3/4 inch (20 mm) larger than outside diagonal dimension of post.
 - a. Extend posts at least 5 inches (125 mm) into concrete.
 - b. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink grout, mixed and placed to comply with grout manufacturer's written instructions. Finish and slope top surface of grout to drain water away from post.
 6. Space posts uniformly at 8 feet (2.44 m) o.c. unless otherwise required by Performance Requirements or as indicated on the Drawings.

3.4 GATE INSTALLATION

- A. 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.

3.5 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: Hand excavate holes for bases in firm, undisturbed soil to dimensions and depths and at locations as required by gate operator component manufacturer's written instructions and as indicated.
- C. Concrete Bases: Cast in place or precast concrete, depth not less than 12 inches (300 mm), dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.
- D. Vehicle Loop Detector System: 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.

3.6 GROUNDING AND BONDING

- A. Comply with Section 26 05 26.
- B. Fence Grounding: Install at maximum intervals of 1500 feet (450 m) 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).
 - 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 at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches (460 mm) below finished grade.
- C. 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.
- D. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.
- E. 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 grounding location.
- F. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

- G. 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 are galvanically compatible.
 - 1. Use electroplated or hot in 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.

- H. 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.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 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 of grounding resistance at each test location certified by a testing agency. Include observations of weather and other phenomena that may affect test results.

3.8 ADJUSTING

- A. Gates: Adjust gates 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.

- B. Automatic Gate Operators: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices, alarms, and limit switches.
 - 1. Hydraulic Operators: 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.
 3. Test and adjust controls, alarms, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Lubricate hardware and other moving parts.

3.9 DEMONSTRATION

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

END OF SECTION