# SECTION 26 42 19.01 – CATHODIC PROTECTION IMPRESSED CURRENT FOR FUELING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This section covers materials, installation, and testing for cathodic protection systems for buried infrastructure.

B. The Cathodic Protection system shall be installed in accordance with the provisions of the specifications, applicable plans, codes and standards, and is subject to other terms and conditions of the project.

### 1.2 REFERENCES

A. National Association of Corrosion Engineers/Association for Materials Protection and Performance (NACE/AMPP)

1. SP0169-2013 - Control of External Corrosion on Underground or Submerged Metallic Piping Systems
2. SP0286-2007 - Electrical Isolation of Cathodically Protected Pipelines
3. TM0497-2012 – Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
4. SP0104-2014 - The Use of Coupons for Cathodic Protection Monitoring Applications

B. American Society of Testing and Measurements (ASTM)

1. G57-20 – Standard Test Method for Measurement of Soil Resistivity Using the Wenner Four-Electrode Method
2. D1248 – Polyethene Plastics Extrusion Material for Wire and Cable
3. B843 – Standard Specification for Magnesium Alloy Anodes for Cathodic Protection

C. National Fire Protection Association (NFPA)

1. No. 70 – National Electric Code

D. Occupational Safety and Health Association (OHSA)

1. 29 CFR, Part 1910 Q – Welding, Cutting, and Brazing

E. Underwriters Laboratory (UL)

1. Safety Standards

## 1.3 DEFINITIONS

A. Corrosion: The deterioration and loss of a material and its critical properties due to chemical, electrochemical and other reactions of the exposed material surface with the surrounding environment.

B. Cathodic Protection (CP): The electrochemical method for minimizing or eliminating external corrosion on buried metallic infrastructure.

C. Galvanic Cathodic Protection: A cathodic protection technique using magnesium, aluminum or zinc to provide cathodic protection current to buried metallic infrastructure. No external power is required for a galvanic cathodic protection system.

D. Coating: A uniform protective coating or tape applied to the surface of buried metallic infrastructure to create a dielectric layer between the surface and the surrounding electrolyte. The coating is the primary mechanism to prevent external corrosion.

E. Electrical Isolation: The condition of being electrically isolated from other metallic structures, such as but not limited to casings, electrical grounding, and rebar. Refer to NACE SP0169 for more detail.

F. Electrical Isolation Flange: A specialty flange kit and gasket used to electrically isolate segments of pipe. Generally used between cathodically protected pipe and non-protected pipe.

G. Pipe-to-Soil Potential: The potential DC voltage difference between a buried metallic structure (pipe) and a calibrated permanent reference electrode when placed in contact with the electrolyte.

H. Lead, lead wire, cable: Insulated copper conductor, wires.

I. Test Station: A post or flush mounted panel utilized for the purpose of indirect testing of underground infrastructure.

J. Exothermic Welding: A thermal fusion welding technique for joining metal components using exothermic chemical reaction in place of electrical current.

## 1.4 SYSTEM DESCRIPTION

A. Materials and equipment shall be new and comply with NACE standards for corrosion control.

B. An existing impressed current cathodic protection system shall be used to protect the buried infrastructure.

## 1.5 SUBMITTALS

A. Submit as specified in Section 01 33 00.00. Include data for all products listed under specification section Part 2.

B. Product Data

1. Test Stations above Grade and Flush Mounted
2. Wires, Cables, Splice Kits, Copper Crips
3. Permanent Reference Electrodes
4. Cathodic Protection Coupons
5. Exothermic Weld Material
6. Coating Repair
7. Shunts

C. Shop Drawings

1. Include shop drawings for items where additional information may be required for installation that is not detailed in contract documents.

D. Quality Assurance

1. Design Data
    a. Calculations
    b. Professional Engineer Design
2. Manufacturer's Instructions
3. Qualification Statements
    a. Include basic resume/information and work experience for cathodic protection designer, tester, contractor and manufacturer.
4. Test Reports
    a. Tests and measurements – Cathodic protection startup and commissioning report
5. As-built or record drawings
    a. Contractor modifications

## 1.6 QUALITY ASSURANCE

A. Qualifications:

1. Design:
    a. The design shall be completed by a corrosion expert certified by National Association of Corrosion Engineers as a Cathodic Protection Specialist NACE CP-4 with at least five (5) years' experience or a Professional Engineer with cathodic protection experience. Design must conform with NACE standards.
2. Testing:

a. The testing shall be conducted by a certified National Association of Corrosion Engineers as a Cathodic Protection Technician, NACE CP-2, under the direct supervision of a Senior Cathodic Protection Technologist with at least five (5) years' experience.

3. Contractor:

a. Installation shall be done by a qualified contractor with at least five (5) years' experience with installing and testing cathodic protection systems.

4. Manufacturer:

a. Regularly engaged on a full-time basis in the manufacture and sales of cathodic protection product in this specification for a minimum of five (5) years.

B. Design Minimum:

1. Design Life: 20 years
2. An effective design should meet or exceed NACE SP0169-2013 100 mV polarization or -850 mV polarized potential criteria.

C. Performance

1. The installed cathodic protection system shall meet the minimum requirements indicated, include components not indicated but necessary for proper function and performance, and shall be a complete and operational system.

**1.7 DRAWINGS:**

A. The drawings indicate the arrangement of cathodic protection equipment. Coordinate installation of cathodic protection equipment with structural system and mechanical equipment and access there too.

B. Do not scale drawings. Obtain dimensions for layout of equipment from Civil, Mechanical or Architectural plans unless indicated on Electrical plans.

C. Bring all discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions to the immediate attention of the Engineer.

**1.8 DELIVERY, STORAGE, AND PRODUCT HANDLING**

A. Ensure materials are in proper good working order upon arrival and are as specified.

B. Do not remove materials from packaging until installation.

C. Cathodic protection materials must be stored in a dry weatherproof container such as a Conex, warehouse or shed. Most cathodic protection materials are sensitive to precipitation (rain, snow, etc). Some materials are sensitive to cold temperatures and should be stored in a climate-controlled area.

D. Materials that were damaged or improperly stored must be replaced.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Use established manufacturers who regularly engage in the full-time production and sale of cathodic protection materials for a minimum of five (5) years.

B. Furnish all materials specified herein. All materials shall be new.

### 2.2 TEST STATIONS

A. Post Mounted Test Stations:

1. Cott Big Fink with sufficient terminal lugs or approved equivalent.

    a. Test station lid shall be color coded per details.
    b. Test station posts shall be 5’ long 3” PVC.

B. Flush Mounted Test Stations:

1. Test station shall be rated for vehicle traffic and set in concrete pad. The bottom of the test station shall be open with access to native soil for testing. Do not fill test station with concrete. Test station shall be furnished with non-metallic test board with sufficient terminal lugs for all test station lead wires.
2. CP-Test NM Test station with terminal board and locking lid or approved equivalent.

C. Flush Mounted Test Station for Airport:

1. Cavotec Dabico USA, Inc. DAB-9-CPE-4-24, Open Bottom, 4200391-D9 Door Cathodic Lid or approved equivalent.
2. Opening shall be 9-inch diameter with open bottom, concrete anchors, and ¼-inch wall thickness.
3. Cover loading over footprint shall result in minimum 740 psi rating with a maximum 0.100-inch deflection at the center indication and a deflection rebound within 0.01-inch after load release.

### 2.3 WIRE, CABLES

A. Anode cables:

1. Black # 12 AWG stranded copper wire with RHH/RHW/USE-2 or greater coating.

B. Structure test lead cables:

1. White #10 AWG stranded copper wire with RHH/RHW/USE-2 or greater coating.

C. Permanent Reference Electrodes:

1. Yellow #14 AWG stranded copper RHH-RHW coating.

D. Coupon:

1. Green #12 AWG stranded copper THHN or greater coating.

E. All cables must have sufficient length to reach their final termination point without splices.

## 2.4 PERMANENT REFERENCE ELECTRODES

A. Copper-copper sulfate permanent reference electrodes:

1. Reference electrodes shall be copper-copper sulfate with a minimum operating life of 30 years.
2. Reference electrodes shall be pre-packaged for use in soils to minimize surface contact resistance.
3. Changes in the moisture content shall not change the performance of the electrode.
4. Lead wire shall be yellow #14 AWG RHH-RHW coated wire, per industry standard, with sufficient length to reach its termination point without splices.
5. Ensure permanent reference electrodes remain in areas above freezing before installation.

## 2.5 CATHODIC PROTECTION COUPONS

A. Steel Coupons:

1. Coupons shall be steel or similar metal to the buried structure with $10cm^2$ surface area with similar material to buried structure.
2. Coupons shall be cylindrical and have two redundant test leads.
3. Coupon leads shall have green #12 THHN or greater coating.

## 2.6 EXOTHERMIC WELD MATERIAL

A. All electrical cable connections to the buried structure shall be made using exothermic welding.

B. Erico Cadweld, Thermoweld or approved equivalent shall be used. Follow instructions from manufacturer for mold and weld cartridge sizing.

C. Use copper sleeves for wires smaller than #8 AWG per manufacturers' guidance to prevent burn through.

## 2.7 COATING REPAIR

A. Royston Handy Cap with integrated primer or approved equivalent for all coating repair up to #8 AWG wire. For wires larger than #8 to #2 AWG use Royston Handy Cap XLIP.

### 2.8 SHUNTS

A. Cott 0.01-ohm yellow shunts or approved equivalent.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Install all cathodic protection components according to contract drawings and specifications.

B. Installation shall be done by a contractor with a minimum of five (5) years' experience in installing cathodic protection systems.

C. All modifications must be approved by engineer and noted on as-built drawings.

### 3.2 TEST STATIONS

A. Post mounted test stations:

1. Ensure sufficient wire slack is present inside the test station post for all leads. A minimum of 18-inches of slack should be present with wires coiled or doubled back inside the post.
2. Terminate all wires using either compression lugs or onto solderless test station hardware, if present.
3. Multiple wire leads can be terminated to the same lug, if necessary.
4. Label all structure test lead wires with structure name using a printed heat shrink sleeve like Brady MC21-187-C-342 or approved equal. Wires from coupons, reference electrodes, and anodes will be color coded and do not require labeling.
5. Set test station to a height of three feet above grade to the top of the PVC post.

B. Flush mounted test station:

1. Ensure sufficient wire slack is present inside the test station post for all leads. A minimum of 18-inches of slack should be present with wires coiled in or below the base of the test station.
2. Terminate all wires using either compression lugs or onto solderless test station hardware, as specified.
3. Multiple wire leads can be terminated to the same lug if necessary.
4. Label all test lead wires with structure name using a printed heat shrink sleeve like Brady MC21-187-C-342 or similar. Wire form coupons, reference electrodes, and anodes will be color coded and do not required labeling.

### 3.3 WIRES, CABLES

A. All buried wires, and cables should be installed 18-24 inches below grade unless being routed into a test station.

B. Ensure all wires remain protected during installation and throughout the project.

C. Wires and cables should be continuous to termination point with no splices.

D. Wires and cables above grade should be inside a test station housing, or rigid conduit to protect them.

**3.4 PERMANENT REFERENCE ELECTRODES**

A. Follow manufacturer's instructions for storage and installation of permanent reference electrodes. Reference electrodes must be stored in areas above freezing and generally require soaking in water before installation.

B. Install reference electrodes horizontally 12-inches to 24-inches away from the buried structure below spring line with the conductor attachment pointed away from the structure.

C. Compact native soil around the permanent reference electrode after placement and ensure there are no voids.

**3.5 CATHODIC PROTECTION COUPONS**

A. Install coupons within 12-inches of the buried structure surface near the bottom.

B. Install coupons within 12-inches of the permanent reference electrode.

C. Compact native soil around the coupon after placement and ensure there are no voids.

D. Coupon installation should comply with NACE SP0104.

**3.6 EXOTHERMIC WELD MATERIAL**

A. Follow manufacturer's instruction for exothermic welding.

1. Ensure the surface is properly prepared.
2. Use the correct mold and charge are selected for the surface and wire type.
3. Ensure the charge is loaded properly, ignited and the mold is cleaned between uses.

B. Obtain a hot work permit, if required. Ensure adequate PPE is used and fire precautions are taken based on hot work permit requirement and manufactures' recommendations.

C. Ensure mold is dry and has no moisture present.

D. After welding remove slag and test conductor for adhesion before repairing coating. Repeat procedure if the weld is not secure or if the conductor breaks.

E. Install a coating repair patch after testing for adequate adhesion and the weld has cooled.

## 3.7 COATING REPAIR

A. Install coating repair patch per manufacturer's instruction and contract documents. Ensure the surface is clear of mud, dirt, grease or any contaminants.

B. Ensure the coating repair patch remains adhered during backfilling.

## 3.8 ENGINEERING TESTING

A. Qualifications:

1. All cathodic protection field testing shall be conducted by a NACE certified cathodic protection technician (NACE CP-2) or higher under the supervision of a Senior NACE qualified cathodic protection technologist (NACE CP-3) or professional engineer with five years of cathodic protection experience.

B. Functional Testing:

1. Reference NACE TM-0497-2012 for standard testing procedures.
2. Test and record native pipe-to-soil potentials with a calibrated high impedance (≥10M-ohm) multimeter and calibrated portable copper-copper sulfate reference electrode on all test leads, coupon, reference cell and anode wires.

C. Startup and Final Testing:

1. Terminate all wires and connect the anodes to the structures through a calibrated shunt in the test station. Record startup pipe-to-soil potentials.
2. After a twelve-hour minimum startup period test and record polarized pipe-to-soil potentials of the structures.

D. Electrical Isolation & Stray Current Testing:

1. Test all electrical isolation flanges with a calibrated flange tester, such as a Tinker and Rasor RF-IT or McMiller MIC or equivalent. In addition, conduct a fixed cell survey, if possible, to verify electrical isolation.

    a. Identify and correct any failed electrical isolation flanges.
    b. Testing shall be done in accordance with guidelines in NACE SP0286.

2. Test for stray current at known crossings or near other cathodic protection structures. If depressed potentials caused by stray current are found, identify stray current source and recommend solutions to mitigate.

E. Reporting:

1. Report shall detail cathodic protection system components for each structure. Include all functional, startup and final testing data in a compiled and analyzed formal report. Identify

discrepancies with installation and make recommendations for repair or modification to the cathodic protection system.

**END OF SECTION**