

Special Specification Item 4156

Cathodic System Conversion to Bulk Anodes



1. DESCRIPTION

Furnish all labor, tools, materials, equipment, and services necessary to install bulk sacrificial cathodic protection anodes and applicable connections. Bulk anodes are to be installed on all substructure pile footings, concrete piles with sacrificial cathodic protection jackets at trestle bents, and steel fender H and pipe piles.

2. MATERIALS

Provide materials specifically intended for bulk anode applications and meeting the following requirements:

Bulk Anodes: 48 lb. minimum zinc units, 99% pure zinc hull type anode with a steel strap core in accordance with ASTM B418, *Standard Specification for Cast and Wrought Galvanic Zinc Anodes*, Type 1. The following manufactures are pre-approved for use on this project:

- Farwest Corrosion Control Company
- Galvotec Alloys, Inc.
- Vector Corrosion Technologies

Anode Wiring: Supply bulk anodes with No. 6 AWG stranded copper wire with HMWPE insulation brazed to a 3/8 in. diameter steel bar welded to the steel strap core. Provide wire of sufficient length to avoid splicing wires.

PVC Conduit and Fittings: Provide rigid PVC conduit and fittings conforming to the requirements of EPC-40-PVC conduit of NEMA TC 2 and fittings for EPC-40-PVC conduit of NEMA TC 3. Provide conduit and fittings that are UL 651 listed and conforming to Article 347 of the Electrical Code for underground and exposed use.

Junction Boxes: Marine listed, NEMA Enclosure Type 4X waterproof enclosures, and cable glands.

Stainless Steel. Type 316 stainless steel sections of the indicated sizes in accordance with ASTM A276, *Standard Specification for Stainless Steel Bars and Shapes*. Fabricate in accordance with Item 441, *Steel Structures*. Weld in accordance with AWS D1.6.

Provide Type 316 stainless steel anchors, rods, lock washers, and nuts in accordance with the following:

- ASTM F593, *Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs*
- ASTM F594, *Standard Specification for Stainless Steel Nuts*

Epoxy Coating. Provide Type X epoxy in accordance with TxDOT DMS-6100, *Epoxies and Adhesives*.

Concrete Repair Material. Provide pre-approved concrete repair material in accordance with DMS-4655, *Concrete Repair Materials* for vertical or overhead repair.

Coatings for Stainless Steel. Provide a marine-grade immersion top coating system for stainless steel assemblies, recommended by the manufacturer for marine immersion service, and meeting the requirements of NORSOK Standard M-501, Coating System No. 7. Submit a manufacturer's certification that states the material meets the requirements of NORSOK Standard M-501, Coating System No. 7. Upon completion of installation of new anode assemblies, coating system to also be used to coat new connection hardware.

Size the abrasive particles for blast cleaning to provide the prepared surface profile height (anchor pattern profile) in accordance with the requirements for the coating system and graded in accordance with ISO 8503. Use non-metallic grit, free from chlorides, as blast medium on stainless steel surfaces.

2.1. Submittals

Provide manufacturer's literature and technical data for each type of manufactured material and product indicated.

Provide a CP quality control plan with proposed testing means and methods, and sample data collection forms.

Samples: Provide one bulk anode proposed for the Project for each type of manufactured material and product indicated. If multiple manufacturers are to be used, provide one sample from each supplier.

Shop drawing details for electrical connections of bulk anodes. Provide proposed electrical connection details approved by the anode manufacturer. Include connections to bulk anodes, embedded reinforcing steel, and junction boxes.

- Include procedures to remove concrete for electrical connection and approved concrete repair material.
- Include mounting details for bulk anodes, wiring, and junction boxes.

2.2. **Delivery:** Deliver materials to the site in original containers and packaging with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, lot number, directions for storing, and complete manufacturer's written instructions.

2.3. **Storage:** Store and handle materials in accordance with manufacturer's written instructions and safety requirements. Remove from Site, and replace at no cost to Department, any materials that are damaged or otherwise negatively affected by not being stored or handled in accordance with manufacturer's written instructions. Store materials on land and transport to the site only the amount expected to be installed each day. Do not store materials on temporary structures on the water overnight.

2.4. **Replacement Anodes.** Furnish to the Department 10 anodes of each size and type for future replacement needs.

3. EQUIPMENT

Concrete Reinforcing Steel Locator: Electromagnetic or magnetic equipment capable of locating reinforcing steel within concrete.

Multimeter: Capable of measuring voltage and resistance to a precision of 1 millivolt and 0.1 ohms, respectively.

Concrete Removal and Repair Equipment. Meet requirements of TxDOT Item 429, *Concrete Structure Repair*.

- Concrete coring equipment
- Pneumatic chipping hammers nominal 30-lb class or less
- High-pressure, oil-free compressed air equipment capable of removing dust and dirt
- Percussive or rotary drilling equipment for making holes in concrete substrate
- Equipment for mixing and transporting concrete
- Equipment for finishing of placed concrete

4. CONSTRUCTION

- 4.1. **Field Quality Control:** Engage a NACE-qualified cathodic protection technician (CP-2 qualification or higher) to confirm electrical continuity testing of reinforcement and anodes before and after concrete placement. Submit CP quality control and testing plan for Engineer review.
- 4.2. **Bulk Anode Assemblies A and B.** Shop-paint new stainless steel sections with a marine-grade immersion coating system recommended by the manufacturer for marine, immersion and splash service, and meeting the requirements of NORSOK Standard M-501, Coating System No. 7. Submit product data sheets and obtain approval of paint system before performing the work.
- Do not paint over zinc anode surfaces.
- 4.3. **Installation of Bulk Anode Assemblies A and B:** Install anodes in accordance with recommendations of anode manufacturer at locations specified in the Drawings.
- Locate existing reinforcing steel within pier caps at installation location.
 - Select existing embedded reinforcing bars to establish electrical connection and expose bar by coring and/or chipping. Do not cut through existing reinforcing bars.
 - Clean surfaces of removal area, including vertical edges, to remove surface contaminants, loose pieces of concrete, and concrete that is bruised or micro-fractured and to roughen surfaces.
 - Make electrical connections per details established in approved submittal.
 - Mix, place, and cure concrete repair material at locations of electrical connections in accordance with Manufacturer's instructions.
 - Mount bulk anodes assembly as established in approved submittal details.
 - Apply the marine grade immersion top coat to all un-coated stainless steel surfaces, including installation new hardware, in accordance with the manufacturer's requirements.
- 4.4. **Installation of Bulk Anode Assembly C (Monitored Bent Locations):** Install anodes in accordance with recommendations of anode manufacturer at locations specified in the Drawings.
- Locate existing reinforcing steel within pier caps at installation location.
 - Select existing embedded reinforcing bars to establish electrical connection and expose bar by coring and/or chipping. Do not cut through existing reinforcing bars.
 - Clean surfaces of removal area, including vertical edges, to remove surface contaminants, loose pieces of concrete, and concrete that is bruised or micro-fractured and to roughen surfaces.
 - Make negative electrical connection as shown in the Drawings.
 - Mix, place, and cure concrete repair material at locations of electrical connections in accordance with Manufacturer's instructions.
 - Mount bulk anodes as shown in the Drawings.
 - Mount wiring and junction boxes as established in approved submittal details.
 - Refer to Item CCCC Cathodic Protection Monitoring System and manufacturer information for electrical connection requirements.
- 4.5. **Electrical Continuity of Reinforcing Steel.** Confirm electrical continuity between reinforcing steel for all pier caps with Bulk Anode Assemblies A, B, and C by measuring DC resistance (ohms) with a multi-meter.
- Electrical continuity is acceptable if the DC resistances measured with multi-meter are less than 1 ohm.
 - If the electrical continuity is not acceptable as described above, re-establish by welding or other approved means.

- 4.6. **Electrical Anode Connections.** Confirm electrical connection between anode assemblies and reinforcing steel for all pier caps with Bulk Anode Assemblies A and B by measuring DC resistance (ohm) with a multi-meter.
- Verify continuity between all negative anode connections after installation of anode assemblies.
 - Electrical continuity is acceptable if the DC resistance measured with multi-meter is less than 1 ohm.
 - If the electrical continuity is not acceptable as described above, remove and reinstall negative anode connections.
- 4.7. **Electrical Continuity of Fender Piles.** Confirm electrical continuity between new bulk anodes and existing fender piles by measuring DC resistance (ohm) with a multi-meter.
- Verify continuity between all installed bulk anodes and connected fender pile.
 - Electrical continuity is acceptable if the DC resistances measured with multi-meter are less than 1 ohm.
 - If the electrical continuity is not acceptable as described above, remove and reinstall as shown in the Drawings.

5. **MEASUREMENT**

This Item will be measured as Lump Sum.

6. **PAYMENT**

The work performed and the materials furnished in accordance with this Item and measured under "Measurement" will be paid for at the unit price bid for "Cathodic System Conversion to Bulk Anodes". This price is full compensation for providing and installing anodes, wiring and associated hardware, electrical testing, replacement anodes, and for tools, labor, equipment, and incidentals.