Iowa Department of Transportation

SPECIAL PROVISIONS
for
GALVANIC CORROSION PROTECTION SYSTEM FOR PROTECTION OF CONCRETE BARRIER RAIL REINFORCEMENT

Black Hawk County
BRFN-020-6(59)--39-07
BRFN-027-7(2)--39-07

Effective Date
March 15, 2011

THE STANDARD SPECIFICATIONS, SERIES 2009, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

090121.01 DESCRIPTION.
The work under this specification 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 contract documents.

The galvanic corrosion protection shall consist of galvanic zinc anodes installed full length of the barrier rail sections tied to the inside face of the new reinforcing bars and No. 3 black continuity bars installed full length of the barrier rail sections attached to the back-face leg of the existing stirrups as shown in the contract documents. The anode units are connected intermittently to the front-face legs of the existing stirrups and encased in concrete with a minimum of 2 inches of clear concrete cover over the anode units. The No. 3 black continuity bars are connected to the back-face legs of all existing stirrups and encased in concrete with a minimum of 2 inches of clear concrete cover over the No. 3 black continuity bars. After the anodes and No. 3 black continuity bars are installed and encased in concrete, the anodes will provide galvanic protection to the existing stirrups.

090121.02 MATERIALS.

A. ZINC ANODES.

1. Distributed galvanic units shall be alkali-activated zinc with nominal exterior dimensions of 7/8 inch diameter by 7.5 feet nominal length. The distributed anode unit shall consist of 0.2 pounds of zinc per lineal foot of anode. The zinc anode shall be manufactured in compliance with ASTM B 418 Type II (Z13000) and ASTM B 69 Rolled Special High Grade Zinc (Z13004) using zinc in compliance with ASTM B 6 Special High Grade (Z13001) with iron content less than 15 ppm.

2. The zinc shall be alkali-activated with a pH greater than 14. The anode unit shall contain no constituents, such as chlorides, bromides, or other halides, that are corrosive to reinforcing steel as per ACI 222R. The anode unit shall be supplied with galvanized strapping of sufficient length to make connections between anodes and the reinforcing steel.

3. The galvanic protection shall be Galvanode DAS distributed anode system or approved equal. This anode product is manufactured by Vector Corrosion Technologies, 2237 Twelve Oaks Way #103, Wesley Chapel, FL 33544, telephone 813.830.7566, website: www.vector-corrosion.com.

4. Submit application for approved equals in writing at least two weeks prior to the deadline for submission of bids. Application shall include verification of the following information:
   a. The zinc anode is alkali-activated with a pH of 14 or greater.
   b. The anode unit does not contain any corrosive constituents detrimental to reinforcing steel, e.g. chloride, bromide, etc.
   c. Proven track record of the anode technology showing satisfactory field performance with a minimum of three projects of similar size and application.
   d. Independent third party evaluation of the anode technology, e.g. Hitec, Concrete Innovations Appraisal Service, BRE, etc.

B. CONCRETE.

If ground-granulated blast-furnace slag or fly ash will be used in the proposed barrier rail concrete mix, then the concrete shall be tested by the supplier of the galvanic corrosion protection system to measure the electrical resistivity. In this case, use a previously tested and approved mix, or make a trial batch of the proposed barrier rail mix and provide three 4 inch diameter by 8 inch long test cylinders to the supplier of the galvanic corrosion protection system for testing of electrical resistance. Cast and cure cylinders in accordance with Materials I.M. 315. Cure test cylinders for 28 calendar days prior to testing. Send test cylinders to the location approved by the supplier of the galvanic corrosion protection system. Include the cost of testing in the bid. If testing indicates that the electrical resistance exceeds 15,000 ohm-cm, or does not provide satisfactory electrical resistance to allow the galvanic corrosion protection system to function as intended, modify the barrier rail mix and retest to obtain a mix that meets the requirements determined by the supplier of the galvanic corrosion protection system. Do not place concrete in any barrier rail until testing has been completed and either the proposed mix has been determined to be satisfactory or a new mix has been designed, tested, and approved.

090121.03 CONSTRUCTION.

A. MANUFACTURER TECHNICAL ASSISTANCE.

1. Enlist and pay for the services of a National Association of Corrosion Engineers (NACE) qualified corrosion technician supplied by the galvanic anode manufacturer to provide one full day training and on-site technical assistance at the outset of the installation of the galvanic protection system. The qualified corrosion technician shall have verifiable experience in the installation and testing of embedded galvanic protection systems for reinforced concrete structures.

2. Coordinate work with the designated corrosion technician to allow for site support during project startup and initial anode installation. The technician shall provide training and support for development of application procedures, anode and concrete installation, reinforcing steel connection procedures, and verification of electrical continuity of embedded steel.

3. If ground-granulated blast-furnace slag or fly ash will be used in the proposed concrete mix enlist and pay for the services of the manufacturer to test the concrete mix to measure the electrical resistivity and evaluate if the electrical resistivity is satisfactory to allow the galvanic corrosion protection system to function as intended. If the results of proposed mix testing with

respect to electrical resistivity are deemed not satisfactory according to the manufacturer, enlist and pay for the services of the manufacturer to test a modified mix. Enlist and pay for the services of the manufacturer to test concrete mixes until a satisfactory mix has been found.

B. CLEANING AND ESTABLISHING CONTINUITY OF REINFORCING STEEL.

1. Test all existing stirrups within the repair areas with an appropriate multi-meter to ensure continuity between the back-face and front face legs. If continuity does not exist, establish continuity by removing the epoxy coating from a small area of both the back-face and front-face legs and mechanically connecting a piece of No. 3 black bar. Review proposed electrical connections for approval by the anode manufacturer. Remove epoxy by use of a hand-held grinder. Once continuity has been established and verified, coat continuity connections with a 100% solids, non-conductive epoxy such that no wire material is in contact with the concrete when concrete placement is complete. Verify continuity between the connections prior to coating with epoxy.

2. Maximum DC resistance shall be 1 ohm or maximum DC voltage shall be 1 mV. Steel found to be discontinuous shall have continuity re-established.

3. Establish continuity between all individual existing stirrups by removing the epoxy coating from a small area of the back-face leg and attaching a No. 3 black continuity bar by brazing or welding at the location shown on the plans. Welder shall be Iowa DOT certified. Remove epoxy by use of a hand-held grinder. Once continuity has been established and verified, coat continuity connections with a 100% solids, non-conductive epoxy such that no weld or brazing material will be in contact with the concrete when concrete placement is complete. Verify continuity between the connections prior to coating with epoxy.

4. Lengths of the individual No. 3 continuity bars shall be at the discretion of the Contractor. All individual continuity bars shall overlap each adjacent continuity bar by at least 12 inches and each lap shall be brazed or welded to provide satisfactory electrical continuity along the total length of continuity bar in each barrier rail section. Once continuity has been established and verified, coat continuity connections with a 100% solids, non-conductive epoxy so that no welding or brazing material is in contact with the concrete when concrete placement is complete. Verify continuity between the connections prior to coating with epoxy.

C. GALVANIC ANODE CONNECTIONS.

Connect each anode unit in series to each other for the full length of the barrier rail sections. Make a minimum of one electrical (negative) connection per every three lengths of galvanic anode to the front-face leg of an existing stirrup. Establish continuity between anodes and existing stirrups by removing the epoxy coating from a small area of the front-face leg and attaching the anode to that location using mechanical techniques. No welding or brazing will be allowed for this connection. Remove epoxy by use of a hand-held grinder. Review proposed electrical connections for approval by the anode manufacturer. Once continuity has been established and verified, coat continuity connections with a 100% solids, non-conductive epoxy such that no wire material will be in contact with the concrete when concrete placement is complete. Verify continuity between the connections and the anodes prior to coating with epoxy.

D. GALVANIC ANODES.

Install distributed galvanic anode units with a maximum spacing of 6 inches between anodes. Secure anodes to new reinforcing steel at locations shown on the plans providing minimum clearance between the existing concrete surface and the anode unit of 1 inch. Firmly tie anodes to the inside face of new reinforcing stirrups with a minimum of one tie to every stirrup. Plastic or epoxy coated tie wires or zip ties may be utilized to tie the anodes firmly to the reinforcing steel.

090121.04 METHOD OF MEASUREMENT.

The Engineer will measure the number of lineal feet of concrete barrier rail satisfactorily protected by Galvanic Corrosion Protection System.

090121.05 BASIS OF PAYMENT.
The Contractor will be paid the contract unit price for the number of lineal feet of Galvanic Corrosion Protection System measured. The unit price bid for Galvanic Corrosion Protection System shall be full compensation for furnishing all material, including the anodes and No. 3 black continuity bar, and all the equipment and labor to install and energize the galvanic corrosion protection system in accordance with the contract documents. This payment includes continuity testing, establishing continuity, making electrical connections (including furnishing and installing all wire ties and welding or brazing), epoxy coating continuity connections, obtaining corrosion technician services, and concrete mix testing (including making trial batches, shipping samples, and payment for testing).