SECTION 13 47 13
CATHODIC PROTECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The CONTRACTOR shall design, furnish and install all materials and equipment and provide all labor necessary to complete the work in accordance with the typical drawings and/or listed below and all other work and miscellaneous items not specifically mentioned but reasonably inferred for a complete installation, including all accessories and appurtenances required for a completed system.

1.2 RELATED WORK

A. Section 31 23 00: Excavation and Fill
B. Section 32 00 01: Site Restoration and Rehabilitation
C. Section 33 10 01: Domestic and Lake Water System
D. Section 33 10 02: Recycled Water System
E. Section 33 61 01: Underground Chilled Water System

1.3 REFERENCE SPECIFICATIONS

A. American Society of Testing and Materials (ASTM)
B. National Electrical Manufacturers Association (NEMA)
C. Industrial Cable Engineers Association (ICEA)
D. American Water Works Association (AWWA)
E. National Association of Corrosion Engineers (NACE)
F. American National Standards Institute (ANSI)
G. National Fire Protection Association (NFPA)
1.4 WORK INCLUDED

Work included in this section consists of the design, supply and installation of all components of the cathodic protection system, including anodes, dielectric isolating joints, cables, test stations, coating repair, joint bonds, and any other work necessary to complete the installation.

A. Cathodic protection of all new metallic fittings on non-metallic pipelines

B. Design of cathodic protection system utilizing this guide specification and typical details, including soil resistivity testing as required to do the design. The anodes shall be designed for a minimum 20-year design life. The design shall consider the type of coating on the pipe and fittings, and soil resistivity at the site

C. Trenching and other excavation

D. Installation of anodes, cables, joint bonds, dielectric isolating joints, and test stations

E. Dust alleviation and control

F. Provide shop drawings, reports, permits, and obtain engineer's approval where required

G. Correction of all deficiencies

H. Cleanup and restoration of surfaces in improved areas

1.5 QUALITY ASSURANCE

A. General

All work shall be performed under the supervision of and to the satisfaction of the Stanford Utilities. The design of cathodic protection system shall be by a NACE International certified Cathodic Protection Specialist or State of California Registered Professional Corrosion Engineer.

B. Testing

All cathodic protection components shall be subject to testing in accordance with NACE SP0169-07 to ensure proper installation and operation. The CONTRACTOR shall be responsible for correction of all deficiencies and all costs incurred for associated re-testing prior to final acceptance.

1.6 CODE REQUIREMENTS

A. All materials, workmanship, and installation shall conform with all requirements of the legally constituted authority having jurisdiction. These authorities include, but are not limited to, the latest revision of the National Electric Code, General Construction Safety Orders of the Industrial Accident Commission; and all other applicable State,
County, or City codes and regulations. Nothing in the drawings or specifications is to be construed to permit work not conforming to these regulations or codes. Where larger size or better grade materials than that required by these regulations and codes are specified, the specifications and drawings shall have precedence.

1.7 SUBMITTALS

A. Prior to commencing work the Contractor shall receive approval by the S for the following items in accordance with submittal procedures:

1. A complete list of equipment and material, including name and manufacturer, catalog number, size, and any other pertinent data necessary for proper identification and to determine conformance with specifications.

2. Cathodic protection design drawings, calculations, and installation details.

B. Following completion of the cathodic protection installations, but prior to final site restoration, the Contractor shall submit the following items for approval by the Stanford Utilities in accordance with submittal procedures:

1. Testing report including pipeline fitting electrical continuity, effectiveness of dielectric isolating joints, and cathodic protection potential data, anode current output, adequacy of test stations, and conclusions.

PART 2 PRODUCTS

2.1 GENERAL

All materials shall conform to the requirements set forth herein or as designated on the drawings, unless otherwise specified. All materials must be new, free from defects, and shall be of the best commercial quality for the purpose specified. All necessary items and accessories not shown on the drawings or specified herein, but which are required to fully carry out the specified intent of the work, shall be furnished by the CONTRACTOR without additional cost to the OWNER.

2.2 ANODES

A. Anodes used shall be prepackaged, high-potential magnesium, as manufactured by Harco Technologies or approved equal. The anode sizes shall be as shown in the drawings and shall conform to the chemical composition listed in the table below:
<table>
<thead>
<tr>
<th>Element</th>
<th>Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>0.010</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.50 to 1.30</td>
</tr>
<tr>
<td>Copper</td>
<td>0.02 max.</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.001 max.</td>
</tr>
<tr>
<td>Iron</td>
<td>0.03 max.</td>
</tr>
<tr>
<td>Other</td>
<td>0.05 each or 0.3 max. total</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Remainder</td>
</tr>
</tbody>
</table>

B. The anodes shall be factory assembled with a chemical backfill in a water permeable cloth sack. The chemical backfill shall be a mixture consisting of 75% gypsum, 20% bentonite, and 5% sodium sulfate. The backfill shall be firmly packed around the anode within the cloth bag by vibration so that the metal ingot is completely surrounded by minimum one inch of backfill material. The anode shall be supplied with a factory installed lead wire, as shown in the drawings. The anode wire shall be of sufficient length to reach appropriate test station without splicing.

2.3 TEST STATION BOXES

Test station boxes shall be concrete traffic valve boxes with cast iron lid marked “CP-TEST” rated for H-20 loading. The box shall be 10-3/8 inch inside diameter and 12-inch high. Terminal board to be installed within test station boxes shall be made of polycarbonate material, model Big Fink, as manufactured by Cott Manufacturing Co., or approved equal. The terminal board shall be provided with sufficient number of terminals and shunts, as indicated in the Drawings.

2.4 SHUNTS

Shunts used in test stations shall be 0.01 ohm, 8 ampere capacity, as manufactured by Cott, or approved equal.

2.5 CABLES

Anode and test lead cable sizes, colors, and type shall be as shown in the drawings.

2.6 EXOTHERMIC WELD

All cable connections to pipe and fittings shall be accomplished utilizing an exothermic welding process such as "Cadweld" by Erico Products, Inc., "Thermoweld" by Continental Industries, Inc., or approved equal. Each cable shall be fitted with a copper sleeve for accomplishing the weld. Cartridge, sleeves and molds for each weld shall be furnished by
the same manufacturer. All materials for welding shall be sized and in accordance with recommendations in manufacturers' literature.

2.7 EXOTHERMIC WELD COVERING

Cover used for sealing cable-to-pipe connections shall be “Handicaps” by Royston Products, T-Caps by Calpico, or approved equal.

2.8 REPAIR COATING

Repair coating may be used in conjunction with an Exothermic Weld Covering and to recoat areas of the pipe or fitting not physically covered by the Exothermic Weld Covering. Coating shall be Scotchcast Resin No. 4, manufactured by 3-M, or approved equal and shall be brush applied to repair coating damage caused by handling or installation damage.

2.9 DIELECTRIC ISOLATING FLANGE KITS

Isolating flange kits shall include full-faced gaskets, isolating sleeves and washers, and steel washers. The complete assembly shall have a pressure rating equal to that of the flanges between which it is installed. Gasket shall be neoprene faced phenolic, 3.18 mm (1/8-inch) thick having a high dielectric constant of 200 volts/mil or greater. Isolating sleeves shall be mylar, 0.8 mm (1/32-inch) thick. Isolating washers shall be 3.18 mm (1/8-inch) thick phenolic, having a high dielectric constant. Steel washers shall fit well within the bolt facing on the flange. Isolating washers shall fit within the bolt facing the flange over the outside diameter of the sleeve. Isolating flange kit shall be as manufactured by Pipeline Seal and Insulator Company (PSI) or approved equal.

2.10 JOINT BONDS

The wires for joint bonds shall be #8 AWG HMW/PE, Type ASTM D-1248, stranded copper cable as shown on the drawings.

2.11 WARNING TAPE

All buried cables shall have plastic warning tape installed a minimum of 12-inches above the top of the cables. The warning tape shall be minimum 3-inches wide and shall be yellow with black lettering with legend, “CAUTION, CATHODIC PROTECTION CABLES BURIED BELOW.”

PART 3 EXECUTION

3.1 GENERAL

A. STORAGE OF MATERIALS

All materials and equipment to be used in construction shall be stored in such a manner that they are protected from detrimental effects from the elements. If actual warehouse storage cannot be provided, materials and equipment shall be stacked well above...
ground level and protected from the elements with tarps, allowing for adequate ventilation to prevent buildup of moisture condensation.

3.2 INSTALLATION

A. Anodes

1. Anodes shall be installed at the locations and in the manner indicated on the drawings. Anodes shall be installed vertically or horizontally minimum 2 feet from the pipe, at or below the pipe invert. Anodes shall not be carried, suspended, or lowered by means of anode lead wires. Damaged anodes shall be replaced by the contractor at his sole expense. Protective plastic or paper covering shall be removed before anodes are installed.

2. Anodes shall be installed in native soil and shall be backfilled with native soil free of rocks, clods, vegetation and debris of any type. Anodes shall be backfilled with six inch lifts of native soil, each lift compacted sufficiently and tightly, taking care to cause no punctures or damage to cloth bag, anode backfill material, anode lead wire or the anode itself. When the native soil backfill is in level with the top of the anode, the anode locations shall be saturated by adding minimum 10-gallons of water per anode.

3. Anode lead wires shall be routed underground to the appropriate test station, as shown on the drawings, in one continuous length with no splicing. Anode lead wires shall be of sufficient length to provide a minimum slack of 18-inches at anode and test station installations to avoid stress during backfilling. Care must be taken to ensure that no damage occurs to wires and insulation.

B. CABLES

Cables for anodes and test leads buried in the ground shall be laid straight and without kinks. Direct buried cable shall have a minimum cover of 30-inches. Each cable run shall be continuous in length and free of joints or splices. Care shall be exercised during installation to avoid punctures, cuts, and similar damage to insulation. Any damage to insulation will require replacement of the entire cable length. Label each cable using cable identification tags before backfilling. Backfill surrounding the cables shall be native soil free of foreign materials. Plastic cable warning tape shall be placed in the backfill twelve inches directly above the cable runs.

C. TEST STATIONS

Install test stations at the locations shown on the drawings. Install the test stations flush with finished grade. Set the test station box in concrete to prevent settling. Terminate all test lead wires on the test station terminals as shown on the drawings. Soil inside the test box shall be free of concrete.

D. EXOTHERMIC WELD CONNECTION
1. Exothermic weld connections shall be installed in the manner and at the locations shown on the plans. Coating materials shall be removed from the surface over an area just sufficient to make the connection. The steel surface shall be cleaned to white metal by grinding or filing prior to welding the conductor. Resin impregnated grinding wheels will not be allowed.

2. Exothermic welds shall be tested by the CONTRACTOR for adherence to the pipe and for electrical continuity between the pipe and wires.

3. A 22-ounce hammer shall be used for testing adherence by striking a sharp vertical blow to the weld. Care shall be taken to avoid hitting the wires.

4. After successfully passing the adherence test, welding slag shall be removed from the weld by tapping the weld with a geologist’s hammer or other device capable of delivering a controlled impact to a precise location. Slag will be visible as black or porous metal, and will frequently be loosened by the adherence test.

5. After welding and slag removal, coat all welds with weld cover and repair coating, as directed.

E. COATING REPAIR

Coating shall be brush applied per factory instructions to recoat any exposed copper wire and any external part of coated pipe or fittings, which may have suffered coating damage.

F. DIELECTRIC ISOLATING JOINTS

Dielectric isolating flange joints shall be installed in the manner and at the locations shown on the plans, using isolating flange kits. All existing and aboveground metallic pipelines and other grounded metallic components shall be electrically isolated from the new underground metallic piping, which will be cathodically protected. At concrete penetrations, reinforcing steel must be electrically isolated from steel pipe by providing minimum 2” mortar/concrete cover.

G. JOINT BONDING

Bond all non-welded, non-isolating pipe joints using joint bond cables as shown in the drawings.

3.3 TESTING

A. After installation of the test stations and cathodic protection facilities, the system shall be tested under the direct supervision of a NACE International certified Cathodic Protection Specialist or State of California Registered Professional Corrosion Engineer hired by the Contractor to ensure conformance with the specifications. A minimum of a 5-day notice shall be given to the STANFORD UTILITIES prior to scheduling the energizing and testing of the systems.
B. Testing shall include a determination of proper operation and adequacy of anodes, test stations, electrical isolation of dielectric isolating pipe joints, and electrical continuity of bonded joints. Prior to introducing test current or connecting the anode, static potentials shall be obtained and recorded using a portable reference electrode and potentials measured using each test lead and the anode lead. A high impedance (10 megohms or more) voltmeter shall be used to measure and record the potential. After connecting the anodes, potentials (On and Off) and anode current output shall also be measured and documented. Testing shall be performed in accordance with NACE Standard SP0169-07.

C. A report containing the results of testing shall be submitted no later than 30 days following completion of field testing.

END OF SECTION