

CATHODIC PROTECTION SPECIFICATION

AUTOMATICALLY CONTROLLED IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM FOR THE INTERIOR OF STEEL WATER TANKS

A. SCOPE

The cathodic protection design/install constructor shall provide all engineering services, materials, equipment, labor, and supervision for the installation of an automatically controlled impressed current cathodic protection system to provide corrosion control for the interior submerged surface of the specified tank. All work furnished shall be in accordance with A.W.W.A. Standard D104-04, ANSI/NSF 61 and features included in this specification. The cathodic protection constructor shall be Corpro Waterworks.

B. DESIGN

All engineering services shall be provided by a Corrosion Specialist who is accredited by the National Association of Corrosion Engineers International as a Senior Corrosion Technologist, Corrosion Specialist or Cathodic Protection Specialist. The system shall be designed by a Corrosion Specialist with experience in cathodic protection for water storage tanks. The Corrosion Specialist shall design the system to provide effective corrosion control in accordance with criteria for protection. The criteria for protection shall be based on a tank-to-water potential, IR drop free, within a range of -0.850 volts to -1.050 volts relative to a copper-copper sulfate reference electrode. This potential shall be measured free of the effect of voltage gradients (IR drop).

The Corrosion Specialist shall also base system capacity and performance on:

1. Total submerged surface area of the tank (*includes area up to high water line within tank bowl and wet risers in elevated tanks which are 30" in diameter or larger*).
2. Type of coating and condition of coating.
3. Total bare surface area to be protected will be a minimum of 25% of total surface area.
4. Minimum current density of 0.5 MA/ft.² bare surface area.
5. Chemical analysis of water including resistivity expressed in ohm-cm.
6. Susceptibility of tank to icing conditions.

7. Minimum anode design life of twenty (20) years.
8. Selection, dimensions, and layout of system components specified in Section C. of this specification.

C. SYSTEM COMPONENTS

C1. RECTIFIER

The rectifier unit shall perform in accordance with ANSI/AWWA Standard D104 and shall include:

1. Transformer.
2. Silicon rectifying elements.
3. Circuit breaker(s).
4. Lightning, surge, and overload protection.
5. Provision for air-cooling operation.
6. Digital voltmeter(s), ammeter(s) and potential meter(s).
7. Weatherproof cabinet in accordance with NEMA 4 requirements.
8. Provision to vary current output from 0% to 100% of rated capacity.
9. Provisions for mounting, grounding, and locking.
10. Provision for 110-120 volt, 60 Hz, single phase A.C. power.
11. D.C. output capacity in volts and amperes in accordance with Design (Section B).
12. Number of circuits in accordance with Design (Section B).
13. Automatic controller shall adjust current output to compensate for changes in water level, temperature of water, water chemistry, and cathodic polarization, and shall include the following provisions:
 - a. Utilize long-life reference electrode(s) installed within the tank.
 - b. Monitor the tank-to-water potential, free of IR drop.
 - c. Automatically adjust the tank-to-water potential, free of IR drop, to a preset value.
 - d. Operate within 25MV of preset value.
 - e. Limit current to a preset value.
 - f. Utilize digital potential meter(s) to display tank-to-water potential, free of IR drop.

C2. LONG LIFE REFERENCE ELECTRODE(S)

The permanent reference electrode shall consist of a copper-copper sulfate electrode which is

manufactured to remain stable (plus or minus 10MV) for minimum of twenty (20) years. The reference electrode to lead wire connection shall be encapsulated to prevent water migration. The reference electrode shall be positioned within the tank to provide the most representative measurements for the submerged surface area(s).

C3. ANODE SUSPENSION SYSTEM

FOR TANKS SUBJECT TO ICING CONDITIONS:

The anode suspension system shall be designed to be resistant to ice damage and in accordance with ANSI/AWWA Standard D104, Section 4.2.4.1.1 Type A, Horizontal System. The anode suspension system shall consist of a minimum 5/16" polyester cord. The cord shall be secured to steel anchors welded to the side wall and/or floor of the tank bowl or to the exterior of the dry access column of spheroidal type tanks. Tanks with wet risers which are 30" diameter or larger shall incorporate an anode suspension system with the steel anchors welded to the sidewall of the riser pipe. All cord to cord connections shall be tied and taped.

FOR TANKS NOT SUBJECT TO ICING CONDITIONS:

The anode suspension system shall be in accordance with ANSI/AWWA Standard D104, Section 4.2.4.2.2 Type C, Vertical System or Section 4.2.4.1.1 Type A, Horizontal System. The anode lead wire for vertical suspension shall be attached to a porcelain insulator bracket bolted to the interior of the tank roof. Handhole assemblies used for the installation of vertical anode suspension systems from the roof of the tank shall consist of a 6" diameter cover, rubber gasket, and a clamping bar with a stainless steel bolt assembly for each 5" diameter access opening.

C4. ANODE MATERIALS

The anode materials shall be selected in accordance with Design (Section B) and shall consist of one of the following:

1. Minimum .062" diameter titanium with a mixed metal oxide coating.
2. Minimum .062" diameter platinized niobium with 25 micro-inches of platinum.

All anode to header cable connections shall be sealed to prevent water migration.

C5. PRESSURE ENTRANCE FITTING

For icing tanks the pressure entrance fitting shall accommodate anode and reference electrode lead wires at the base of the tank or at the base of wet risers for elevated tanks, which are 30" diameter or larger. The fitting shall be manufactured to prevent leakage through the fitting and to prevent

water migration through the wire insulation. The entrance fitting shall be sized for a minimum of 1.0 inch NPT, 3000 p.s.i. steel coupling.

C6. WIRING

All wiring within the tank shall be insulated to prevent copper conductor to water contact.

All wiring on the exterior of the tank shall be insulated and run in rigid conduit.

C7. HARDWARE

All hardware used in conjunction with the system shall be protected against corrosion.

C8. NSF 61/ANSI

Corrpro Waterworks provides all work in compliance with all applicable AWWA Standards and NACE Recommended Practices. Components manufactured by Corrpro Waterworks are certified by Underwriters Laboratories (UL) to meet the NSF/ANSI Standard 61. Contact Corrpro for additional information regarding certification to the NSF/ANSI Standard 61.

D. SUBMITTALS

The cathodic protection constructor shall submit the following information to the purchaser for approval by the Owner or his representative.

- 1.) Drawings showing system design/configuration.
- 2.) Description of system components.
- 3.) Copy of ANSI/NSF 61 classification for all system components located within the tank.
- 4.) Design calculations for required voltage, amperage & life expectancy.

E. WORKMANSHIP AND INSTALLATION

E1. QUALIFICATIONS

The cathodic protection constructor shall have a minimum of five (5) years experience installing and servicing the types of systems described in this specification. The system shall be installed by personnel specifically trained by the constructor to provide all workmanship required for corrosion control performance. All personnel shall be subject to Federal Substance Abuse and Testing Regulations.

E2. PERFORMANCE

All work shall be in accordance with the following requirements:

1. Components of the cathodic protection system shall be installed in the manner and at the locations as shown on the design drawings prepared by the Corrosion Specialist.
2. Pressure entrance fitting shall be installed in accordance with AWWA D100.
3. Welding, cutting, and coating shall be in accordance w/AWWA Standards D100, D102 & D105.
4. Welding of steel coupling and anchors for horizontal anode suspension and rectifier mounting bracket shall be performed by the prime contractor prior to coating the tank. The cutting of 5" diameter access openings for vertical anode suspension shall be performed by the prime contractor prior to coating. The cathodic protection constructor shall furnish drawings and materials to the prime contractor prior to coating.
5. Verification of electrical continuity of all sections of bolted or riveted tanks shall be the responsibility of the purchaser of the cathodic protection system.
6. Materials and equipment shall be inspected prior to installation. Any defective component shall be repaired or replaced.
7. Electrical work shall be in accordance with the National Electrical Code.
8. Lead wires shall be installed to prevent damage from abrasion.
9. Electrical connections within the tank shall be sealed to prevent water migration.
10. The rectifier shall be mounted at a convenient height (eye level) above grade for monitoring and service purposes.
11. A.C. power to the rectifier shall be furnished by the purchaser.
12. Disinfection of the tank shall be the responsibility of the purchaser.
13. Work provided by the constructor shall be completed in a clean and safe manner.

F. ENERGIZING THE SYSTEM

After the system is installed and the tank is filled, the cathodic protection constructor shall provide start-up service which includes energizing, testing, and adjusting the system for optimum performance of the cathodic protection system. This start-up service shall be in performed in accordance with ANSI/AWWA D104 Section 5.2 Testing. This start-up service shall be coordinated with the Owner or his representative.

All tank-to-water potential measurements shall be conducted with a calibrated portable copper-copper sulfate reference electrode and a portable high impedance voltmeter. A minimum of five (5)

locations shall be measured. All test data shall be reviewed and evaluated by the Corrosion Specialist. The final test and adjustment of the system shall be conducted approximately twelve (12) months after the start-up service. In addition to the start-up service, "as-built" drawings and an Owners Maintenance Manual shall be submitted to the purchaser.

G. MONITORING

The cathodic protection constructor shall furnish self-addressed report cards to be completed by the owner. Report cards received by the cathodic protection constructor during the guarantee and service period(s) shall be evaluated for system performance.

H. GUARANTEE

All workmanship, equipment, and materials furnished by the cathodic protection constructor shall be guaranteed for one (1) year.

I. SERVICE AGREEMENT

At the conclusion of the warranty period, the cathodic protection constructor shall furnish a service agreement to the owner for the type of system installed. The agreement shall include the annual service rate and a complete description of the scope of work proposed. The agreement for annual inspection and potential testing shall be in accordance with AWWA D104, Appendix C and include as a minimum:

1. One (1) annual job site visit.
2. Tank-to-water potential measurements conducted at representative locations within the tank. A minimum of five (5) locations shall be measured.
3. Measurements shall be conducted with a portable high impedance voltmeter and a calibrated copper-copper sulfate reference electrode.
4. Adjustments for optimum corrosion control shall be in accordance with criteria for protection.
5. Data recorded shall provide sufficient information to evaluate the performance for the system relating to criteria for protection.
6. In the event additional work is required, the constructor shall submit a report with recommendations for optimizing corrosion control.