

Sika Galvashield® XP Embedded Galvanic Anodes For Corrosion Prevention in Concrete Rehabilitation

Note to Specifier: This document is intended to provide assistance in developing a specification for the use of embedded zinc anodes and should be modified as appropriate to accommodate project specific conditions and applications. For additional information, contact Sika Corporation.

SECTION 03700 – EMBEDDED GALVANIC ANODES

PART 1 GENERAL

1.01 Related Documents

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

1.02 Summary

- A. This Section includes furnishing all labor, tools, materials, equipment and services necessary to properly install embedded galvanic anodes.
- B. Embedded galvanic anodes are designed to provide localized corrosion protection. When placed at the appropriate spacing along the perimeter of concrete patches or along the interface between new/existing concrete, the anodes mitigate the formation of new corrosion sites in the existing concrete in adjacent areas.

1.03 References

- A. ACI/ICRI 2008 Concrete Repair Manual
- B. ACI Guideline No. 222 – Corrosion of Metals in Concrete
- C. ICRI Guideline 310.1R-2008 Guide for Surface Preparation for the Repair of Deteriorated Concrete resulting from Reinforcing Steel Corrosion
- D. ASTM A615/A615M-09 Standard Specification for Deformed and Plain Billet-Steel Bar for Concrete Reinforcement
- E. ASTM B6-09 - Standard Specification for Zinc
- F. ASTM A82-07 Specification for Plain Steel Wire for Concrete Reinforcement

PART 2 PRODUCTS

2.01 Materials

- A. Embedded galvanic anodes shall have the following nominal dimensions: 2.5 in. diameter by 1.1 in. high (64 mm x 27 mm), pre-manufactured, and consist of a minimum of 2.1 oz (60 grams) of zinc in compliance with ASTM B6 Special High Grade cast around a pair of steel tie wires in compliance with bright annealed ASTM A82 and encased in a highly alkaline cementitious shell with a pH of 14 or greater. The cementitious shell shall contain no added sulfate nor shall it contain chloride, bromide or other constituents that are corrosive to reinforcing steel. Anode units shall be supplied with integral unspliced wires with loop ties for directly tying to the reinforcing steel. Embedded galvanic anodes shall be Sika Galvashield® XP available from Sika Corporation (www.sikaconstruction.com or (800) 933-7452), or approved equal.

Application for equals to include:

1. A highly alkaline cementitious shell with a pH of 14 or greater
 2. Provide a minimum of 10 years service life (in similar environment)
 3. Contain no added constituents corrosive to reinforcing steel or detrimental to concrete, e.g. chloride, bromide, sulfates, etc.
 4. Proven track record showing a minimum of 10 years satisfactory field performance
 5. A minimum of three projects of similar size and application
 6. Anode units shall be supplied with solid zinc (ASTM B6 Special High Grade) core cast around integral bright annealed steel (ASTM A82) tie wires for tying to the reinforcing steel
 7. Anode units shall be supplied with integral unspliced tie wires such that the zinc anode is connected to the reinforcement with a continuous, unspliced wire
 8. Third party product evaluation, such as from Concrete Innovations Appraisal Service, BBA, etc.
- B. Repair mortars, concrete and bonding agents shall be Portland cement-based materials with suitable electrical conductivity less than 15,000 ohm-cm. Non-conductive repair materials such as epoxy, urethane, or magnesium phosphate shall not be permitted. Anodes used with higher resistance repair materials shall be embedded in Sika Galvashield Embedding Mortar, SikaRepair 222, 223 or SikaQuick 1000 (all mixed with water) to create a conductive bridge to the substrate prior to repair material installation.
- C. Deformed bars for reinforcement shall be hot-rolled steel in accordance with ASTM A615/A615M, Grade 60 (Grade 400).
- D. Deliver, store, and handle all materials in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.01 Concrete Removal

- A. Remove loose or delaminated concrete.

- B. Undercut all exposed reinforcing by removing concrete from the full circumference of the steel as per ICRI R310.1R. The minimum clearance between the concrete substrate and reinforcing steel shall be ¾ inch (19 mm) or ¼ inch (6 mm) larger than the largest size aggregate in the repair material, whichever is greater.
- C. Concrete removal shall continue along the reinforcing steel until there are no visible signs of corrosion as per ICRI R310.1R.

Note to Specifier: If concrete removal will not be extended until clean steel is encountered as per ICRI Guideline 310.1R-2008 Guide for Surface Preparation for the Repair of Deteriorated Concrete resulting from Reinforcing Steel Corrosion, use Sika Galvashield XP+ anodes at the corrosion control spacing for the appropriate chloride level.

3.02 Cleaning and Repair of Reinforcing Steel

- A. Clean exposed reinforcing steel of rust, mortar, etc. to provide sufficient electrical connection and mechanical bond.
- B. If significant reduction in the cross section of the reinforcing steel has occurred, replace or install supplemental reinforcement as directed by the engineer.
- C. Secure loose reinforcing steel by tying tightly to other bars with steel tie wire.

3.03 Edge and Surface Conditioning of Concrete

- A. Concrete patches shall be square or rectangular in shape with squared corners.
- B. Saw cut the patch boundary ½ inch (13 mm) deep or less if required to avoid cutting reinforcing steel.
- C. Create a clean, sound substrate by removing bond-inhibiting materials from the concrete substrate by high pressure water blasting or abrasive blasting.

3.04 Galvanic Anode Installation

- A. Install anodes and repair material immediately following preparation and cleaning of the steel reinforcement.
- B. Galvanic anodes shall be installed along the perimeter of the repair or interface at a spacing of [x in. (x mm)] as specified on the drawings. Anode spacing will vary with changes in the reinforcing steel density, the level of chloride in the structure and the corrosivity of the local environment, etc.

Note to Specifier: Typical spacing for Sika Galvashield XP ranges from 17 -24 in. (430-610 mm). The maximum anode spacing guidelines can be found on the Sika Galvashield XP data sheet. Anode spacing should be adjusted for aggressive service conditions or for an extended anode service life.

- C. Provide sufficient clearance between anodes and substrate to allow repair material to encase anode.
- D. Secure the galvanic anodes as close as possible to the patch edge using the anode tie wires. The tie wires shall be wrapped around the cleaned reinforcing steel and twisted tight to allow little or no free movement.

1. If less than 1 inch (25 mm) of concrete cover is expected, place anode beside or beneath the bar and secure to clean reinforcing steel.
 2. If sufficient concrete cover exists, the anode may be placed along a single bar or at the intersection between two bars and secured to each clean bar.
- E. If repair materials with resistivity greater than 15,000 ohm-cm are to be used or the resistivity is unknown, create a conductive bridge between the anode and the substrate. Pack Sika Galvashield Embedding Mortar, SikaRepair 222, 223 or SikaQuick 1000 (all mixed with water) to cover minimum area of 4 in (100mm) in diameter between the anode and the substrate concrete ensuring no voids exist.
- F. Electrical Continuity
1. Confirm electrical connection between anode tie wire and reinforcing steel by measuring DC resistance (ohm, Ω) or potential (mV) with a multi-meter.
 2. Electrical connection is acceptable if the DC resistance measured with multi-meter is less than 1 Ω or the DC potential is less than 1 mV.
 3. Confirm electrical continuity of the exposed reinforcing steel within the repair area. If necessary, electrical continuity shall be established with steel tie wire.
 4. Electrical continuity between test areas is acceptable if the DC resistance measured with multi-meter is less than 1 Ω or the potential is less than 1 mV.

3.05 Concrete or Mortar Replacement

- A. Pre-wet the concrete surface and the anodes to achieve a saturated surface dry condition, and then complete the repair. Do not soak the anodes for greater than 20 minutes.
- B. Repair materials with significant polymer modification and/or silica fume content may have high resistivity (refer to section 3.04E). Similarly, if bonding agents and/or reinforcing steel coatings are used, they shall have suitable conductivity or be applied in a suitable manner (refer to Sika Galvashield XP Installation Detail at <http://www.sikaconstruction.com/con/con-prod-name.htm#con-prod-SikaGalvashieldXP>). Insulating materials such as epoxy bonding agents shall not be used unless otherwise called for in the design and applied in a suitable manner.
- C. Following normal concrete repair procedures complete the repair with the repair material, taking care not to create any air voids around the anode.

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END OF SECTION