# SECTION 06000 - CATHODIC PROTECTION SYSTEMS

## PART 1 - GENERAL

1.1 WORK INCLUDED IN THIS SECTION

A. The WORK of this Section includes providing a description of materials, installation and testing of cathodic protection equipment including magnesium and zinc anodes, anode backfill, bond and test wires, test stations, reference electrodes, alumino-thermic welds, insulating flange kits, and marker posts used in the construction of pipelines and appurtenances.

1.2 SUBMITTALS

A. The following shall be submitted in compliance with Section 01300.

1. Shop Drawings

a. CONTRACTOR shall submit shop drawings before ordering or supplying corrosion protection materials

2. Manufacturer's catalog data and descriptive literature.

a. Show dimensions and materials of construction by specification reference and grade.

## PART 2 - PRODUCTS

2.1 PREPACKAGED MAGNESIUM ANODES

A. Magnesium Anodes: Anodes shall be a prepackaged magnesium alloy ingot of the following chemical composition:

| | | |
|---|---|---|
| 1. | Aluminum | 0.010% |
| 2. | Manganese | 0.50% to 1.30% |
| 3. | Copper | 0.02% Max. |
| 4. | Nickel | 0.001% Max. |
| 5. | Iron | 0.03% Max. |
| 6. | Other | 0.05% Each or 0.30% Max. total |
| 7. | Magnesium | Remainder |

B. Anode Weight: Ingot weight of the prepackaged magnesium anode shall be 48 pounds.

C. Anode Backfill: Each magnesium anode shall be prepackaged in a permeable cloth bag with a backfill of the following composition:

| | | |
|---|---|---|
| 1. | Gypsum | 75% |
| 2. | Powdered Bentonite | 20% |
| 3. | Anhydrous Sodium Sulfate | 5% |

Backfill grains shall be capable of 100% passing through a 100 mesh screen. The backfill shall be firmly packed around the anode by mechanical vibration to a density which will maintain the magnesium ingot in the center of the cloth bag and surrounded by at least one inch of backfill. The packaged weight of the 48-pound (ingot weight) magnesium anode and backfill shall be approximately 96 pounds.

D. Steel Core: Anode shall be cast with a perforated galvanized steel core and recessed at one end for lead wire connection.

E. Anode Lead Wire: Anode lead wire shall be AWG No. 10 stranded copper wire with THWN insulation conforming to U.L. Standard 83. Wire shall be connected to the core with silver solder. The connection will then be insulated by filling the remainder of the recess with electrical potting compound. Anode lead wire shall be of sufficient length to extend from the anode to the designated termination point without a splice. Wires with cut or damaged insulation will not be accepted and replacement of the entire lead will be required at the CONTRACTOR's expense.

## 2.2 ZINC ANODES

A. Zinc Anodes: Anodes shall conform to ASTM B 418, Type II and shall be a prepackaged zinc alloy ingot of the following chemical composition:

| | | |
|---|---|---|
| 1. | Aluminum | 0.005% Max. |
| 2. | Cadmium | 0.003% Max. |
| 3. | Iron | 0.0014% Max. |
| 4. | Zinc | Remainder |

B. Anode Weight: Ingot weight of the prepackaged zinc anode shall be 30 pounds.

C. Anode Size: Dimensions of the anode ingot shall be 2 inches square by 30 inches long.

D. Anode Backfill: Each zinc anode shall be prepackaged in a permeable cloth bag with a backfill of the following composition:

| | | |
|---|---|---|
| 1. | Gypsum | 75% |
| 2. | Powdered Bentonite | 20% |
| 3. | Anhydrous Sodium Sulfate | 5% |

Backfill grains shall be capable of 100% passing through a 100 mesh screen. The backfill shall be firmly packed around the anode by mechanical vibration to a density which will maintain the zinc ingot in the center of the cloth bag and surrounded by at least one inch of backfill. The packaged weight of the 30-pound (ingot weight) zinc anode and backfill shall be approximately 70 pounds.

E.. Steel Core: Anode shall be cast full length with an electro-galvanized 1/4-inch diameter steel core which shall be exposed at one end for connection of the anode lead wire.

F. Anode Lead Wire: Anode lead wire shall be AWG No. 12 stranded copper wire with THWN insulation conforming to U.L. Standard 83. Wire shall be attached to the steel core with a copper crimp type mechanical connection and silver solder. The connection shall be encapsulated in multiple layers of electrical insulation putty, vinyl electrical tape and coated with an electrical sealing compound. Anode lead wire shall be of sufficient length to extend from the anode to the designated termination point without a splice. Wires with cut or damaged insulation will not be accepted and replacement of the entire lead will be required at the CONTRACTOR's expense.

2.3 REFERENCE ELECTRODES

A. Reference electrode shall be permanent copper-copper sulfate prepackaged electrodes, sized 2" x 8" long, Schedule 80 PVC packaged in special backfill. Lead wire for reference electrode shall be AWG No. 14 stranded copper wire with THWN insulation.

2.4 PIPE LEADS

A. Pipe leads shall be AWG No. 8 stranded copper wire with high molecular weight polyethylene (HMW/PE) insulation specifically designed for cathodic protection service and suitable for direct burial in corrosive soil or water. Polyethylene insulation shall conform to ASTM D 1248, Type 3, Class C, Grade 5. Each pipe lead shall be of sufficient length to extend from the attachment to the pipe to the test box or anode test box without a splice. Wires with cut or damaged insulation will not be accepted and replacement of the entire lead will be required at the CONTRACTOR's expense.

2.5 BOND WIRES

A. Bond wires shall be AWG No. 4 stranded copper wire with high molecular weight polyethylene (HMW/PE) insulation specifically designed for cathodic protection service and suitable for direct burial in corrosive soil or water. Polyethylene insulation shall conform to ASTM D 1248, Type 3, Class C, Grade 5. Each bond wire shall not exceed 18 inches in length.

2.6 ANODE TEST BOXES

A. Post Mounted Anode Test Boxes:

1. Enclosure: The enclosure for a post mounted shunt box shall be approximately 10" x 8" x 6" and suitable for mounting on a post. Enclosure shall be constructed of 16-gauge cold rolled steel, free of loose scale, finished with one coat of epoxy red oxide primer, and two coats of baked-on enamel. Prior to painting, thoroughly clean and treat the enclosure with phosphate to form a corrosion-resistant conversion film at the surface and to improve paint bonding. The bottom of the enclosure shall have a knockout for a two-inch conduit for anode and pipe lead wires. The enclosure shall have a hinged, raintight cover.

2. Components: The post mounted anode test box shall contain solderless, compression-type terminal connectors for AWG No. 10 stranded wire and panel mounted 0.01 ohm shunts. A total of five shunts can be

installed per box each rated at six amperes minimum and accurate to plus or minus 1%. One shunt is required for each anode lead wire. A bus bar with a terminal common to shunts is required for the AWG No. 8 pipe lead. Isolated terminals are required for the other test pipe lead and reference electrode lead. See Standard Drawings for wiring configuration.

3. Panel: The mounting panel shall be micarta or laminated phenolic sheet cross-laminated for resistance to warpage and weathering. Minimum panel thickness shall be 3/16-inch. Panel shall be mounted to the back of the enclosure without shorting the terminal connections.

B. At-Grade Anode Test Boxes: The at-grade test box shall be a precast concrete traffic box measuring 12" x 13-3/4" with a cast iron lid. Cast on the lid the words "CP TEST." Precast box and cover shall be Brooks No. 4-TT, or DISTRICT approved equal. The at-grade anode test box shall contain an appropriately sized split bolt connector and shunt. See Standard Drawings for wiring configuration.

2.7 INSULATOR TEST BOXES

A. Post Mounted Insulator Test Boxes:

1. Enclosure: The enclosure of the post mounted insulator test box shall be the same as specified for the post mounted anode test box.

2. Components: The post mounted insulator test box shall contain separate solderless, compression-type terminal connectors for four AWG No. 8 stranded wire. See Standard Drawings for wiring configuration.

3. Panel: The mounting panel for the post mounted insulator test box shall be the same as specified for the post mounted anode test box.

B. At-Grade Insulator Test Box: The at-grade insulator test box shall be a 8-3/4 inch diameter precast concrete box with a cast iron lid designed for traffic loading. Cast on the lid the word "CP TEST." Precast box and cover shall be Brooks No. 1-RT, or DISTRICT approved equal.

2.8 CASING TEST BOXES

A. Post Mounted Casing Test Boxes: The enclosure, components and mounting panel for the post mounted casing test boxes shall conform to the enclosure, components and mounting panels specified for the post mounted insulator test boxes.

B. At-Grade Test Boxes: The at-grade casing test box shall conform to the at-grade insulator test box.

2.9 TWO WIRE TEST BOXES

A. Post Mounted Two Wire Test Box: The enclosure for the post mounted two wire test box shall be a 6" x 6" x 4" box constructed of 16 gauge steel with a

hinged cover and a quick release hasp. The bottom of the enclosure shall have a knockout for a 1 inch conduit.

B. At-Grade Two Wire Test Box: The at-grade two wire test box shall be a 8-3/4 inch diameter precast, concrete box with a cast iron lid designed for traffic loading. Cast on the lid the words "CP TEST." Precast box and cover shall be Brooks No. 1-RT, or DISTRICT approved equal.

## 2.10 ALUMINO-THERMIC WELD KITS

A. Wire-to-pipe connections shall be made by the alumino-thermic welding process. Weld charges and mold size shall be as specified by the manufacturer for various pipe sizes and surface configurations. Weld charges for use on cast iron and ductile iron are different from those used on steel. Care should be taken during installation to be sure correct charges are used. Welding charges and molds shall be the product of a manufacturer regularly engaged in the production of such materials. Weld charges for steel pipelines have green caps. Weld charges for cast or ductile iron have orange caps.

## 2.11 WELD COATINGS

A. Coating for all alumino-thermic welds shall be a cold applied, fast drying mastic consisting of 80 percent solids by volume and formulated from refined tar resins, synthetic resins and solvent coatings. The mastic shall be Protecto Wrap 160/160H mastic, or DISTRICT approved equal.

## 2.12 INSULATING FLANGE KITS

A. Insulating flange kits shall contain fullface gaskets, full-length sleeves and double washers (steel and phenolic) on each end. Insulation gaskets shall be dielectric neoprene-faced phenolic. Insulation sleeves shall be phenolic and full length. Insulating washers shall be phenolic. Steel washers shall be the same material as the bolts and nuts and shall be either plain carbon steel or cadmium plated. All insulating material shall be of the type designated by the manufacturer as suitable for the operating temperature and pressure of the service.

## 2.13 BURIED INSULATING FLANGE COATING

A. General: Buried insulating flange coating shall be a three part, cold-applied wax tape coating system as described by NACE RP0375.

B. Primer: Primer shall be a blend of petrolatums, plasticizers and corrosion inhibitors having a paste-like consistency. The primer shall have the following properties:

| | | |
|---|---|---|
| 1. | Color | Brown |
| 2. | Pour Point | 100-110E F |
| 3. | Flash Point | 350 |
| 4. | Coverage | One Gallon per each 100 feet |

Primer shall be Trenton Wax-Tape Primer or DISTRICT approved equal.

C. Wax-Tape: Wax tape shall consist of a synthetic-fiber felt, saturated with a blend of micro-crystalline wax, petrolatums, plasticizers, and corrosion inhibitors, forming a tape coating that is easily formable over irregular surfaces. The tape shall have the following properties:

| | | |
|---|---|---|
| 1. | Color | Brown |
| 2. | Saturant Pour Point | 115-120E F |
| 3. | Thickness | 50-70 mils |
| 4. | Tape Width | 6 inches |
| 5. | Dielectric Strength | 100 volts / mil |

Wax-Tape shall be Trenton #1 Wax-Tape or DISTRICT approved equal.

D. Plastic Wrapper: Wrapper shall be a polyvinylidene chloride plastic with three 50 gauge plies wound together as a single sheet. The wrapper shall have the following properties:

| | | |
|---|---|---|
| 1. | Color | Clear |
| 2. | Thickness | 1.5 mils |
| 3. | Tape Width | 6 inches |
| 4. | Water Absorption | Negligible |

Plastic wrapper shall be Trenton Poly-Ply or DISTRICT approved equal.

## 2.14 ABOVE GROUND INSULATING FLANGE COATING

A. The tape coating for all above grade and in-vault insulated pipe flanges shall be a minimum 14 mil thick general utility pipeline tape such as Polyken No. 900-12.

## 2.15 INTERNAL INSULATING FLANGE COATING

A. Coating for the interior lining of the pipeline at the insulating flange shall be a two-part, smooth white, thixotropic liquid epoxy consisting of 100 percent solids. Coating shall be Aquatapoxy Coating System A-5 as manufactured by Raven Linings Corporation, or DISTRICT approved equal.

## 2.16 CONDUITS

A. Conduit for the post mounted anode test box and the post mounted insulator test box shall be a 2-inch diameter galvanized steel conduit approximately 4 feet long. Conduit for the post mounted two wire test box shall be a 1-inch diameter galvanized steel conduit approximately 4 feet long.

## 2.17 BRASS IDENTIFICATION TAGS

A. Brass identification tags shall be 18 gauge brass and 1 inch in diameter. There shall be a small hole in the tag for attachment to the wires in the various test boxes.

## 2.18 PLASTIC WARNING TAPES

A. Plastic warning tape to be run above each buried wire shall be 3 inches wide and shall have a printed warning, "CAUTION: CATHODIC PROTECTION CABLE BURIED BELOW."

2.19 SHUNTS

A. Shunts used in the anode test boxes shall be 0.01 ohms resistance and rated at 6 amperes minimum capacity and accurate to plus or minus 1%.

2.20 MORTAR

A. Mortar used to repair concrete coated pipe after attachment of the various bond or test wires shall be fast drying, non-shrinkable type.

2.21 REDWOOD POSTS

A. Provide a post for each post-mounted test box. Use construction heart garden grade redwood per Standard Specifications for Grades of California Redwood Lumber issued by the Redwood Inspection Service. Provide seasoned redwood, 4" x 4", and surfaced on four sides.

2.22 PIPE CLAMPS

B. Pipe clamp used to attach the zinc anode lead wire to the above ground riser portion of the copper water tubing shall be brass or copper and of a size to fit the tubing. The pipe clamp shall have a screw terminal suitable for AWG No. 12 stranded copper wire.

2.23 INSULATING BLANKET

A. The insulating blanket shall be 1/8" thick neoprene or butyl rubber. The blanket shall be cut square and shall be 24 inches larger than the largest diameter pipeline to be isolated.

2.24 CASING INSULATORS

A. The casing insulators to be used to isolate metallic carrier pipelines from steel casings shall be manufactured from plastic or phenolic and shall fully encircle the carrier pipe. The casing insulator shall be manufactured by PSI (Pipeline Seal & Insulator, Inc.) or DISTRICT approved equal.

2.25 CASING END SEAL

A. The casing end seal shall be a heat shrinkable sleeve with a specially formulated sealant. There shall also be a non-conductive support member to help make the transition between the casing and the carrier pipe. End seals that utilize bands as fasteners are not acceptable. The casing end seal shall be CASEAL as manufactured by Raychem or DISTRICT approved equal.

## SECTION 3 - EXECUTION

### 3.1 GENERAL

A. Cathodic protection installation shall conform to NACE Publication RP0169 (Current Edition)--Recommended Practice, Control of External Corrosion on Underground and Submerged Metallic Piping Systems, including but not limited to Section 8.4 Galvanic Anodes; 8.4.2 Installing Anodes; 8.6 Corrosion Control Test Station, Connections and Bonds.

### 3.2 INSTALLING MAGNESIUM ANODES

A. Each magnesium anode shall be installed horizontally or vertically in a hole a minimum of 3 inches larger than the prepackaged anode diameter. Anodes shall be installed at locations as shown on the Drawings. Care shall be taken to ensure that the cloth bag is not damaged and no backfill lost during installation. Each magnesium anode shall be centered in the cloth bag. It may be necessary to re-center the anode in the cloth bag by rolling it on the ground prior to installation. Each magnesium anode shall be placed vertically or horizontally in the bottom of the hole at a minimum depth of 10 feet as measured from the finish surface to the bottom of the anode. If the 10-foot depth cannot be obtained, the DISTRICT's Representative shall be notified for possible adjustment to the designed depth and position of anodes. There shall be a minimum of 10 feet of separation from the steel pipeline to the anodes and 15 feet of separation between adjacent anodes. Anode beds shall be located on the side of the pipe line as shown on the Drawings. At no time shall an anode be installed outside of the pipeline right-of-way. Each prepackaged anode shall be lowered into the hole using a sling or rope. Do not lower, transport, handle or lift the anode by the lead wire.

1. Backfilling: Once the prepackaged anode is in the hole, water shall be poured into the hole so that the anode is completely covered with water. Stone-free native soil shall then be used to backfill the anode hole. Do not use imported sand for backfilling. The anode hole shall be backfilled in stages and carefully tamped to ensure that no voids exist around the bag and that the bag and anode wire are not damaged. After backfill is level with the top of the anode, a minimum of 15 gallons of water shall be poured into the hole to completely saturate the soil backfill. More water shall be added if it is suspected that the backfill is not completely saturated. Care must be taken to avoid damage to the anode and anode lead wires.

2. Anode Lead Wire: Anode lead wires shall be long enough to reach from the anode to the anode test box without a splice. Anode wires shall be trenched a minimum of 36 inches deep and terminate individually in the appropriate anode test box.

### 3.3 INSTALLING ZINC ANODES

A. Each prepackaged zinc anode shall be installed horizontally in a hole a minimum of 3 inches larger than the prepackaged anode diameter. The anode shall be installed under any new copper water tubing, this includes

service lines, blow-offs, air releases and sample points. The anode shall be positioned midway between the beginning of the copper water tubing and its termination point. There shall be a minimum separation of 2 feet between the copper water tubing and the zinc anode. Do not lower, transport, handle or lift the anode by the lead wire.

1. Backfilling: Backfilling shall be the same as specified for the magnesium anodes.

2. Anode Lead Wire: Anode lead wire shall run in the pipe trench to the end of the pipe run. At meter services, anode lead wire shall be coiled in the meter box and clamped to the pipe. At air releases and sample points, the anode lead wire shall run through the concrete pad in a 1/2-inch diameter PVC conduit and be clamped to the riser. At blow-offs and manual air releases, anode lead wire shall be coiled in the valve box and clamped to the riser. After attachment of the wire to the riser, the entire clamp and exposed wire shall be coated with a three part, cold applied wax tape system per Section 04300.

## 3.4 INSTALLING REFERENCE ELECTRODES

A. The reference electrode shall be placed 6 inches below the pipe adjacent to each test box along the pipeline. The reference electrodes shall be saturated with water prior to backfilling.

## 3.5 INSTALLING PIPE LEAD WIRES

A. Two AWG No. 8 wires with HMW/PE insulation shall be attached to the pipe and terminate in a test box without a splice as shown on the Standard Drawings. A minimum of 18 inches of slack wire from each lead shall remain in each test box.

1. Wire Connection: Connections of copper wire to the pipeline shall be made with the alumino-thermic welding charges or braze welding. Welding charges shall be the product of a manufacturer regularly engaged in the manufacture of the material. Manufacturer's recommended cartridge size and type shall be used. Only one wire may be connected with each weld. Each completed weld shall be coated with a bituminous compound. On mortar coated pipe, the bituminous compound shall be dry prior to repairing the mortar coating.

   a. Preparation of Wire: Use a cutter to prevent deforming wire ends. Remove only enough insulation from the wire to allow the weld connection to be made. Do not use a hacksaw for cutting.

   b. Preparation of Metal: Remove all coating, dirt, grime and grease from the metal pipe at weld location by wire brushing and/or use of suitable safe solvents. Clean the pipe to a bright, shiny surface free of all serious pits and flaws by use of mechanical grinder or a file. The area of the pipe where the attachment is to be made must be absolutely dry. Failure to provide a dry surface for welding will

result in a poor quality weld and could result in serious injury to the workman. Do not cut reinforcing rods when preparing metal surface for wire attachment.

c. Attachment of Wire to Pipe: The attachment of copper wire shall be made using an alumino-thermic weld as shown on the Standard Drawings. The wire is to be held at a 30 degree to 45 degree angle to the surface when welding. One wire only is to be attached with each weld. Wires shall be attached a minimum of 6 inches apart.

d. Testing of All Completed Welds: As soon as the weld has cooled., the weldment shall be tested for strength by striking a sharp blow with a two-pound hammer while pulling firmly on the wire. All unsound welds are to be rewelded and retested. All weld slag shall be removed from the weldment with a wire brush.

e. Coating of All Completed Welds: Thoroughly clean by wire brushing the area to be coated. The area must be completely dry. Apply bituminous mastic coating material in accordance with the manufacturer's recommendations. Completely coat the weld, all bare pipe surfaces around the weld and any exposed copper wire. Allow sufficient time to dry prior to repair of the mortar coating on steel pipe.

2. Wire Trench Backfilling: All buried wiring shall be installed at a minimum depth of 36 inches. The bottom of the finished trench shall be sand or stone-free earth. The first three inches of backfill material shall be placed directly on the cable. The remainder of the trench shall be backfilled with stone-free earth and tamped to a compaction of 90% conforming to ASTM D 1557. Care shall be taken when installing wire and backfilling trench so that insulation is not broken, cut, nicked, or bruised. If wire insulation is damaged during installation, it shall be replaced completely at the CONTRACTOR's expense. Plastic warning tape shall be installed approximately 12 inches above the wire.

## 3.6 INSTALLING BOND WIRES

A. Two bond wires shall be welded across each unwelded joint including valves, special fittings and flanges except insulating flanges, as shown on the Standard Drawings. Three bond wires are required for pipe diameters 18 inches and above. The same method of attachment and subsequent coating shall be used for bond wires as is used for pipe lead wires. Bond wires shall not be attached to valve bodies, but instead on the flange of the valve.

## 3.7 INSTALLING ANODE TEST BOXES

A. Post Mounted Anode Test Box: Locate redwood post above the pipeline, if possible, but not in a roadway. The post and test box shall not be positioned over the buried anodes. Cut post to a 5 foot length. Paint post per Standard Specification Section 04000, System No. 60. Excavate a 2 foot deep hole, set post plumb and backfill with excavated material. Pour a concrete pad 6 inches thick by 2 feet square and center around the post. Concrete shall be Class 450-C-2000 per Section 03000. Connect 2 inch galvanized conduit to the

anode test box with a threaded screw connection. Attach test box to the redwood post using the mounting brackets and threaded fasteners. Attach the conduit to the post with two conduit clamps and threaded fasteners.

B. At-Grade anode Test Box: The at-grade anode test box shall be installed over the pipeline or immediately adjacent to paved roadways behind the curb and out of traffic lanes if the pipeline is in the roadway. Pour a concrete pad 8 inches thick by 2 feet square around the test box. All wire shall be properly identified, with approximately 18 inches of slack wire above finish grade and coiled inside the test box. Keep the inside of the test box clear of all debris and other foreign material so that contact may be made with the native soil in the bottom of the box. Top of box shall be flush with finish grade.

## 3.8 INSTALLING INSULATOR TEST BOXES

A. Post Mounted Insulator Test Box: Post mounted insulator test box shall be installed the same as specified for the Post Mounted Anode Test Box.

B. At-Grade Insulator Test Box: At-grade insulator test box shall be installed the same as specified for the at-grade anode test box.

## 3.9 INSTALLING TWO WIRE TEST BOX

A. Post Mounted Two Wire Test Box: Post mounted two wire test box shall be installed the same as specified for the Post Mounted Anode Test Box.

B. At-Grade Two Wire Test Box: At-grade two wire test box shall be installed the same as specified for the at-grade anode test box.

## 3.10 INSTALLING INSULATING FLANGE KITS

A. Insulating flange kit shall be installed as shown on the Standard Drawings, as recommended by the manufacturer, and by NACE RP0286. Care must be taken to prevent any moisture, soil or other foreign matter from contacting any portion of the insulating joint prior to its being sealed. If moisture, soil or other foreign matter contacts any portion of the insulating joint, the entire joint shall be disassembled, cleaned with a suitable solvent and dried prior to re-assembly. Special attention shall be paid to the manufacturer's recommendations regarding the torquing pattern of the bolts and the amount of torque to the used when installing the insulating flange kit.

## 3.11 BURIED INSULATING FLANGE COATING

A. After testing, wrao the insulating flanges including all bolts, nuts, and washers, and adjacent surfaces of the pipe or valve with wax tape coating per Section 04300.

## 3.12 ABOVE GROUND INSULATING FLANGE COATING

A. All above grade and in-vault insulating flanges shall be coated with two complete layers of half-lapped general utility pipeline tape. The tape coating shall be applied by the CONTRACTOR after all electrical effectiveness tests have been performed and approved by the DISTRICT or it’s Representative.

## 3.13 INTERNAL COATING AT INSULATING FLANGE

A. The interior of the pipeline shall be coated with the two-part, smooth epoxy for a distance of two pipe diameters in each direction away from the insulating flange. At an insulating valve flange, interior of the pipeline shall be coated away from the valve for a distance of two pipe diameters.

1. Surface Preparation: The surface preparation of the mortar lining shall consist of wire brushing to remove all loose mortar to provide a suitable surface for adhesion of the coating.

2. Mixing: The two-part epoxy paint shall be mixed per the manufacturer's recommendations. The two-part epoxy shall be mixed thoroughly for at least two minutes by hand or with a mechanical mixer before being applied by brush. The epoxy for a two-gallon mixture has a pot-life of 30 minutes.

3. Application: Application of undiluted coating shall be made by brushing until a minimum coating thickness of 20 mils is achieved. Each ensuing coat shall be applied before previous coat cures, usually within 3 to 6 hours after previous coat has been applied. Coating shall be at the rate of 140 square feet per gallon. This would ordinarily produce the required coating with a total of two coats. However, the 20 mil minimum thickness shall be satisfied regardless of the number of applications necessary to provide it.

## 3.14 MORTAR REPAIRS

A. On mortar coated pipe, the mortar coating shall be repaired after the bituminous weld coating has dried, using fast-setting, non-shrinkable mortar to restore the original outside diameter of the pipe at each weld location.

## 3.15 INSTALLING IDENTIFICATION TAGS

A. Identification tags shall be securely attached to each of the wires in the test box. Tags shall be stamped "P" for pipe, "A" for anode, and "E" for reference electrode to indicate to which structure each wire is attached. Tags on wires in the test box at insulating flanges shall be stamped "N", "S", "E", or "W" or North, South, East, or West and with the pipeline diameter to indicate on which side of the insulating joint and to which pipeline the wires are attached.

## 3.16 INSTALLING PLASTIC WARNINGS TAPES

A. Plastic warning tape shall be placed 12 inches above each buried wire.

## 3.17 INSTALLING INSULATING BLANKETS

A. An insulating blanket shall be installed whenever a metallic pipeline crosses or closely parallels another metallic pipeline when the distance between the two pipelines is 18 inches or less. If there is a cathodic protection system protecting one of the structures within 1500 feet of the crossing point, then an

insulating blanket shall be installed when the distance between the two structures is 36 inches or less.

## 3.18 INSTALLING CASING END SEALS

A. The heat shrinkable casing seal shall be installed according to the manufacturer's recommendations. Care shall be taken that the annular space between the casing and the carrier pipe is free of contaminants prior to installation of the end seal. At no time shall organic materials be placed inside the casing. Also, care should be taken that no wrinkles or holes are present that could allow water to penetrate the end seal after installation.

## 3.19 CONTINUITY TESTS

A. The CONTRACTOR shall notify the DISTRICT's representative when continuity bonding has been completed and all test boxes have been installed. A corrosion engineer designated by the DISTRICT will test and measure the electrical continuity of metallic pipelines at the CONTRACTORS expense, unless otherwise indicated in the Special Provisions of the Contract Documents. The pipeline shall be considered electrically continuous when the measured longitudinal resistance of the pipeline between each pair of adjacent test stations is no greater than 20 percent higher than the theoretical resistance of that section of pipeline.

B. If tests indicate that adequate electrical continuity has not been achieved, the CONTRACTOR shall excavate to investigate and locate improperly bonded joints at his expense until electrical continuity is achieved to the satisfaction of the corrosion engineer.

## 3.20 CATHODIC PROTECTION TESTS

A. The CONTRACTOR shall notify the DISTRICT's representative when the anode test boxes and other test boxes are ready for hookup. The wires shall remain disconnected to facilitate testing. A corrosion engineer designated by the DISTRICT will conduct tests before anode hookup to check that none of the anodes or wires were damaged or broken during the installation, at the CONTRACTORS expense, unless otherwise indicated in the Special Provisions of the Contract Documents. If tests indicate damage, the entire wire and/or anode shall be replaced and retested at the CONTRACTOR's expense.

END OF SECTION