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**REVISION OF SECTION 522
DUPLEX COATING SYSTEM**

Add Section 522 of the standard specifications to the Standard Specifications for this project as follows:

DESCRIPTION

522.01 This work consists of hot dip galvanizing and duplex coating steel structures as shown in the Contract.

MATERIALS AND CONSTRUCTION REQUIREMENTS

522.02

(a) *General.* The Contractor shall provide, install, and repair if necessary, all steel items that are prepared and coated in conformance with this Section. All repair and replacement of the finished coating necessary for final acceptance shall be at the Contractor's expense.

Steel products to be galvanized and coated shall be cleaned of weld spatter and bevel finished at exposed corners, edges and points. Areas having welds, cuts, bores, notches, or grooves shall also be beveled unless otherwise noted in the Contract or directed by the Engineer. Bevel work shall produce a uniform, smooth finish for galvanizing. Bevel size to be used is based on steel thickness and other criteria as follows:

Steel Thickness/Type	Bevel Size (inches)
Less than 1/2" thick	1/32" to 1/16"
Over 1/2" thick	1/16" to 1/8"
Bores, notches & grooves	root face of 1/32" to 1/16"

Welds shall be cleaned and finished according to AWS standards.

All coating measurements shall be taken with a Type 2 fixed probe Dry Film Thickness (DFT) gauge. The gauge shall be calibrated, and measurements shall be taken, according to the Society for Protective Coatings (SSPC) Standard PA-2.

(b) *Galvanizing.* Galvanizing shall be done in accordance with the Contract requirements and AASHTO M 111 (ASTM A123) for the type of material being galvanized, except that items shall only be quenched with ambient air. The poles and arms for traffic signals and signs shall be hot dipped galvanized inside and outside. Chromate treatment of any type will not be permitted. Zinc-phosphate pretreatment or acrylic passivation pretreatments shall be as described in (d) below.

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The Contractor shall submit a certificate of compliance (COC), conforming to subsection 106.12, confirming that all materials meet or exceed the galvanizing requirements described herein.

All galvanized surfaces shall be free from drips, slag or surface irregularities..

Spot areas not requiring galvanizing shall be marked and cleanly patched with material that prevents galvanization but does not weaken the adjacent spelter coating. Repair of patched areas shall be achieved by metallizing as described in (c) below.

Prior to galvanizing, the Contractor's galvanizer shall notify the Engineer in writing that the galvanized order is chromate free, and air quenched. Products not certified chromate free by the Contractor's galvanizer shall be tested prior to galvanizing. The Contractor shall provide the Engineer with certification from an independent ASTM accredited laboratory listing all individual items that test chromate free. Testing shall comply with ASTM D-2092 Appendix X2. Test results shall be provided to the Engineer prior to galvanizing.

- (c) *Repair of Galvanized Products.* Uncoated areas or damaged coating exceeding applicable specification limits shall be re-galvanized to meet the original specification requirements. Cuts made after galvanizing shall be ground, beveled, and smoothed before repair. Damaged galvanized areas shall be re-galvanized or metallized.

Re-galvanizing shall conform to ASTM A-780, Annex A1. Metallizing shall conform to ASTM A-780, Annex A3, except that minor repair areas shall be cleaned according to SSPC method SP-3. SSPC Method SP-2 may be used to clean difficult access areas. Thickness of the repair coat shall match adjacent galvanizing, as measured by a calibrated DFT gauge.

Coating imperfections such as burring, runs or drips, high spots, heavy dross, or ash inclusion shall be removed and cleaned at the Contractor's expense. Areas of re-work falling below zinc thickness limits shall be repaired at the Contractor's expense.

Printed Technical Data Sheets (PTDS) shall be provided to the Engineer for repair materials used.

- (d) *Preparing Galvanized Surfaces for Coating.* Products shall be inspected for shipping and handling damage before surface preparation begins. Damage shall be reported to the Contractor's galvanizer and to the Engineer prior to repair. The Engineer will determine whether damaged items are to be repaired or replaced. Minor repair of galvanizing shall conform to (c) above and shall be at the Contractor's expense.

The Contractor shall prepare each surface to be coated so that it has a slightly roughened profile without removing over 1.0 mil of the galvanized coating. Minimum ASTM zinc thickness specifications shall still apply after preparation.

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Surfaces of fasteners to be coated shall be lightly brushed or sanded in a manner that will remove the least amount of zinc.

Surfaces that become soiled after pretreatment shall be cleaned prior to coating by low pressure, mild detergent wash and rinse. Stained or oiled surfaces may also be mildly scrubbed with a soft bristle nylon brush. Stubborn stains may be mildly scrubbed with a mix of 1 - 2 percent ammonia solution and thoroughly rinsed. Wash and rinse pressure shall not exceed 100 psi at 185° F temperature.

Surface preparation work shall be done according to one of the following methods:

1. *Zinc-Phosphate Pretreatment.* This treatment may be used only on new galvanizing less than 48 hours of age.

Items shall be immersed in a bath of acidic zinc-phosphate solution for 3 - 6 minutes, rinsed with clean water, and dried. The first epoxy coat shall be applied within 48 hours after immersion treatment.

If treated items are shipped to a different coating facility they shall be rewashed, rinsed and dried to remove surface soiling. The first epoxy coat must still be applied within 48 hours after immersion treatment.

2. *Acrylic Passivation Pretreatment.* This treatment may be used only on fresh hot galvanizing or new galvanizing less than 48 hours of age. Only chrome-free solutions shall be used, applied by a method that ensures complete coverage of all surfaces to be coated. The Contractor shall provide the Engineer with treatment dates for each item and the PTDS for the solutions used.

The Contractor's galvanizer may apply solution to fresh hot galvanizing that is less than 6 hours of age, still clean, and dry and that has cooled to treatment application temperature guidelines.

If newly galvanized items are shipped to another treatment facility they shall be washed, rinsed and dried to remove surface soiling. The solution shall then be applied and cured according to the supplier's instructions.

Fully cured and treated items shall be rewashed, rinsed, and dried again just before coating. Items not coated within 100 days of treatment shall be abrasive blasted in conformance with subsection (d) 3.

3. *Abrasive Blasting.* This treatment may be used on galvanized items of any age if beveling requirements as listed in the third and fourth paragraphs of subsection (a) have been met.

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The Contractor shall notify the Engineer in writing at least five working days before blasting begins. Zinc thickness shall be measured and recorded immediately after blasting and provided to the Engineer within 48 hours of blasting. Thickness limits and measurement frequency shall comply with the original applicable ASTM specification. Blast operations shall reasonably conform to ASTM Standard Practice D-6386, Subsection 5.4.1 except for small areas falling below required zinc thickness. These areas shall be repaired in accordance with subsection (c). No single area shall exceed 2 inches at its largest width or 12 inches at its longest dimension. The total repair area shall not exceed 1 percent of the coatable surface of the item; if limits are exceeded or zinc thickness is below the specification requirement, the item shall be re-galvanized in conformance with the original specification.

The Contractor shall measure and record the size, location and repair method used for all repairs. This information shall be included on the report of thickness measurements.

The first epoxy coat shall be applied within 24 hours of abrasive blasting. Items shall be cleaned free of blast debris before coating. Compressed air used to clean items shall be free of oil, residue, oil and other harmful contaminants.

Thickness measurement is not required after surface preparation work has been completed.

(e) *Coating and Paint Systems.* Prepared items shall be coated with a two or three coat system described in this subsection. Alternative coating systems shall be pre-approved in writing by the Engineer. Manufacturer's PTDS for each coating type shall state test values for ASTM requirements of this subsection. Prior to product use the coating supplier shall provide the PTDS and certify to the Engineer in writing that all furnished coating materials meet applicable requirements of this subsection.

Faying surfaces shall not be painted unless written approval is given by the Engineer. All shop fabrication, including welds and attachments, shall be completed prior to coating unless otherwise specified in the Contract or directed in writing by the Engineer.

Inorganic zinc coatings shall not be used. Combined DFT of all coats applied over the galvanizing shall range from 6.5 to 10 mils with a topcoat DFT of 3 mils minimum. Dried color of the base coat and topcoat shall be visually contrasting. Finished color shall not vary more than $4 \Delta E^*_{ab}$ units from the specified color determined in accordance with ASTM D 2244.

Volatile Organic Compound (VOC) levels shall not exceed 3.5 pounds per gallon for each applied coat. Dry films shall contain less than 1 percent lead and other toxic heavy metals. The zinc concentration of each epoxy coat shall not exceed 40 percent. Topcoats shall have a semi-gloss value of 50-75.

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All coatings shall be able to withstand temperatures up to 180° F without sag, blister, or peel damage. Topcoat formulation shall provide weathering, chemical, and ultraviolet (UV) resistance. All coatings shall meet the following ASTM requirements as amended:

- (1) Corrosion Weathering. ASTM D-5894, minimum 6-cycles of exposure:
Corrosion rating of 8 or higher according to ASTM D-1654.
Blistering rating of 8 or higher according to ASTM D-714.
- (2) Impact Resistance. ASTM D-2794, 30 day test:
Epoxies - Minimum 40 inch-pounds
All Topcoats - Minimum 90 inch-pounds
- (3) Adhesion Testing. ASTM D-4541, 30 day test, Minimum 500 psi for either: Method B - flat surface or Method E - curved surface.
- (4) Abrasion Resistance. ASTM D-4060, 30 day test: Maximum 90 mg loss after 1000 cycles with a CS10 or CS17 wheel.
- (5) Flexibility. ASTM D-522, 30 day test - Method B: Epoxies shall pass a 180 degree bend over a 3/4 inch mandrel. All Topcoats shall pass a 180 degree bend over a 3/8 inch mandrel.

Each coat shall be applied uniformly to provide an appearance free of laps, streaks, sags, drips, pinholes, and other discontinuities; all such defects shall be repaired prior to product shipment.

The Contractor's coater shall measure the DFT of each applied coat according to SSPC, Guide PA-2, except that measurements shall be taken with a calibrated Type 2 fixed probe gauge. Thickness records shall be provided to the Engineer prior to project shipment. The following two coating systems do not require pre-approval:

1. Powder Coating. The Contractor's coater shall oven preheat the articles to abate out-gassing potential. The Contractor's coater shall use compatible materials and coating processes to obtain proper coat to coat adhesion.

The epoxy powder base coat shall measure 2 to 6 mils DFT and be applied by electrostatic or airstatic spray. The powder formulation shall be a non-hybrid epoxy of anti-gassing grade.

The powder topcoat shall be electrostatic or airstatic spray applied and measure 3 to 6 mils DFT. The powder formulation shall be a non-acrylic, high-build, aliphatic-based, enhanced polyester or urethane polyester of anti-gassing grade.

2. Liquid Coating. The Contractor's coater shall apply coats by conventional or airless spray according to the supplier's guidelines. Minimal striping at difficult work areas

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is permissible. The Contractor's Coater shall use proper work methods and compatible materials to obtain proper coat adhesion. Thinning of paints shall be done according to the manufacturer's instructions so that thinned products conform to the solids content and VOC limits of this subsection.

The epoxy base coat shall measure 2 to 6 mils DFT. Paint shall be a low-blush epoxy polyamide, or a low-blush cycloaliphatic bisphenol-A polyamine. Minimum solids by weight of all epoxies used shall be 68 percent.

The topcoat shall measure 3 to 6 mils DFT. Paint shall be an aliphatic-based urethane polyester or aliphatic-based polyurea urethane. Specially formulated aliphatic-based polyaspartic polyureas may also be used over compatible epoxy bases.

(f) *Repair of Coated Products.* The Contractor shall repair damage from shipment, installation, field welding, or other activity during the construction. Damage shall be reported to the Engineer prior to repair. Repairs shall be as directed by the Engineer.

Significant repair procedures require written submittal of a proposed repair process from the Contractor. The Engineer shall approve the proposal in writing before repairs begin. Significant repairs are classified as:

- (1) Any damaged area to the base coat material over 1 square inch
- (2) Total repair areas exceeding 5 percent of the coating per item.
- (3) Any single topcoat repair area over 64 square inches

Minor and touchup repair of topcoats shall be done as follows:

A UV rated, aliphatic-based liquid topcoat paint shall be used. The paint shall be compatible with the existing topcoat material and closely match existing color. The paint shall meet the requirements of subsection (e). The paint supplier shall provide the Engineer with PTDS for the products used.

Single areas smaller than 8 square inches requiring repair shall be scuffed with 220 grit sandpaper or equivalent scuff material. Larger areas up to 64 square inches may be cleaned according to SSPC, Method SP-2. All border areas at the undamaged topcoat shall be scuffed with 220 grit material.

Cleaned, scuffed areas shall be bordered and coated by airless or conventional spray. Work areas shall be adequately shielded to contain errant spray. Fresh repair areas shall be protected as necessary during the initial cure. Repair thickness shall reasonably match the adjacent coating.

The repair coat shall provide an appearance free of sags, runs, streaks, drips, pinholes, or other discontinuities. Spray can paint repair shall not be used.

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(g) *Conditions for Final Acceptance of Coating.* Within six weeks immediately prior to final project acceptance, the Engineer and a representative of CDOT’s Staff Bridge Branch will conduct a final inspection of the coating. The Contractor’s Superintendent shall also attend the inspection. Before final project acceptance, the Contractor shall repair the following defects found during the inspection:

- (1) Peeling on any portion of the coatings.
- (2) Blistering on any portion of the coatings.
- (3) Color fading below a 35 gloss rating, in accordance with ASTM D523.
- (4) Mottling defects that exceed 3 percent of the topcoat surface.
- (5) Visible cracking of the topcoat material.
- (6) Visible rusting discoloration on the coating.
- (7) Sag or other evidence of coating adhesion loss.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Duplex Coating System will not be measured and paid for separately but shall be included in the work.

INSTRUCTIONS TO DESIGNERS: (delete all instructions and symbols from final draft):

Use this project special provision when painting is required on galvanized metal. Environmental Stain (Galvanized) may be used as an option for a brown color.

PERMANENT CHANGES TO PROJECT DATED SPECIAL PROVISIONS

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<u>DATE</u>	<u>AUTHOR</u>	<u>DESCRIPTION OF CHANGE</u>
1/14/19	Staff Bridge	Initial Website Issue
04.11.2023	M. Kayen	Revisions to make spec online ADA-compliant. 5.22.23 Additional ADA.