DUPLEX COATING FOR STRUCTURAL STEEL
(REV 4-13-26)

The following new Section is added:

SECTION 564
DUPLEX COATING FOR STRUCTURAL STEEL

564-1 Description.

Coat structural steel in accordance with the requirements of this Section using a duplex coating system. The duplex system must consist of a thermal spray coating (TSC) aluminum base coat, and an epoxy seal coat with an aliphatic polyurethane top coat. Use a clear top coat if included as part of the approved top coat paint system.

TSC application must conform to the requirements of AASHTO/NSBA S 8.2-2017/SSPC-PA 18, unless otherwise indicated in this Section.

564-2 Materials.

564-2.1 Abrasive Blast Media: Use abrasive blast media meeting the requirements of SSPC-AB 1 "Mineral and Slag", or SSPC-AB 2 "Recycled Ferrous Metallic", or SSPC-AB 3 "Newly Manufactured or Re-Manufactured Steel Abrasives". Each lot of abrasive media must be free of oil and contain less than or equal to 7 micrograms per square centimeter ($\mu g/cm^2$) concentration of chlorides.

564-2.2 Thermal Spray Feedstock Wire: The feedstock wire material must be 99.5% aluminum in accordance with AWS C2.25/C2.25M.

564-2.3 Seal Coat and Top Coat: Use epoxy intermediate (seal) coat and aliphatic polyurethane finish (top) coat systems meeting the requirements of Section 975 and listed on the Department's Approved Products List (APL) for this Section. The seal coat and top coat must be provided from the same manufacturer. Apply the seal and top coat systems to the TSC per the manufacturer's product data sheet or as modified by the manufacturer's technical representative for application over TSC.

564-3 Qualifications.

564-3.1 General: Submit the appropriate documentation to the Engineer for approval, at least 21 calendar days prior to beginning TSC or any coating work. Do not begin TSC or coating work until the following have been approved by the Engineer:

1. Corporate Quality Control (QC) Plan
2. Industry Endorsement
3. Experience and Credentials of all QC Personnel
4. Experience of the Operators and Applicators
5. Site-Specific Coatings Plan
6. Job Reference Standard(s) (JRS).

564-3.2 Shop Application: Obtain shop application of TSC from a company that is currently on the Department's Production Facility Listing. Fabricators seeking inclusion on the list must meet the requirements of this Section and Section 105. Submit a current QC Plan approved by the American Institute of Steel Construction (AISC) under the Sophisticated Paint Endorsement Program, or a Society of Protective Coatings

(SSPC) QP 6 or QP 3 certification or NACE International Institute Contractor Accreditation Program (NIICAP) AS-1S certification with the Corporate QC Plan that was reviewed under the current certification, and a site-specific coatings plan that meets 564-4 to the Engineer.

564-3.3 Field Application: Submit a current SSPC QP 6 or QP 1 certification, or NIICAP AS-1F certification, with the Corporate QC Plan that was reviewed under the current certification, and a site-specific coatings plan that meets 564-4 to the Engineer. For the removal of hazardous coatings, submit a current SSPC QP 2 certification with the Corporate QC Plan that was reviewed by SSPC under the current certification and a site-specific coating plan.

564-3.4 Quality Control Supervisors: Personnel designated as QC Supervisors must possess the following:

1. 5 years of experience in corrosion control using coatings on structural steel,
2. 3 years of experience in the inspection of TSC application on structural steel, and
3. Valid SSPC Bridge Coatings Inspector II, or SSPC Protective Coatings Inspector Level III, or NACE International Coating Inspector Level III Certification.

564-3.5 Quality Control Inspectors: Personnel performing QC inspections must report directly to a QC Supervisor and are required to possess the following qualifications:

1. 1 year of experience in corrosion control using coatings on structural steel,
2. 1 year of experience in inspection of TSC application on structural steel, and
3. Valid SSPC Bridge Coatings Inspector I, or SSPC Protective Coatings Inspector Level I, or NACE International Coating Inspector Level I Certification.

564-3.6 Thermal Spray Coating Applicators: All TSC operators must be able to produce a plan and work history for training, testing, and demonstration of capability related to TSC application. TSC operators must identify their knowledge and experience in applying TSC on steel substrates, using various materials and troubleshooting complex configurations. Prior to the completion of a Job Reference Standard (JRS), each TSC operator must meet the following requirements:

1. Spray specimens that meet project specifications for wire type and coating thickness that pass the destructive bend and adhesion tests in accordance with AASHTO/NSBA S 82-2017/SSPC-PA 10,
2. Demonstrate knowledge of how to verify the correct feedstock, load the TSC feedstock wire, and adjust the TSC equipment,
3. Demonstrate acceptable skills to test compressed air cleanliness, environmental conditions, surface profile, and film thickness, and
4. Demonstrate knowledge of the blast cleaning process, applicable blast-cleaning standards, and surface profile requirements.

564-4 Coatings Plan.

564-4.1 Procedures: Procedures for the site-specific coatings plan must include inspection items, inspection methods, acceptance criteria and the frequency of inspections. Submit written procedures for approval including the following:

564-4.1.1 Storage of Materials: Include the methods of storage for the application equipment, blast media, TSC feedstock wire, coatings and any solvents.

564-4.1.2 Job Reference Standard (JRS): Include the configuration, surface preparation, documentation, type of base steel, and conformance testing that will be done to qualify the JRS. Based on the complexity of the project, multiple JRS's may be needed to address geometry challenges on a complex configuration.

564-4.1.3 Controlling Ambient Conditions: Include the methods for assessing and controlling humidity, air temperature, wind, and dew point.

564-4.1.4 Air Handling and Dust Removal: Include the methods for assessing air cleanliness, contamination in the application of TSC, the surface of applied TSC, and coating over TSC.

564-4.1.5 Surface Preparation of the Steel: Include the methods for assessing surface temperature, surface cleanliness, surface profile, and chloride contamination. Include methods of illumination, taping off faying surfaces, and grinding of base metal edges.

564-4.1.6 TSC Application: Include the criteria for general application, application on faying surfaces, application in confined spaces, method(s) of illumination and the use of companion coupons.

564-4.1.7 Repairing TSC: Include the evaluation process, surface preparation, and feathering of TSC.

564-4.1.8 Seal Coating TSC: Include the time for application, surface preparation, manufacturer's recommended dry film thickness and method(s) for controlling ambient conditions.

564-4.1.9 Top Coating TSC: Include the time for application, surface preparation, manufacturer's recommendation dry film thickness, and method(s) for controlling ambient conditions.

564-4.1.10 Repairing Top Coated TSC: Include the plan for evaluation, surface preparation and feathering of the top coat.

564-5 Quality Control (QC).

564-5.1 Inspection: Each shift must have at least one QC Supervisor present on the jobsite. The QC Supervisor must maintain daily inspection reports at the job site for review by the Engineer. Submit all daily inspection reports upon completion of the project to the Engineer, or more frequently as requested by the Engineer. Ensure that all inspection equipment is maintained, calibrated, and in good working condition in accordance with the manufacturer's instructions.

564-5.2 Commercial Inspection: The Quality Assurance Inspector(s) (QAI) must have access to all TSC and coating operations, materials, documentation and repairs. All TSC and coating operators will be subject to producing project related JRS or companion coupons if the quality of the work differs from the JRS or has resulted in multiple nonconformances, as determined by the Engineer.

564-5.3 Material Documentation: Submit technical and safety data sheets and certificates of conformance to contract requirements for the following:

1. TSC feedstock wire (including composition, size, certification and storage).
2. Blast media (including SSCP AB, oil testing and chloride testing).

3. Any liquid-applied coating, including top coat (product data sheets, lot numbers, and APL numbers).

4. Manufacturer's recommendation for compatibility of top coat with seal coat and TSC.

5. Calibration records for all inspection equipment.

564-5.4 Mechanical Removal of Surface Defects: Break all corners resulting from sawing, burning, or shearing. In areas where burning has been used, chamfer or radius flame hardened surfaces between 1/16 inch and 1/8 inch. Remove all weld slag and weld spatter.

564-5.5 Surface Preparation: Unless otherwise specified, prepare steel by abrasive blast cleaning to "white" metal condition as defined in SSPC-SP 5/NACE No.1. Use SSPC-VIS 1 as an aid in establishing cleanliness. Unless otherwise listed in the contract documents, ensure the surface profile meets the requirements of AASHTO/NSBA S 8.2-2017/SSPC-PA 10. Take representative surface profile measurements every 200 square feet (ft^2) in accordance with ASTM D 4417, Method B or C. If rust blooming, rusting or contamination occurs after the completion of the surface preparation, restore the surfaces back to the initial requirements. Perform surface preparation work only when the temperature of the substrate is at least 5ºF above the dew point temperature. Perform surface preparation only on areas to be thermal spray coated within the same shift. Blast surface preservation products are prohibited.

564-5.6 Surface Contamination: Ensure all surfaces to be coated are clean, dry, and free from oil, grease, dirt, dust, corrosion, weld spatter, mill scale and any other surface contaminants. Prepare all surfaces that will become inaccessible after fabrication, erection, or installation while accessible. Sequence the surface preparations and coating operations so that freshly applied TSC will not be contaminated by dust or foreign matter. Protect all equipment and adjacent surfaces not to be coated from surface preparation operations. Protect working mechanisms against intrusion of abrasive. If any rusting or contamination occurs after the completion of the surface preparation, prepare the surfaces again to the initial requirements. Perform surface preparation work only when the temperature of the steel surface is at least 5ºF above the dew point temperature, and relative humidity is less than 90% and falling.

Determine the chloride, sulfate and nitrate concentrations on all steel surfaces using soluble salts test kits meeting the requirements of 564-6.1. Measure the concentration levels in $\mu g/cm^2$ and conductivity in microsiemens per square centimeter ($\mu S/cm^2$), in accordance with Table 564-1. When any concentration or conductivity measurement exceeds the levels specified in Table 564-1, rewash the entire surface area nd retest all potentially contaminated steel to the satisfaction of the Engineer. If additional washing does not reduce the concentration to the acceptable level, a surface treatment or water additive may be used. Use a surface treatment or water additive that is approved by the coating system supplier and the Engineer.

Table 564-1

Allowable Surface Contamination

Coating Stage	Frequency of Test	Acceptance Criteria
Post-Blast, Pre-Coating	1 test (per 1000 ft^2)	$\leq$ 17 $\mu g/cm^2$ Sulfates $\leq$ 10 $\mu g/cm^2$ Nitrates

Table 564-1		
Allowable Surface Contamination		
Coating Stage	Frequency of Test	Acceptance Criteria
		≤ 70 µS/cm^2 Conductivity ≤ 7 µg/cm^2 Chlorides
Between Coats	3 tests (first 1,000 ft^2) 1 test (each additional 1,000 ft^2)	≤ 7 µg/cm^2 Chlorides

564-5.7 Weather and Temperature Limitations: Do not apply TSC, the seal coat or top coat when the measured wind speed in the immediate coating area is above 15 miles per hour. Do not apply coatings when contamination from rainfall is imminent or when the ambient air temperature, relative humidity, dew point temperature, or temperature of the steel is outside limits listed in AASHTO/NSBA S 8.2-2017/SSPC-PA 10 or the product data sheet.

564-5.8 Protection of Adjacent Surfaces: Protect all surfaces and working mechanisms not intended to be coated during the application of TSC or coating operations. Clean adjacent surfaces that have been contaminated with TSC or coatings until it has successfully passed a wipe test, as described in SSPC-SP 1.

564-5.9 Adhesion Testing: The minimum adhesion values must be maintained throughout the project. The minimum adhesion value for aluminum TSC must be ≥ 1100 psi. If adhesion values fall below the specified values, the surface preparation, materials and the operator's operation should be examined. Adhesion values must be performed using an adhesion tester meeting ASTM D 4541 Method D and Method E as modified below:

1. Method D: Type IV; average of 5 pulls.
2. Method E: Type V; average of 3 pulls.

Do not perform adhesion testing to failure once the target adhesion is measured. Use heat to remove the loading fixture without damage to the thermal spray coated steel.

564-6 Equipment.

564-6.1 Soluble Salt Test Kit: Measure soluble salts using methods in compliance with SSPC-Guide 15, Table 1. Use a fully automated conductivity meter, fiber strip, or multi-cell patch, cell or ring. Ensure the test sleeve or cell creates a sealed, encapsulated environment during ion extraction and is suitable for testing the various surfaces.

564-6.2 Abrasive Blasting System: Use a compressed air system capable of delivering clean, dry, continuous nozzle pressure to achieve the required surface cleanliness and profile or spray pattern. The system must comply with the instructions and recommendations of the manufacturer of the abrasive blasting system or coating application system.

564-6.3 Adhesion Testing: Adhesion testing must be performed with an adhesion tester meeting ASTM D4541 Method D, using 12.5 millimeter (mm) loading fixtures; or Method E, using 20.0 mm loading fixtures.

564-6.4 Hand & Power Tools: Use tools that are appropriate to prepare the surface edges and remove any physical non-conformances that would impede a proper coating application.

564-6.5 Lifting and Handling Equipment: Use soft, clean, and dry material between coated products and support blocks or metal apparatus such as hooks or chains when conducting shop application. Ensure that areas supporting access platforms (and/or other construction equipment) are also properly thermal sprayed and coated when conducting application in the field.

564-6.6 Thermal Spray Equipment: Use thermal spray equipment of the electric arc type with protection to avoid contamination of the feedstock.

564-7 Application.

564-7.1 Application of Thermal Spray Coating: Apply 8.0 to 12.0 thousandths of an inch (mils) of TSC using electric arc equipment in accordance with the requirements of the material supplier and AASHTO/NSBA S 8.2-2017/SSPC-PA 10, and using the approved procedure submitted to the Department.

Apply the TSC within six hours after the final abrasive blast cleaning is performed. If the steel is blast cleaned and remains without TSC for longer than six hours, or if the cleaned steel exhibits evidence of rust-back, blast clean the steel again prior to applying the TSC. Remove abrasive residue and dust from the surface. Blast surface preservation products are prohibited.

After application of the TSC, protect the contact surfaces of members to be joined by high-strength bolts in friction type joints from all other coatings and foreign material.

564-7.2 Application of Seal Coat and Top Coat: Apply the seal coat and top coat within the time specified by the coating manufacturer's product data sheet for drying and recoating. Test the coating for proper cure before handling and shipping. Test for cure in accordance with the manufacturer's recommended method. Do not apply seal coat or top coat over faying surfaces.

Use spray equipment recommended by the manufacturer and as authorized by the Engineer that gives satisfactory results. Apply each coat free of runs, sags, blisters, bubbles, and mud cracking; variations in color, gloss, or texture; holidays; excessive film buildup; foreign contaminants; orange peeling; and overspray.

If brushes are used for specific areas, manipulate the paint under the brush to produce a uniform, even coat. Work the paint into corners and crevices. Move the brush in a series of small circles to thoroughly fill irregularities in the surface, then brush out and smooth by a series of parallel strokes until the paint film has an even thickness. Do not use brushes if prohibited by the manufacturer.

Apply stripe coats and apply caulk as described in Specifications Section 560.

Remove lubricant and other surface contaminants from galvanized fasteners. Apply the same seal coat used on main components to galvanized fasteners (i.e., nuts, bolts, washers) and areas such as connection plates that had not previously received the seal coat after cleaning.

564-7.3 Interior of Box or Tub Girders: Apply a coat of white amine epoxy directly to the prepared surfaces of all interior components (except faying surfaces) of steel box or tub girders. Mask off faying surfaces after metalizing, to prevent overspray.

The epoxy coating must meet the requirements of Section 975 for Interior Box Girder Coating. Caulk and paint all bolted assemblies and joints in accordance with 560-9.7.

564-7.4 Thickness of Coatings:

564-7.4.1 Thickness of Thermal Spray Coating: TSC thickness readings must be taken by an electronic dry film thickness gauge, in accordance with SSPC-PA 2 with the thickness restrictions in Table 564-2. Take representative readings every 550 ft². Remove TSC thicknesses greater than 14.4 mils on faying surfaces.

Table 564-2				
Thermal Spray Coating Thickness Restrictions				
Surface	Spot Measurement (mils)		Area Measurement (mils)	
	Minimum	Maximum	Minimum	Maximum
General	6.4	18	8.0	12.0
Faying	6.4	14.4	8.0	12.0

564-7.4.2 Thickness of Seal Coat: The seal coat must visibly cover all the peaks of the TSC profile and penetrate to the valley areas of the TSC. Multiple coats of the sealer may be necessary. The initial coat of sealer may be thinned to penetrate the valleys of the TSC profile.

564-7.4.3 Thickness of Top Coat: Meet the requirements of the manufacturer's product data sheet. Coating thickness readings must be taken by an electronic dry film thickness reader, in accordance with SSPC-PA 2, Level 3.

564-7.5 Drying and Curing: Cure the coating for the time and temperature required by the manufacturer's product data sheet. Test the coating for proper cure, per the manufacturer's product data sheet before handling and shipping. Do not apply seal, intermediate or top coats on faying surfaces.

564-7.6 Surfaces Not to be Duplex Coated: Do not apply aluminum TSC, seal coat, or top coat to these surfaces. The requirements for these surfaces will be incidental to the Duplex Coating System.

564-7.6.1 Surfaces to be in contact with Concrete: Prepare surfaces that will be encased in, or coated with, concrete and apply a mist coat of an inorganic zinc primer listed on the APL. Prevent rust bleeding from the top flange of girders from staining adjacent coated surfaces.

564-7.6.2 Machine Finished Surfaces: Apply a coating of rust preventative compound to all machine finished or similar surfaces that are not to be coated, or will not be coated immediately.

564-7.6.3 Surfaces to be Welded: For areas where shear studs will be welded, prepare the surfaces and apply a mist coat, that is less than 1 mil dry film thickness, of an inorganic zinc primer listed on the APL.

564-8 Coating Finish.

564-8.1 Thermal Spray Coating Finish: The finished TSC surface must be uniform, firmly adherent, free from thin spots, misses, or lumps. Tightly adhering material may remain, if it can adhere to the surface after being struck with a dull putty knife or stainless-steel brush. Sanding of the surface is prohibited.

564-8.2 Seal Coat and Top Coat Finish: The finished product must be free of runs, sags, blisters, bubbles, rust bloom, variations in color, gloss, or texture, holidays, excessive film buildup, foreign contaminants, orange peeling. All finished surfaces must have a smooth finish free from cracks, pin-holes, shrinkage, excessive material, and other flaws.

564-9 Touchup and Repair.

564-9.1 Touch Up and Repair of Thermal Spray Coating: Standard repairs should follow the approved repair procedures identified in the site-specific coating plan. Repair areas should not exceed 1.0 ft^2 in any one location. Repairs exceeding 1.0 ft^2 must be removed and replaced. Repairs to the coating surface that are less than complete removal will require Engineer approval for both removal and application. Engineer approval is required prior to beginning repair work.

564-9.2 Touch Up and Repair of Faying Surfaces: Standard repairs should follow the approved repair procedures identified in the site-specific coating plan. Repair areas that exceed 6.0 square inches (in^2) in any one location on a faying surface should be removed by abrasive blasting and the TSC should be re-applied per this Section. Repairs to the faying surface that are less than complete removal will require Engineer approval for both removal and application. Engineer approval is required prior to beginning repair work.

564-9.3 Touch Up and Repair of Seal Coat and Top Coat: Standard repairs should follow the approved repair procedures identified in the site-specific coating plan. Repair areas should not exceed 1.0 ft^2 in any one location. Repairs exceeding 1.0 ft^2 should be investigated per SSPC-PA 2 and the extent of the failure should be removed and replaced. Repairs to the coating surface that are less than complete removal will require Engineer approval for both removal and application. Engineer approval is required prior to beginning repair work.

564-10 Protection of the Environment, Public, and Workers.

564-10.1 New Structural Steel: Meet the requirements of 560-4.

564-10.2 Existing Structural Steel: Meet the requirements of 561-10 and 561-11.

Prepare a traffic control plan for each phase of construction activities signed and sealed by the Contractor's Engineer of Record in accordance with the FDOT Design Manual. Do not begin work until the traffic control plan is approved by the Engineer. Maintain traffic in accordance with Section 102.

For work over navigable waters, submit a work plan to the United States Coast Guard including any scheduled restrictions to navigation channels or marine traffic. Obtain Coast Guard approval at least 30 days in advance of any restrictions.

564-11 Method of Measurement.

For new I-Girder and Box or Tub Girder Superstructures and Bent Caps, the quantity for duplex coating to be paid for will be the lump sum quantity, completed and accepted.

For all existing structural steel:

When a lump sum pay item is provided, the quantity to be paid for duplex coating existing structural steel will be the lump sum quantity for the areas shown in the Plans, completed and accepted.

When a square foot item is provided, the quantity to be paid for duplex coating existing structural steel will be the plan quantity in square feet of surface area as shown in the Plans, completed and accepted.

564-12 Basis of Payment.

For new I-Girder and Box or Tub Girder Superstructures and Bent Caps, price and payment will be full compensation for all work specified in this Section, including furnishing and applying all materials to complete the duplex coating for the structural steel.

No separate payment will be made for duplex coating all other new structural steel.

Payment for duplex coating new I-Girder and Box or Tub Girder Superstructures and Bent Caps shall be made under:

Item No. 920-564- Duplex Coating for Structural Steel – lump sum.

Payment for duplex coating all existing structural steel will be made under:

Item No. 920-564- Duplex Coating Existing Structural Steel - lump sum.

Item No. 920-564- Duplex Coating Existing Structural Steel - per square foot.