TECHNICAL SPECIAL PROVISION

FOR

ARC-SPRAYED ZINC SACRIFICIAL CATHODIC PROTECTION

Financial Project ID 429140-1-52-01, 429140-2-52-01 & 428267-1-52-01

The official record of this Technical Special Provision is the electronic file signed and sealed under Rule 61G 15-23.003, F.A.C.

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SECTION T459
ARC-SPRAYED ZINC SACRIFICIAL CATHODIC PROTECTION

T459-1 Description
T459-1.1 General: The installation of this system requires the application of zinc (anode) to the selected damaged areas that exhibit severe corrosion problems. Perform this application by thermal spraying (metalizing) the concrete with the required surface preparation necessary to produce a good bond between the zinc and the concrete. Continuity to the reinforcing shall be established through the connection plate wires as detailed in the plans.

T459-1.2 Continuity: Verify and provide electrical continuity of the reinforcing steel or any other steel components within the component to be metalized.

T459-1.3 Quantities: Due to the nature of the deterioration present on these bridges, the Engineer may add or delete quantities beyond the limits per Section 4-3 of the Standard Specifications with no adjustment to the contract unit prices.

T459-1.4 Submittals: All submittals shall be in accordance with Standard Specification Section 5.

T459-2 Quality Control/Quality Assurance
T459-2.1 Quality Assurance: The Contractor shall secure the services of a National Association of Corrosion Engineers (NACE) certified Cathodic Protection Specialist (CPS) with a minimum of two years of verifiable experience in the application of sprayed zinc on concrete and a minimum of five years of experience in the field of corrosion control on concrete structures.

As an alternate, the CPS may be either:
- Cathodic protection practitioner with a minimum of 10 years of experience in the field of thermally sprayed zinc and 15 years of verifiable experience in the field of corrosion control on marine concrete structures.
- Licensed professional engineer with similar requirements as for the NACE certified specialist.

The CPS shall be independent of the metalizing or construction operation.

Submit in writing the qualifications of the individual selected for the Engineer’s approval. Acceptance of the CPS shall be subject to approval of the Engineer.

T459-2.2 Quality Control: Submit a Quality Control/Quality Assurance (QC/QA) plan, which has been reviewed and approved by the CPS, for approval by the Engineer prior to commencing the system installation or concrete removal. QC/QA plan shall describe all tasks to be executed by the Contractor as well as those executed by the Specialist. It is recommended that the Contractor discuss the intended installation schedule with the CPS prior to preparing his bid to assure that the intended schedule does not conflict with the QC/QA plan.

T459-2.2.1 Quality Control Plan: The plan shall include method and frequency of Contractor’s QC testing, continuity testing by the CPS, zinc anode application, time dedicated for training, frequency of random QA testing, method for updating the Engineer, and method(s) for final approval of the cathodic protection systems. The CPS shall also provide a final report
to the Engineer describing the general characteristics of the metalizing work for each bridge, the thickness and bond strength results for each metalized component. The report and all collected data shall be in typed form and a digital version of the report must be provided along with 4 bound hard copies.

**T459-2.3 Quality Assurance Tasks:** For this work, the minimum quality assurances that shall be provided are:

- Responsible for determining the production minimum target bond strength of the zinc based test patches.
- Overseeing the quality of the surface preparation and metalizing as required.
- Conduct electrical continuity testing of all reinforcement and connection plates.
- Training Contractor’s and Department’s personnel in performing the required quality control testing.
- Conduct random quality assurance testing on a minimum of 50% of components (beams, strut, column, etc.) metalized in CPS absence. Conduct all the specified testing to meet the requirements of the contract documents and supervise all phases of the metalizing work.
- On a Monthly basis visit the project to perform random testing and update the Engineer, verbally and in writing, regarding quality of the work in progress.
- Provide a final report.

**T459-2.3.1 Random Testing:** The random testing (based upon quantity) shall be in addition to the Contractor’s QC testing specified further in these Technical Special Provisions. Random testing shall be conducted at a minimum frequency of once per month and satisfactory approval shall be required for periodic partial payments of the metalizing work.

**T459-2.3.2 Certification Statement:** The Contractor shall submit from the CPS original final construction reports to the Department after completion of the project. The report shall include the following statement signed and notarized by the CPS:

“I hereby certify that the facilities constructed under Financial Project Number 428267-1-52-01 have been completed and are functionally complete. I further certify that construction on these facilities has preceded substantially in accordance with the contract plans and specifications or that any deviations which are noted below will not prevent the system from function in compliance with the intent of the contract when properly operated and maintained. These determinations have been based upon my on-site observation of construction, scheduled and conducted by me or by a project representative under my direct supervision, for the purpose of determining if the work proceeded in compliance with the contract plans and modifications.”

**Quality Control/Quality Assurance:** Provide specialized independent quality assurance in addition to the Contractor’s quality control.

**T459-3 Materials**

**T459-3.1 Zinc:** The metalizing material shall be essentially pure zinc (99.9% pure) produced in wire form of 1/8” standard size which can be made molten and sprayed. The zinc wire shall be available on a commercial basis. Provide laboratory certified chemical composition of anode
wire for approval by the Engineer that includes verifiable lot or batch numbers that coincide with the provided production wire.

**T459-3.2 Overcoat:** The overcoat material shall be water based inorganic zinc silicate primer. Provide technical and safety data sheets of overcoat material for approval by the Engineer.

**T459-3.3 Connection Plate:** Connection plates shall be ASTM A-36 hot-dipped galvanized in accordance with Standard Specification Section 962.

**T459-4 Metalizing Equipment**

**T459-4.1 General:** Metalizing equipment must consist of the self-contained electric arc type with support equipment and accessories as to deposit non-contaminated zinc anode material on the steel and/or concrete surfaces as specified in the Contract Documents.

**T459-5 Method of Construction**

**T459-5.1 General:** The work shall be performed as indicated in the contract documents. All work shall be performed from the water. Location of equipment on the roadway will not be permitted.

Prior to commencing work, submit for approval by the Engineer, a list of proposed equipment and materials. Such list shall include: brand names, specifications, and model numbers as applicable. All residue material and debris resulting from sand blasting, water blasting, mechanical removal, or any other type of removal shall be contained by the contractor and disposed of properly.

Provide continuity connection plates as detailed in the plans prior to zinc spray application. Verify and provide electrical continuity to all exposed reinforcement.

Dimensions and locations of the areas to be metalized shall be recorded by the Contractor and verified by the Engineer.

**T459-5.2 Surface Preparation for Sprayed Zinc Cathodic Protection:** Remove and repair all cracked, delaminated, or hollow sounding concrete according to Technical Special Provision Section T401. All deficient concrete surfaces, existing metallization, or other deleterious material shall be removed prior to zinc application.

The blast gun nozzle shall be sized to remove all old metalizing and foreign matter from the concrete surface without damaging the concrete and the best blasting media shall be determined to meet the surface preparation requirements. Blast material must be plant packaged and maintained in a clean and dry condition at all times. Do not use material stored in the blaster pot overnight. Provide a copy of the Material Safety Data Sheet (MSDS) for the blasting material to the Engineer for approval prior to performing any blasting.

All blasting shall be done by the metalizing contractor. Do not perform any metalizing until concrete removal and deficient metalizing areas have been approved by the Engineer.

Install continuity wiring and connection plates as shown in the plans after the surface preparation is complete. Install the electrical negative connections element as shown on the plans.
sufficient length of wire shall be used such that the wire(s) can be routed to the connection plate without any splices. The connection shall be properly insulated after completion. Wire connections and connection insulating method and materials shall be submitted for approval prior to performing this work. Metalize under the connection plate and attach plate so that the entire perimeter is in firm contact with surface. Metalize over plate within 2 hours of the under-plate metalizing.

**T459-6 Arc Sprayed Zinc Anode Application**

**T459-6.1 General:** Follow application procedures, these Technical Special Provision and joint standard of NACE No. 12/AWS C2.23/SSPC-C2.23.

**T459-6.2 Test Sections:** Prior to commencing the arc-spraying operation, metalize a minimum of four on-site test sections with minimum dimension of two (2) square feet each. Use these test sections to determine the field application rate for the specified thickness and the grain size and texture acceptability. Test locations will be determined by the Engineer.

Perform preliminary tests prior to production metalizing. Measure adhesion strength on all test sections to determine if sufficient bond is achieved between the concrete surface and the zinc coating. Perform bond strength testing on the test sections at no less than 24 hours after metalizing per ASTM D4541. Make a minimum of three bond tests at each location and average the results. A minimum of 100 psi of bond strength shall be achieved using a bond strength tester as described in these Technical Special Provisions. From the test locations, obtain the highest most reasonable values for the properly applied zinc and those approved by the Engineer will be established as the production target values. Provide a minimum of 14 days advanced notice for the application of the tests such that appropriate Department personnel and the CPS are present for the application and testing. Do not locate test patches on designated production components. However, test locations should be representative of all the concrete surfaces receiving metalizing.

Mock-ups will be necessary to test bond on new patch and repair concrete.

**T459-6.4 Application:** Areas to receive cathodic protection are listed in the plans. Prior to zinc application, the concrete surface shall be air blasted to remove any sand residue from the sandblasting operation. Air stream shall be 100% moisture free.

**T459-6.5 Weather and Time Constraints:** Do not perform thermal spraying operation during periods where rainfall, high seas or choppy waters are present. Do not perform zinc spraying when excessive wind is blowing which could interfere with the operation as determined by the Engineer. Complete metalizing within two hours following surface preparation. Metalizing shall be continuous and uninterrupted within each bridge component. No cold overlaps of the zinc shall be allowed.

For repairs with concrete restoration, allow a minimum 10 day cure period prior to metalizing. Repair areas must be properly prepared prior to metalizing. Metalizing of element shall be completed within 90 days of repair.

**T459-6.6 Coating Thickness:** Perform zinc application by employing multiple spray passes to achieve a coating thickness of 15 to 20 mils as determined by thickness measurements on test coupons or by other means acceptable to the Engineer. A minimum of one thickness
measurement shall be obtained at 100 square foot intervals of production or at each element with less than 100 square feet of surface area. Obtain and record measurements with verification by the Engineer. Obtain thickness measurements using a spherical anvil and spherical spindle micrometer capable of performing measurements ranging from 0 to 1 inch. Electronic thickness measuring devices may be allowed as approved by the Engineer based on calibration with the mechanical instrument. Where deficient coating thickness values are found, the deficient test section entire areas (one square foot minimum) shall be blasted to remove all the applied zinc and shall be re-metalized to the requirements. The necessary repairs shall be performed within two hours of initial application or the entire element shall be re-metalized in accordance with these technical special provisions.

T459-6.7 Adhesion: Conduct a minimum of three coating adhesion strength test (pull-off test) on each metalized element less than 200 square feet or at every 200 square feet on component(s) with area larger than 200 square feet. Make three spot measurements and average the values. Record the results, which shall be subject to verification by the Engineer. Conduct pull-off tests using a 0 to 500 psi fixed alignment adhesion tester as per ASTM D 4541. Pull-off strength shall be a minimum of 90% of the target values obtained from the preliminary on-site test sections. Obtain production measurements at no less than two hours after metalizing but at no more than 72 hours. Production values below 90% of the target value will not be deemed acceptable. If the test fails, determine the area of deficient bond, remove the new metalizing and reapply until results are satisfactory to the Engineer. No additional payment will be made for failed metalizing and retesting.

T459-6.8 Quality Control: Provide all equipment and materials necessary to perform all quality control testing as required by these Specifications. Blast clean the areas not meeting the minimum required bond strength of all sprayed metal prior to re-spraying as directed by the Engineer. Protect surfaces not intended to be metalized that are adjacent to, or in close proximity to, the surface to be metalized with suitable masking during the zinc application.

T459-6.9 Deficient Areas: Surfaces of the zinc-coated sections shall be uniform in appearance, free of visible coating defects such as: cracking, burning, blistering and un-coated areas and/or other defects that will affect the function of the coating. If a deficient coating area is found, perform the correction in the same manner as deficient thickness correction. Abrasive blasting of the defective metalized areas will be required.

T459-6.10 Overcoat: After zinc coating is approved satisfactory by the Engineer, coat the surface of the zinc with the approved water based inorganic zinc silicate over the metalized areas of the structure. Perform this work between 24 and 72 hours after the metalizing. Coating shall be spray applied in accordance with manufacturer specifications. The coating application shall extend 6” beyond the metalized areas in each direction and shall be spray applied as per manufacturer specifications but to a thickness no less than of 5 – 8 mils. Properly mask areas not to be coated to protect them from over-spraying or over-run. Costs of inorganic zinc coating shall be considered as incidental to the metalizing work. No additional payment will be made for materials, equipment and/or labor associated with the inorganic zinc silicate application.

T459-7 Method of Measurement
The actual surface area of finished metalized work shall be as installed and accepted by the Engineer.
**T459-8 Basis of Payment**

No separate payment will be allowed for concrete removal, clean-up, blasting, pollution control, or any additional surface preparation. Payment under this section shall be at the unit price and shall be made based on actual area (square feet) of metalized concrete surface approved by the Engineer. Payment shall be full compensation for all incidentals, including but not limited to: concrete removal and disposal, surface preparation, continuity wiring, continuity connection plates and wires, tarps, metalizing testing, deficiency repairs, overcoat, testing and CP Specialist services.

Payment for this work shall be included under Pay Item Number:

400-142-3 Cathodic Protection System, Zinc Aluminum Spray - per square foot