*Note to Specifier: This document is intended to provide assistance in developing a specification for the use of the Galvashield® SM-DAS distributed anode system and should be modified as appropriate to accommodate project specific conditions and applications. Anode selection including weight and length are determined on a project-by-project basis. For additional information, contact Vector Corrosion Technologies.*

SURFACE MOUNTED DISTRIBUTED ANODE SYSTEM FOR GALVANIC

PROTECTION OF CONCRETE STRUCTURES

SECTION 03770 – DISTRIBUTED GALVANIC CORROSION PROTECTION

PART 1 GENERAL

* 1. DESCRIPTION

A. The work under this section consists of supplying, installing, and energizing a zinc-based galvanic corrosion protection system, including required electrical connections, materials, testing, and ensuring continuity of the reinforcing steel to all elements as outlined in the construction drawings.

B. Surface mounted galvanic anodes are designed to provide galvanic corrosion protection. The anodes are connected to reinforcing steel and secured to the surface of the concrete with mechanical anchors and an ionically conductive medium between them to mitigate corrosion.

* 1. REFERENCES

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

B. ICRI Guideline 310.1R-2008 Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion

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

1.3 BID QUANTITY

Base bids on the quantity, dimensions, length, weight and information in this specification and shown on the drawings.

1.4 SUBMITTALS

Shop drawings showing typical galvanic corrosion protection system installation details, such as distributed anode installation locations steel connections, and inter-anode connections shall be prepared by the Contractor and submitted for approval prior to any field installations.

PART 2 PRODUCTS

2.1 SURFACE MOUNTED DISTRIBUTED ANODE SYSTEM

*Note to Specifier:*

*Typical Galvashield® SM-DAS Sizes and Weights As of June 19, 2023*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Lengths:*  *Typical 39 in. (100 cm) but can be customized to project requirements.*   |  |  |  | | --- | --- | --- | | **Corrosion Risk Category** | **Chloride Level\*** | **Minimum Current Density at end of life\*\*** | | Low to Moderate | <0.8% | 0.6mA/m2 (0.06mA/ft2) | | High | 0.8%-1.5% | 1.2mA/m2 (0.11mA/ft2) | | Extremely High | 1.5% | 2.4mA/m2 (0.22mA/ft2) |   *\*Chloride content is based on percent by weight of cement.*  *\*\*designer to specify end of life minimum current.* | *Nominal Dimensions\*:*  ***SM-DAS****:*  *0.6 lb./ft. (0.89 kg/m)  1” x 6” (25.4mm x 150mm)*  ***SM-DAS-X****:*  *1.65 lb./ft. (2.45 kg/m)  1.18” x 6.3” (30mm x 160mm)*  *\*typically, +/- 1/8” (3mm)*  *Design based on aging term of 12.5 years and an efficiency/utilization of 75%.* |
| *Note: In environments with average annual temperatures higher than 15°C (60°F), use Galvashield® SM-DAS-X. Find your annual average temperature at https://en.climate-data.org/.* | |

The surface mounted distributed galvanic anode units shall be alkali-activated with a pH greater than 14 and shall not contain intentionally added constituents that are corrosive to reinforcing steel as per ACI 222R such as chlorides, bromides, or other halides. The anode core shall be manufactured with zinc in compliance with ASTM B418 Type II (Z13000) with iron content less than 15 ppm and that is evenly distributed around a steel core that is continuous along the length of the unit. Unless otherwise specified, the anode unit shall be supplied with an insulated steel tie wire.

Individual anode units shall be approximately *[enter nominal dimensions from the table above]*. The length of individual anode units shall be *[enter length of each anode] [as shown on the drawings]*. Anode units shall be supplied with insulated steel tie wire for *[direct connection to the steel or connection to an inter-anode connecting header wire as per the design].* Surface mounted distributed galvanic anodes shall be *[GalvashieldSM-DAS] [GalvashieldSM-DAS-X]* available from Vector Corrosion Technologies (www.vector-corrosion.com) USA (813) 830-7566, Canada (204) 489-9611, UK (44) 1384 671 400 or approved equal.

The spacing of the distributed galvanic anode units will be *[enter spacing here]* as per the design. The basis of design is as follows:

Anode: [*Galvashield SM-DAS] [Galvashield SM-DAS-X]*

Service Life: *[specified service life]*

Efficiency\*Utilization Factor: 75%

Minimum current density delivered over the anode service life

*[select one from table above:*

* *Low to Moderate Risk – 0.6 mA/m2 of steel surface area*
* *High Corrosion Risk – 1.2 mA/m2*
* *Extremely High Risk – 2.4 mA/m2]*

Anode aging factor: 12.5 years (approximate half-life, the time when anode current drops by 50%)]

Application for approved equals shall be requested in writing two weeks before submission of project bids. Application for galvanic anode approved equals shall include verification of the following information:

1. Type of activation mechanism must be stated and demonstrated.
2. The distributed anode contains no intentionally added constituents corrosive to reinforcing steel or detrimental to concrete, e.g. chloride, bromide, sulfate, etc.
3. Initial startup current per anode per area at specified average annual temperature of structure.
4. Aging term - This is the number of years over which the electric current produced by the installed anode drops to half of the initial measured current.
5. Submittal of monitored performance data for two examples of satisfactory field performance where said aging term has been achieved.
6. Efficiency and utilization determined from site performance data of no less than seven years.
7. Anode spacing to achieve specified current density at specified service life
8. Initial mass of zinc and projected consumption over the life of the anode.
9. Anode units contains zinc cast around (non-galvanized) steel tie wire.
10. Third party product evaluation, such as from Concrete Innovations Appraisal Service, BBA, etc.
11. Using the information above, model how the alternative design will meet the minimum current density at the end of life of [enter service life here].

2.2 CONCRETE

Concrete surface and repair material shall have an electrical resistivity of less than 50,000 ohm-cm. Concrete mixtures that contain elevated levels of pozzolanic materials such as silica fume, ground-granulated blast-furnace slag, or fly ash will reduce the electrical conductivity of the concrete and may not be suitable for use.

PART 3 – EXECUTION

3.0 GENERAL DESCRIPTION

The galvanic corrosion protection system shall consist of alkali-activated distributed galvanic anodes placed *[evenly across the concrete surface] [in a single line]*. The anode units are connected to the reinforcing steel to be protected and secured to the surface with an ionically conductive mortar filling all voids between the anode and concrete surface. After the anode units are installed, the system provides galvanic protection to the embedded reinforcing steel.

3.1 MANUFACTURER TECHNICAL ASSISTANCE

A. The contractor will enlist and pay for the services of a NACE-qualified cathodic protection technician (CP2 or greater) supplied by the galvanic anode manufacturer. The qualified corrosion technician shall have verifiable experience in the installation and testing of embedded galvanic protection systems for reinforced concrete structures.

B. The technician shall provide contractor training and support for the development of application procedures, shop drawings for submittals, anode and concrete installation, reinforcing steel connection procedures, and verification of electrical continuity of embedded steel. The contractor shall coordinate its work with the designated technician to allow for site support during project startup and initial anode installation.

3.5 ELECTRICAL CONTINUITY OF STEEL AND ANODES

Reinforcing steel shall be tested for electrical continuity by procedures as directed by the cathodic protection technician. The electrical connection is acceptable if the DC resistance measured with the multi-meter is 1 W or less or the DC potential is 1 mV or less. Reinforcing steel found to be discontinuous shall be bonded to continuous reinforcement by steel tie wire.

Any new steel added to the structure, such as supplemental reinforcing, wire mesh or rebar shall be electrically continuous. The new steel shall be connected to the anode grid or bonded to existing reinforcing steel. After the distributed galvanic anodes are installed, the continuity of the connection between anode tie wire and reinforcing steel is verified using the same procedures prior to concrete placement.

3.6 CONCRETE SURFACE PREPARATION

Before starting the installation, ensure that the concrete surface is clean and even. Complete any necessary concrete repairs, and remove any dirt, loose barriers, or coatings. The surface should be flat with variations in profile of no more than 3mm (1/8”) and a ICRI Concrete Surface Profile = CSP 2 (griding). Blow the surface clean of any dust and blast media with dry compressed air, and vacuum clean if required. If the concrete surface contains large voids or depressions, fill them with Galvashield® Embedding Mortar to ensure no air gaps are left behind the anode.

3.7 SURFACE MOUNTED ANODE PLACEMENT

Surface mounted anodes shall be placed in locations as per the design and indicated on the drawings. Install anodes as per the manufacturer’s instructions. Use Galvashield® Embedding Mortar to fill the area between the anode and the surface of the concrete. Mix the mortar as directed by manufacturer. Wet the anode assembly before applying mortar. Spread the mortar completely along the entire length of the anode, leaving a ridged profile of the mortar to ensure proper bonding of the anode to the concrete. Ensure no air gaps are left between anode and concrete surface.

3.8 REINFORCING STEEL CONNECTIONS

Surface Mounted anode system must be connected to the reinforcing steel to provide protection. The anodes are connected to cleaned exposed steel or can be interconnected to header wires to create a distributed anode grid. When installed individually, each anode shall be connected to the reinforcing steel with a minimum of two connections. When installed in series, the anode string shall be connected to reinforcing steel with a minimum of two connections for every five anodes.

Anode wires are connected to the steel connections at both ends of the anode using the wiring connection lever nuts provided. If the anode connection wire requires insulation stripping, remove insulation to the length specified by the connector. Lift levers fully and place wires into the connector, one wire per connection hole. Fold down the lever and firmly click into the locked position—test the connection by lightly tugging each wire. Encapsulate the entire connection inside of the gel-filled insulation box provided, closing firmly.”

\*\*\*END OF SPECIFICATION\*\*\*