SECTION 02285
CATHODIC PROTECTION

PART I: GENERAL

1.1 GENERAL REQUIREMENTS
- A. Cathodic protection for metallic water mains, fittings and appurtenances.
- B. Trenching, drilling, and other excavation.
- C. Installation of anodes, cables, junction boxes and test stations.
- D. Backfill and compaction of backfill.
- E. Protective coating or wrap for metallic pipe, fittings, restraining devices, and appurtenances.
- F. Dust alleviation and control.
- G. Cleanup and restoration of surface in improved areas.
- H. Supplying all labor, materials, equipment and apparatus not specifically mentioned herein or noted on the Drawings, but which are incidental and necessary to complete the Work specified.
- I. All electrical equipment and materials and the design, construction and installation thereof shall comply with all applicable provisions of the National Electrical Code (NEC) and applicable local codes and regulations.

1.2 MEASUREMENT AND PAYMENT
- A. UNIT PRICES:
  1. Measurement for cathodic protection used is on a linear foot basis measured along the centerline of the pipe.
  2. Refer to Section 01270 – Measurement and payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
  1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES
- A. AASSHTO – American Association of State Highway and Transportation Officials.
  1. H20 – Specification for Highway Bridges.
- B. ASTM – American Society for Testing and Materials.
  1. B3 – Standard Specification for Soft or Annealed Copper Wire.
  2. B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
  3. B418 – Standard Specification for Cast and Wrought Galvanic Zinc Anodes.
  4. C94 – Standard Specification for Ready-Mixed Concrete.
  5. D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
  6. D2220 – Standard Specification for Polyvinyl Chloride (PVC)

Insulation for Cable and Wire.

C. AWWA – American Water Works Association.
   1. C213 – Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
   2. C550 – Protective Epoxy Interior Coatings for Valves and Hydrants.
D. CFTS – City of Friendswood Technical Specifications.
E. IEEE – Institute of Electrical and Electronic Engineers.
F. IPCEA – Insulated Power Cable Engineers Association.
G. NACE – National Association of Corrosion Engineers.
   1. RP0169 – Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems.
   2. RP0286 – Electrical Insulation of Cathodically Protected Pipelines.
   3. RP0375 – Wax Coating Systems for Underground Piping Systems.
   4. TM0497 – Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping System.
H. NEMA – National Electrical Manufacturers Association.
I. OSHA – Occupational Safety and Health Administration.

1.4 SUBMITTALS

A. Conform to requirements of Section 01330 – Submittal Procedures.
B. Submit shop drawings and certification signed and sealed by a Professional Engineer registered in the State of Texas.
C. A complete list of cathodic protection equipment and material, including name and manufacturer, catalog number, size, finish and any other pertinent data necessary for proper identification and to establish conformance with these Technical Specifications.
D. The submitted data shall be marked with a clear indication of the Contractor's choice of the specific item or items, or class of items proposed, in order to establish written record of the Contractor's intent. A list of items indicating "as specified" shall not suffice.

1.5 QUALITY ASSURANCE

A. Cathodic protection components shall be new, of the highest quality, and standard products from a manufacturer regularly engaged in the production of such material or equipment. Bring all cathodic protection materials to the job site in original sealed containers. Cathodic protection components shall be subject to testing to ensure proper installation and operation. The Contractor shall correct all deficiencies and perform any required re-testing.
B. Brands or trade names are mentioned in these Technical Specifications to set standards of quality; use no substitute materials unless approved by the Project Manager in writing. Approval of substitute materials does

not relieve the Contractor of responsibility for providing a workable and functioning system as designed.

PART II: PRODUCTS

2.1 ZINC GALVANIC ANODES

A. Galvanic anodes shall be zinc anodes having a Type II chemical composition conforming to the requirements of ASTM B418. Bare anode weight shall be as indicated on the Project Detail Sheets.

B. Anodes shall be cast with a galvanized steel core strap. One (1) end of the anode shall be recessed to provide access to the rod for connection of the lead wire. The lead wire shall be silver brazed to the rod, making a mechanically secure connection. The connection shall be insulated to a six hundred volt (600 V) rating by filling the recess with asphalt. The asphalt material shall be extended over the lead wire insulation by not less than one-half inch (1/2 In). The Contractor shall repair all damaged lead wire insulation as directed.

C. The entire soldered connection and core shall be sealed with epoxy. The zinc anode shall be prepackaged in a cloth bag containing a low resistivity backfill consisting of seventy-five percent (75%) hydrated gypsum, twenty percent (20%) bentonite and five percent (5%) sodium sulfate.

2.2 WIRE

A. Wires utilized for test stations shall be solid single conductor copper wire Type THHN insulation, No.10 AWG, as shown.

B. Wires for joint bonds shall be stranded single conductor copper wire Type HMW/PE insulation No. 8 AWG. Two (2) joint bonds shall be used for each joint.

C. All wire test leads and anode leads shall extend a minimum of eighteen inches (18 In) above grade after connection to the test station panel board.

2.3 PANEL BOARDS

A. Test station panel boards shall be made of four inch by four inch by one-fourth inch (4 In x 4 In x 1/4 In) fabric reinforced Micarta. Double-nutted nickel plated brass studs shall be installed on the panel boards as shown on the Drawings. Tinned copper ring terminals shall be soldered to the ends of all wires terminated in the test station.

2.4 SHUNTS

A. Shunts for all sacrificial anode test stations shall be one hundredth ohm (0.01 Ω), six ampere (6 A) capacity, manganin wire type.

2.5 EXOTHERMIC WELD EQUIPMENT

A. Cable connections to pipe and fittings shall be made with exothermic weld kits specifically designed by the manufacturer for welding the types of materials and shapes indicated by each installation unless otherwise

specified on the Drawings. Connections to ductile iron and cast iron pipe or fittings shall use the weld metal and mold for exothermic connections to cast iron pipe. The mold and weld metal shall be supplied by the same manufacturer. Weld metal shall be Type XF manufactured by Erico, Inc. or approved equal.

B. Exothermic weld equipment shall be as manufactured by "Cadweld" Erico Products, "Thermoweld" Continental Industries, Inc., or approved equal.

C. All welds shall be made utilizing copper wire sleeves and individual components shall not be interchanged between different manufacturers.

2.6 BITUMASTIC COATING

A. Bitumastic Coating shall be TC Mastic, as manufactured by Tapecoat Company; Bitumastic 50, as manufactured by Koppers Company, Inc., or an approved equal.

2.7 INSULATING FLANGE

A. Insulating flange gaskets shall be Neoprene-faced phenolic, suitable for the Work as indicated on the details shown on the Drawings. Sleeves shall be full length and of a material indicated by the manufacturer as suitable for domestic water. Flange bolts, nuts and washers shall be stainless steel and shall fit within the bolt facing of the flange.

B. Contractor shall provide two (2) sets of insulating washers which are one-eighth inch (1/8 In) thick laminated phenolic. Insulating washers shall fit within the bolt facing the flange over the outside diameter of the sleeve.

C. Insulating sleeves shall be spiral wound Mylar, one-thirty-second inch (1/32 In) thick.

D. Underground dielectric insulating flanges shall be covered with petrolatum wax tape.

2.8 PETROLATUM WAX TAPE SYSTEM (FOR ISOLATED FITTINGS AND ALL RESTRAINING DEVICES)

A. Petrolatum wax tape system for coating buried insulating flanges shall be Trenton Primer and #1 Wax-tape, as manufactured by Trenton Corp., or Denso Paste and Densyl Tape by Denso North America, Inc., or approved equivalent.

B. Petroleum Tape System Primer: Saturated petroleum hydrocarbon, non-drying, non-hardening.

C. Mastic: Saturated petroleum hydrocarbon, non-hardening, self-supporting compound.

D. Tape: Non-woven synthetic fabric, fully impregnated and coated with neutral petroleum-based compound.

E. Overwrap: Plasticized PVC tape with natural and synthetic rubber adhesive.

2.9 TEST STATION BOX

A. The traffic valve box for test stations shall be an H10 rated, G5 Utility Box as manufactured by Christy Concrete Products, Inc., or approved equal.

B. The traffic box covers for insulating test stations shall be cast iron with the legend "ANODE" as indicated on the Drawings.

2.10 COATING AND LINING

A. All cast-iron and steel valves, burys, spool pieces, flanged adapters, reducers, tees, crosses and other buried, ferrous metallic fittings, shall require a fusion epoxy coating and lining prepared from a one hundred percent (100%) dry epoxy resin applied by either the fluidizing bed method or electrostatically, in accordance with AWWA C213 for fittings and with AWWA C550 for valves. The minimum coating thickness shall be eight (8) mils and the maximum coating thickness shall be twenty-four (24) mils.

B. For valves, lining materials shall not be applied to valve stems, valve discs or parallel disc seats. Lining materials shall not be built up in thickness so as to interfere with joint assembly or with operation of the valve being epoxy lined, and in any case, should not be greater than twelve (12) mils.

C. Inspection shall be carried out to determine the dry film thickness of the coating and or lining of each fitting. Any fitting not meeting this specification shall be replaced.

D. Holidays in the protective coating shall be repaired in the field as directed.

PART III: EXECUTION

3.1 EXCAVATION AND BACKFILL

A. Refer to Section 02125 – Excavation and Backfill for Utilities.

3.2 FOREIGN STRUCTURE INTERFERENCE

A. Prevent electrical contact between the metallic pipe and/or fittings being cathodically protected and other existing buried metal structures at the time of the installation of the cathodic protection system. Where necessary, or required by the Project Manager, the Contractor shall install appropriately sized micarta sheeting, one-fourth inch (1/4 In) in thickness between the two (2) metallic surfaces.

3.3 INSULATED FLANGED JOINTS

A. Insulating components of each insulation flange kit shall be cleaned of all dirt, grease, oil, and other foreign materials immediately prior to assembly. Bolt holes in mating flanges shall be properly aligned at the time bolts and insulating sleeves are inserted to prevent damage to the insulation. After flange bolts have been tightened, each insulating washer shall be inspected and replaced by the Contractor if cracked or other damaged.

B. Install insulated flanged joints at flanges connecting above-ground installations, and at other locations shown on the Drawings.

3.4 JOINT BONDING

A. For metallic pipe, joint bond all non-welded rubber gasket joints, mechanical joints, and fusion epoxy coated flanged joints as indicated on the details shown on the Drawings to provide electrical continuity between all metallic sections of the facility to be protected.

B. All buried fusion-bonded epoxy coated pipe fittings shall be bonded for continuity. Joint bonds, for fusion-bonded epoxy coated pipe fittings shall be installed with a wire loop extended above the bonded joint. The overall length of the conductor shall permit sufficient flexibility of each fitting across the joint without transferring any tensile stress to the bond cable. Cable to fitting connections shall be in conformance with these specifications. Coat all exposed surfaces of each fitting with liquid epoxy patch kit, as supplied by the pipe coating manufacturer.

3.5 EXOTHERMIC WELDS

A. Exothermic weld connections shall be installed in the manner and at the locations shown on the Drawings. 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 shall not be allowed.

B. No connections to the structures or piping shall be buried until the Project Manager has inspected the connections and given permission to backfill. Connections made in violation of this provision shall be rejected.

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

D. A twenty-two ounce (22 Oz) hammer shall be used for testing adherence by striking a blow to the weld. Take care to avoid hitting the wires.

E. After welding, coat all bonds with Bitumastic coating as directed. Protect all exposed wires and welds with Royston Handy Cap, or equal.

3.6 WIRES

A. Wires buried in the ground shall be laid straight, without kinks, and provide a minimum cover of twenty-four inches (24 In). Keep the bottom of the finished trench free from stones, roots or other materials that might injure the insulation of the conductors.

B. Each cable run shall be continuous in length and free of joints or splices, unless otherwise specified or shown on the Drawings. Care shall be used during installation to avoid punctures, cuts and similar damage to the insulation. Any damage to insulation shall require replacement of the entire cable length by Contractor. Copper ring terminals shall be crimped and soldered to the ends of the test leads, drain wires and anode leads terminated in the test station.

C. At least eighteen inches (18 In) of slack shall be left for each conductor

at each test station housing. Slack shall be that amount of wire which, when the cover is removed and the wire extended, protrudes beyond the opening of the box or enclosure. No wire bend shall have a radius of less than eight (8) times the diameter of that wire. Copper terminal rings sized for wire and stud shall be used to make all wire connections to terminal studs.

3.7 GALVANIC ZINC ANODES

A. Excavate a hole to a minimum of three inches (3 In) larger than the packaged sacrificial anode diameter, and to a depth one foot (1 Ft) below the fittings to be protected. Excavate the lead wire trench to the depth indicated on the details shown on the Drawings, and backfill in conformance with these Technical Specifications.

B. Exercise care to preclude damaging the cloth bag and lead wire insulation on the sacrificial anode. Do not lift or support anode by the lead wire. Plastic or paper bags shall be removed from the anode before lowering into the hole.

3.8 PETROLATUM WAX TAPE

A. Install per manufacturer's instructions.

B. Wire brush dirt and loose rust from substrate, apply primer by brush and work in to obtain a full film cover on substrate.

C. Install mastic to contour all sharp edges and irregular profiles.

D. Spirally apply tape with minimum fifty-five percent (55%) overlay smooth tape to exclude voids and seal overlaps.

3.9 ANODE TEST STATION

A. Anode test stations shall be installed at the locations shown or called for on the Drawings. Two (2) test leads shall be connected at the nearest pipe joint to the test station.

B. All connections of test lead wires to metal surfaces at the point of connection shall be cleaned by grinding or filing prior to welding the conductor. Cover finished connections with bitumastic.

C. Anode test station boxes shall be installed using a concrete collar satisfactory to prevent settlement. Set this concrete collar level and flush with the top of curb or finish grade.

D. No more than one (1) test station is allowed in each test station box.

3.10 SYSTEM TESTING

A. System testing shall be performed by the Project Manager, a Professional Engineer Licensed by the State of Texas or a qualified testing firm.

B. After installation of the sacrificial anode system, testing shall be conducted to verify proper operation of the cathodic protection system. This testing shall include, and not be limited to the following: bond continuity tests, sacrificial anode current output, pipe-to-soil potentials and other tests deemed necessary to verify proper operation of the systems.

C. Upon completion of testing, a detailed written report shall be submitted to the Contractor describing any deficiencies detected. All such deficiencies shall be corrected by the Contractor at no cost to the City.

D. Upon completion of any corrections or repairs, the system shall be re-tested.

END OF SECTION