SPECIAL NOTE FOR

T2 – LV CATHODIC PROTECTION

Galvashield® Fusion® T2 - Anode Type 2A, Class C – powered galvanic anodes embedded within drilled holes to extend the life of existing reinforced concrete structures.

SECTION 03700 – EMBEDDED ANODES

PART 1 GENERAL

1.1 Related Documents

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 Summary

A. This Section includes furnishing all labor, tools, materials, equipment and services necessary to properly install embedded anodes.

B. Powered galvanic anodes are designed to mitigate corrosion in chloride-contaminated or carbonated concrete. When placed in drilled holes at the appropriate spacing, the anodes will extend the service life of the concrete structure.

C. The two-stage anode system shall be installed by a cathodic protection specialist with three years of experience in two-stage anode installation on similar projects. Training and technical oversight will be provided by a certified corrosion technician supplied by the anode manufacturer.

1.3 References

A. ACI/ICRI Concrete Repair Manual

B. ACI Guideline No. 222 – Corrosion of Metals in Concrete

C. ACI Repair Application Procedure (RAP) Bulletin 8 – Installation of Embedded Galvanic Anodes (2010)

D. ICRI Guideline 310.1R Guide for Surface Preparation for the Repair of Deteriorated Concrete resulting from Reinforcing Steel Corrosion

E. ASTM B418 – Standard Specification for Cast and Wrought Galvanic Zinc Anodes

F. ASTM C 309 Curing Compounds for Concrete

G. ISO 12696 - Cathodic protection of steel in concrete

H. NACE SP0290 - Impressed Current Cathodic Protection of Reinforcing Steel in Atmospherically Exposed Concrete Structures.

PART 2 PRODUCTS

2.1 Embedded Two-Stage Anodes

1. Embedded anodes shall be GalvashieldFusion T2 Slim, a Type 2A Class C anode with the following nominal dimensions: 1-1/8” x 5-3/8” available from Vector Corrosion Technologies (www.vector-corrosion.com).
2. The anode unit shall be a single, pre-manufactured unit, capable of providing 2-stage protection without the need for external power or manual switching. Stage 1 shall be characterized by a period of self-powered Impressed Current Cathodic Protection (ICCP). Stage 2 shall be delivered by an alkali-activated galvanic anode capable of providing Cathodic Prevention for the design life of the system.
3. Each anode shall operate independently in Stage 1 and be able to deliver a similar charge, irrespective of the variability in concrete resistance.
4. The Stage 1 impressed current treatment shall last for a minimum period of 60 days.
5. The zinc core of the galvanic anode shall be in compliance with ASTM B418 Type II and be encased in an activating cementitious mortar with a pH of 14 or greater. The activating mortar shall contain no intentionally added chloride, bromide, sulphate or other constituents that are corrosive to reinforcing steel as per ACI document 222R.
6. All anodes shall be installed such that the resistance between the first and last anode of a zone is 1 Ohm or less.
7. A maximum anode to steel connection ratio of 20:2 shall be used to maximize redundancy such that the failure of any one connection shall not impair the performance of the system.

Approved equals shall be requested in writing two weeks before submission of project bids. The application shall include verification of the following:

1. A single, pre-manufactured anode capable of delivering 2-stage protection.
2. Stage 2 shall be a solid zinc core (ASTM B418) surrounded by a highly alkaline cementitious shell with a pH of 14 or greater with a proven activation track record showing a minimum of 20 years of field performance.
3. Contain no intentionally added constituent’s corrosive to reinforcing steel or detrimental to concrete, e.g. chloride, bromide, sulphates, etc.
4. Autonomous switching between Stages 1 and 2 with single wire installation
5. Provide warranty indicating galvanic stage will provide protective current for a minimum of 10 years from the date of anode installation independent of the level of chloride in the concrete.
6. Recommended anode spacing utilizing anode aging factor (half life) calculated from field data to achieve 0.11mA/ft2 current density at 20 years.
7. Assured charge density per square foot or square meter of concrete.

2.2 Grout

A. Anode grouting material shall be Galvashield Embedding Mortar from Vector Corrosion Technologies or equal approved by the anode supplier and the Cabinet.

2.3 Anode Connections

A. For individual anode connections, use Vector Rebar Connection Kit and Vector Setting Tool from Vector Corrosion Technologies or approved equal.

B. To connect anodes in series, use Vector Anode Connection Kit or Rivet Connection Kit from Vector Corrosion Technologies or approved equal.

2.4 Storage

Deliver, store, and handle all materials in accordance with manufacturer’s instructions. Anode units shall be stored in dry conditions in the original unopened containers in a manner to avoid exposure to extremes of temperature and humidity.

PART 3 EXECUTION

3.1 Anode Layout

1. Using a suitable rebar locator, the location of the reinforcing grid should be determined and marked out in areas where anodes are to be installed.
2. Mark out locations for anode installation. The anodes shall be installed in a grid pattern on center, in each direction at a spacing as specified on the plan notes. When possible, anodes shall be installed in the center of the reinforcing grid.
3. Mark out location of rebar connections. If the anodes are to be individually connected, one rebar connection per anode is required. If the anodes are to be installed to a common header wire, two rebar connections per string of anodes are required with a maximum of 20 anodes per string.

3.2 Drill Holes and Saw Cuts

1. Rebar Connection – Electrical connections shall be established using a Vector Rebar Connection Kit or Rivet Connection Kit.

B. Anode Location - Drill a hole of sufficient size to accommodate the anodes (approximately 1-3/8” x 6-1/2” in close proximity to marked out anode location. Do not damage rebar when drilling holes.

C. Saw cuts – All saw cuts into the concrete surface between the anode installation holes and the rebar connection holes shall be approximately ¼ inch (6 mm) wide by ½ inch (12.5 mm) deep. Saw cut a single continuous groove between the anode installation holes and the rebar connection holes.

1. All holes and saw cuts shall be cleaned of debris and concrete dust.

3.3 Rebar Connections

A. Option 2 - Rivet Connection Kit

* 1. 2 in (50 mm) diameter holes shall be cored to the reinforcing steel taking care to avoid cutting steel.
	2. Electrical connection to the steel can shall be established by drilling a 5-7mm deep hole using the 3.5mm drill bit provided.
	3. 3.2mm stainless steel pop rivets are used to connect the connecting wire to the steel.
	4. The connection shall be insulated by a neutral cure sealant or epoxy.
1. Proper connection and rebar continuity for each rebar connection shall be verified between two installed rebar connectors using a multi-meter. Maximum resistance between the two locations shall be less than 1 ohm.

3.4 Anode Installation

1. Prewet the holes and anodes to a saturated-surface dry condition prior to anode placement. Do not let the anodes soak for longer than 20 minutes in a shallow water bath.
2. Mix one 44 lb. (20 kg) bag of embedding mortar with 3.2 to 3.7 liters of potable water using a slow speed drill and paddle 3 minutes until a smooth consistency is achieved.
3. After removing any excess water from the presoaked holes, fill each anode installation hole approximately 2/3 full with mixed embedding mortar.
4. Insert an anode into each hole, forcing the embedding mortar to fill the annular space from the bottom up.
5. Clean out excess mortar from the top of the anode leaving the wire fully exposed
6. Complete wiring between the anodes and the rebar connections.

1. Insert the interconnecting coated wire though the open side of the button-type wire connectors supplied in the Vector Anode Connection Kit and the coated anode wire into the terminated side. With the anode alongside of the installation hole, crimp the button connector to cut through the wire coating until the connector is flush with its casing.

2. After all anodes along the string are connected to the interconnecting cable, verify continuity between anodes and rebar connections with a multi-meter. Testing is carried out using a portable copper/copper sulfate reference electrode once the anodes have been connected to the steel. Connect the DC Volt port of the multi-meter to the steel. Connect the portable reference cell to the COM port. With the reference cell on top of each anode within the string record the individual readings at each anode. A reading more negative than -1.0V indicates a positive connection.

1. Top off the hole with embedding mortar or other approved mortar and strike off excess flush with the concrete surface. Minimum cover over the top of the anode shall be 1 in. (25 mm).
2. Bury all wiring into the saw cuts and drilled holes with embedding mortar or other material approved by the owner and strike off flush with the concrete surface.
3. Wet cure cement-based mortar or cure with two coats of a membrane-forming concrete curing compound meeting the requirements of ASTM C309.

3.5 Manufacturer Corrosion Technician

A. The contractor will enlist and pay for a technical representative employed by the galvanic anode manufacturer to provide training and on-site technical assistance during the initial installation of the galvanic anodes. The technical representative shall be a NACE-qualified corrosion technician (Cathodic Protection Technician–CP2 or higher).

B. The qualified corrosion technician shall have verifiable experience in the installation and testing of embedded galvanic protection systems for reinforced concrete structures.

C. The contractor shall coordinate its work with the designated corrosion technician to allow for site support during project startup and initial anode installation. The corrosion technician shall provide contractor training and support for development of application procedures, verification of electrical continuity, and project documentation.

END OF SECTION