SECTION 26 42 60

CATHODIC PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install sacrificial anode system to protect the underground ductile iron pipe or steel pipe as shown on the drawings and as specified herein. Unless otherwise specified, all anode beds shall be installed vertically as shown on drawings.

B. Locations of anode beds and the amount of the anodes shall be as shown on Drawings.

C. All non-welded joints shall be properly bonded.

D. All corrosion testing shall be performed prior to the paving of the roadway.

E. Contractor shall provide qualified personnel to perform all testing. Qualification of the testing personnel shall be as outlined in Section 3.5.A.

F. GPS coordinates of all test stations shall be submitted to City Representative at the end of project.

1.2 RELATED WORK

A. Section 26 42 40 - Corrosion Control

1.3 SUBMITTAL

A. Contractor shall submit all items as listed in Section 2.1.A through Section 2.1.E for approval.

B. Resume of Corrosion engineer or specialist performing the System Checkout.

C. A comprehensive test report shall be submitted to City Representative upon the completion of the testing. The report shall be certified by a corrosion engineer as outlined in Section 3.5.A.

D. GPS coordinates per Section 1.1.F.

1.4 REFERENCED SPECIFICATIONS, CODES AND STANDARDS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition available on the date of Notice Inviting Bids shall be used.

B. National Association of Corrosion Engineers (NACE)

1. SP0169, Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems

2. SP0286, Electrical Insulation of Cathodically Protected Pipelines

3. SP0497, Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping System

4. SP0200, Standard Practice, Steel-Cased Pipeline Practices

C. National Electrical Manufacturers Association

D. Institute of Electrical and Electronic Engineers

E. Insulated Power Cable Engineers Association

F. Occupational Safety and Health Administration

G. All electrical equipment and materials and the design, construction and installation thereof shall comply with all applicable provisions of the National Electric Code (NEC) and applicable local codes and regulations.

H. Where the Drawings or these Specifications require a higher degree of workmanship or better quality of material than implied by the above codes and standards, these Drawings and Specifications shall prevail.

1.5 QUALITY CONTROL

Cathodic Protection installation and testing shall be supervised by a Corrosion Engineer registered in State of California, a NACE certified Cathodic Protection Specialist, or a NACE certified Corrosion Specialist. The person in charge of installation and testing shall have minimum 5 year experiences in the Water and Wastewater industries.

The Corrosion Engineer shall be at the jobsite for the following stages:

- Prior to the excavation and anode hole drilling.
- Testing of the insulated flange joints
- Testing of the exothermic welds
- Native pipe-to-soil potential survey
- On/Off Pipe-to-soil potential survey

PART 2 - PRODUCTS

2.1 MATERIALS

A. Anode shall be high potential cast magnesium, with open circuit potential of 1.75 – 1.77 volts, with #10 AWG stranded copper conductor, Type HMW/PE, or Type CP or Type RHW-USE, 600 volt, Black insulation.

1. Anode composition shall be as follows:

ELEMENT	PERCENT
Aluminum, Max.	0.01%
Manganese	0.5 - 1.3%
Iron, Max.	0.03%
Copper, Max.	0.02%
Nickel, Max.	0.001%
Others	0.05 each or 0.3% Max Total
Magnesium	Balance

2. Anode shall be installed in the special mixture, which lowers anode-to-earth resistance. The backfill shall be 75% gypsum, 20% bentonite, and 5% sodium sulfate.

3. Anode shall be minimum of 60 pounds, packaged high-potential magnesium anode, Harco Type 60S4 or approved equal.

B. Cable:

1. Unless otherwise specified by the manufacturer, all cables shall be stranded copper, type USE-2/RHW-2, or approved equal suitable for direct burial, color code as shown below, and size as shown on the Drawings.

2. Anode header cable: black color.

3. Anode lead: black color.

4. Pipeline cable: white color.

5. Reference electrode cable: yellow color, insulation type per manufacturer.

6. Insulated Flange Joint cable: red color.

7. Bond cable: #8 AWG, white color.

C. Shunt: 0.1-ohm brass/manganin ribbon, 2-ampere capacity.

D. Splice Connection: Epoxy resin poured in 2-piece plastic mold. A filler hole shall be provided as shown on Drawings.

E. Split bolt connector: Burndy Servit Type KS, or equal.

PART 3 – EXECUTION

3.1 ANODES

A. The quantity and configuration of anodes installed shall conform to the drawings.

B. Anodes shall be inspected for damage to lead wire. Anodes with nicked, cut, abraded or otherwise damaged lead wires shall not be installed and shall be removed from the jobsite.

C. The wire attached to the anodes shall be stranded, single conductor, copper and insulated for 600 volts. Connection of wire to the anode shall have a pulling strength, which shall exceed the tensile strength of the wire. Any damage to the wire insulation or anode shall require complete replacement of the wire and anode.

D. Sufficient slack shall be left for the Big-Fink terminal boxes to permit removal of the covers during inspection and measurement.

E. All wires used for cathodic protection systems shall be visually inspected for breaks in the insulation by the City Representative at the jobsite just prior to installation.

F. The anode lead wire and the anode header cable shall be spliced using split bolt and Epoxy resin poured in 2-piece plastic mold as shown on Drawing. The splice shall be performed per the approved submittal.

G. Prepackaged anodes shall be installed at the locations indicated for protection of the pipe. Plastic or paper wrapping shall be removed from the anode prior to lowering the anode into the hole.

H. Anodes shall not be suspended by the lead wires. Anodes shall be backfilled with native soil. Upon completion of compaction of backfill to the top of the anode, and prior to filling the hole and compacting the backfill to the surface, a minimum of 10 gallons of water shall be poured into the hole to saturate the prepackaged anode backfill and surrounding soil.

I. Anodes shall not be backfilled prior to inspection and approval of the City Representative.

J. Backfilling with native soil shall proceed in 6- inch lifts, compacting the soil around the anode during each lift. Damage to the canvas bag, anode to wire connection, and copper wire or wire insulation will require replacement of the entire assembly.

3.2 PIPELINE CABLES

A. Cables connected to the pipe shall be by Exothermic welding.

B. Prior to exothermic welding, the steel shall be cleaned to bare metal by filing or grinding.

C. When the weld has been tested successfully, Royston Handy-Cap shall be used to completely cover the connection and exposed conductor.

3.3 ANODE HEADER CABLE

A. Header cable shall be installed to electrically connect all anodes.

B. Header cable shall be routed to the test station. Contractor shall not connect the anodes to the structure. Final anode connection shall be performed by a qualified corrosion Engineer. (See Section 3.4)

C. Provide adequate slack in the header cable to permit removal of the anode splice for inspection.

D. Anode cable shall be spliced into the header cable using a properly sized copper alloy split bolt and plastic molds.

E. Connection between the anode bed and the steel pipe shall be accomplished through the use of the test station and the shunt.

F. Traffic box covers for test stations shall be cast iron with welded bead legend as shown on the drawing.

G. At least 18 inches of slack (coiled) shall be left for each conductor at each test station housing. Slack in the wire shall be sufficient to allow removal of wire extension for testing. Wire shall not be bent into a radius of less than 8 times the diameter of the wire.

3.4 SYSTEM CHECKOUT

A. All testing shall be performed by a corrosion engineer, registered in State of California, or by a NACE certified Cathodic Protection Specialist, or a NACE certified Corrosion Specialist to ensure conformance with the Contract Documents, NACE SP0169, and NACE SP0286. Notify the City Representative at least 5 working days prior to the testing. All testing shall be witnessed by the City Representative.

B. The native pipe-to-soil potential survey shall be performed prior to the backfill of the roadway. The survey shall be performed prior to the connection of the anode bed to the steel pipe. The survey shall be performed at the beginning and the end of the pipeline, at the midpoint between the beginning of the line and the first anode bed, at each anode bed and test station location, at the midpoint between the 2 consecutive anode beds, and at the midpoint between the last anode bed and the end of the pipeline. Pipe-to-soil potential at every discreet anode shall be recorded.

Contractor may be required to drill additional 1-inch holes to accommodate the pipe-to-soil potential survey. These holes, if drilled, shall be backfilled upon the completion of the survey, to meet all the requirements of the local jurisdiction having authority.

GPS coordinates shall be recorded for the locations of the anode test stations. The GPS coordinates shall be clearly identified in the cathodic protection activation report.

C. When the native pipe-to-soil potential survey is complete, connect the anode beds to the steel pipe through the test stations. Allow at least 72 hours for pipeline polarization. Perform the pipe-to-soil potential survey at the same locations as previously performed in step 3.4.B.

D. Test results and interpretation of the data shall be submitted to the City Representative for review and final approval.

E. Any defects shall be corrected by the Contractor prior to the backfill of the roadway, or as agreed upon by the City Representative.

F. Testing shall include the following and shall be conducted in accordance with NACE SP0497:

1. Verify electrical isolation at all insulating joints, insulating unions, and casing

insulators per NACE SP0286.

2. Confirm electrical continuity of the pipeline or cathodically protected structure in accordance with this section.

3. Measure and record native structure-to-soil potentials at each location.

4. Measure and record the 'On' and 'Instant-off' structure-to-soil potentials at each location.

5. Measure and record the current outputs of each anode.

G. Test results shall be analyzed to determine compliance with NACE SP0169.

H. Test results shall be analyzed to determine if stray current interference is present. Stray current interference is defined as a shift in a pipelines pipe-to-soil potential by ±50 mV that is caused by a foreign current source. Stray current interference shall be tested on the project pipeline and foreign pipelines that have a reasonable chance of being affected by stray currents.

I. The Contractor shall provide a written report, prepared by the Corrosion Engineer documenting the results of the testing and recommending corrective work, as required to comply with the contract documents. Any deficiencies of systems tested shall be repaired and re-tested by the Contractor at no additional cost to the City.

END OF SECTION