DESIGNER NOTES

*The full text of this Special Provision as presented below is written to be included as part of Item 960.1, STRUCTURAL STEEL – COATED STEEL, or as a Heading within a Lump Sum item, such as Item 995.01, where coated structural steel is used.*

*The Designer shall specify the Environmental Zone to be used in the highlighted sentence.*

*DELETE ALL DESIGNER NOTES, AND REMOVE HIGHLIGHTING PRIOR TO SUBMITTAL*

 **THERMAL SPRAYED COATING (METALIZING) FOOTSHOP APPLIED**

**PURPOSE**

This section provides the requirements for shop performed surface preparation; the application of a thermal spray coating (TSC/metalizing); the application of a coating system; and includes field application of coatings and repairs and touch up of all coatings after site erection of the coated structure.

**GENERAL INFORMATION**

1. All fabrication shall be completed prior to the application of a thermal sprayed coating. (TSC)
2. All surfaces to be coated shall be cleaned in accordance with SSPC SP-5.
3. All TSC shall be sealed with an approved sealer, except for faying surfaces.
4. After site erection of the structure, perform field touch-up of any damaged coating.
5. All fasteners shall be galvanized and coated with the intermediate and topcoat if applicable.
6. The products of only one thermal spray wire manufacturer and one coating manufacturer shall be used on the entire project.
7. All field painting shall be in accordance with applicable sections of Item 961 of the MassDOT Standards and Specifications.

**MATERIALS**

**Abrasives**

Provide abrasives that are clean, dry, and sized properly to provide the specified surface profile. The profile shall be dense, uniform and of sufficient angularity to be acceptable for the application of TSC.

Abrasives shall conform to the following as applicable:

* SSPC-AB 1 for mineral slag abrasives
* SSPC-AB 2 for recycles ferrous metal abrasives
* SSPC-AB 3 for new steel abrasives

**Thermal Spray Feedstock**

The contractor shall provide material certificates from the supplier that includes the chemical composition and lot number of the wire. MassDOT will perform random sampling of wire from lots provided. Wire shall conform to ASTM A833. See table below for application and selection of wire type, thickness, and coating system.

Environmental Zone **X** shall be used for this project.

|  |  |  |  |
| --- | --- | --- | --- |
| **ENVIRONMENTAL ZONE\*** | **WIRE TYPE** | **THICKNESS** (mils)\*\* | **COATING SYSTEM\*\*\*** |
| 1 | Zinc-Aluminum | 6-9 | Three Coat |
| Zinc-Aluminum  | 6-9 | Sealer Only |
| 2 | Zinc- Aluminum | 8-11 | Three Coat |
| Zinc-Aluminum | 9-12 | Sealer Only |
| 3 | Zinc Aluminum | 9-12 | Three Coat |
| Zinc Aluminum | 12-15 | Sealer Only |

**\*Zone 1** – Bridges in rural environments, not over waterways, and not over high speed state or interstate highways with potential for salt spray and heavy salt use and de-icing chemical use.

\***Zone 2** – Bridges in urban environments, near industrial and manufacturing plants, power plants, or warehouses, over heavy road traffic, or over waterways.

\***Zone 3** – Bridges in marine environments, over or close to saltwater waterways, or over high speed state or interstate highways with potential for salt spray and heavy salt use and de-icing chemical use.

\*\* Mil thickness on faying surfaces shall meet the requirements of the slip certificate.

\*\*\* Coating systems shall consist of a three coat paint system applied over the metalized surface or a clear sealer applied over the metalized surface.

**SUBMITTALS**

Submit the following information to the MassDOT - Highway for approval a minimum of thirty days prior to beginning any coating operations:

1. Manufacturer’s recommendation and field history for the coating system proposed. Include data sheets for all selected coatings to be applied.
2. Procedures for shop surface preparation, the application of the TSC and application of coatings.
3. Procedures for coating of field connections.
4. Procedures for field touch-up surface preparation, application of TSC and application of coating.
5. Proposed abrasive for use in the shop.
6. Proposed thermal spray wire to be used and product data sheets. Provide certification of Class B slip coefficient.
7. A copy of SSPC-QP3/AISC (SPE) certification. This certification must be in effect at the time of bid and must remain in effect throughout the duration of the project.
8. Quality Systems Manual
9. Work schedule. Contractor must notify the Engineer a minimum of seven days prior to starting work.

**QUALITY CONTROL**

1. The shop performing the application of TSC and coating shall be certified by the American Institute of Steel Construction (AISC) Sophisticated Paint Endorsement (SPE) quality program, or under the Society for Protective Coatings (SSPC) QP3 program, “Standard Procedure for Evaluating Qualification of Shop Painting Applicators” and shall maintain certification throughout the project.
2. The coating applicator shall have completed a minimum of three structural steel TSC projects that utilized the same coating system as that being specified on this project. Provide project locations, TSC/painting; name, e-mail address, and the telephone number of the owner or owner’s representative.
3. Provide an on-site Quality Control Specialist (QCS) who shall function as a TSC inspector with a minimum of five years of each TSC and coating application experience; and possess SSPC BCI Level 1 or NACE Certified Level 3 or other related certification as accepted by the MassDOT - Highway. The QCS shall not be a foreman or a member of the Contractor’s production staff. The QCS’s sole purpose shall be quality control testing, inspection and reporting.

**PRE-APPLICATION MEETING**

A pre-application meeting will be held prior to any steel fabrication that includes the application of thermal spray applied coatings. This meeting is separate from the pre-construction meeting for the entire project.

 The following parties are required to attend this meeting: TSC/applicator, QCS, and MassDOT – Highway Representatives. Other project personnel should attend as may be needed.

**PERSONNEL QUALIFICATION**

The applicators of the thermally applied material shall be individually qualified to apply the TSC as follows:

1. Each applicator must complete a practical test designed to demonstrate the ability to set up and operate the equipment to apply the material to the specified thicknesses to a minimum of 10 square feet of representative steel surfaces, and to successfully pass the surface preparation, bend, and cut tests specified herein. Administer the qualification testing, document the results in writing, and retain the bend test coupons for the duration of the project.
2. At the discretion of MassDOT - Highway, requalify the applicators at any time during the project to reconfirm the proficiency and the quality of the workmanship being provided. This may be required at any time due to unacceptable or failing results of the bend test, cut test, or poor workmanship.

**SHOP QUALIFICATIONS**

Prior to proceeding with the production blast cleaning operations prepare a minimum of five Job Reference Standards (JRS) test plates*.* Blast clean all surfaces of each test plate using the same equipment and abrasive that will be used for the production work. After acceptance of the surface cleanliness and profile, apply the TSC to all surfaces of each test plate. After acceptance of the TSC apply the sealer to be used with the three coat system to three test plates excluding the bottom surface of all test plates. After curing apply a coat of epoxy to two of the three test plates excluding the bottom surface. After curing apply a coat of the polyurethane topcoat to one test plates on all surfaces excluding the bottom surface. Apply the clear sealer to the last remaining TSC plate. Bottom surfaces of the prepared plates shall be used for cut testing as specified. Surface preparation and application shall be witnessed by a MassDOT representative. *See drawing below for dimensions and construction*



 **Configuration of JRS Test Plates**

**SURFACE PREPARATION**

For cleaning that utilizes compressed air, utilize only clean, dry air. Conduct blotter test(s) in accordance with ASTM D4285 a minimum of one time each shift for each compressor system in use to verify that the air supply is free of moisture and oil contamination. Conduct the tests in the presence of the MassDOT – Highway Representative.

**Weld Spatter, Sharp Edges, Flame-Cut Steel, Holes, Fins, and Silvers**

Remove slag, flux deposits, fins, slivers, burrs, and weld spatter from the steel. Grind any sharp edges around holes. Break all flame-cut and sheared edges. If blast profile is degraded by grinding restore profile by abrasive blasting.

**Solvent Cleaning**

Where oil and grease are present on the bare steel, remove by solvent cleaning to SSPC-SP 1 prior to blast cleaning. If contamination remains after blast cleaning, reclean with solvent prior to application of the TSC.

Cleaning of galvanized bolts prior to the application of paint to bolted connections in the shop or in the field all galvanized fasteners shall be cleaned of all lubricating wax. Cleaning shall be in accordance with SSPC-SP-1, Solvent Cleaning, method 4.1.1. The contractor is responsible to identify the solvent and method needed to remove all lubricant. Cleanliness will be determined by the use of a white cloth wipe test. The test will be performed by the engineer using a clean white cloth and the same solvent used by the Contractor for cleaning. The cloth shall be wetted and rung to a damp condition, placed on selected fasteners and rubbed with a twisting motion around the entire exposed surface of the previously waxed surfaces of the fastener. A minimum of 3 alternating rotations shall be done. Acceptance of cleanliness is with no color transfer to the cloth. A minimum of 10% of the bolts at each bolted connection shall be tested for cleanliness.

**Abrasive Blasting**

Blast clean all steel to, SSPC-SP5 “White Metal Surface Cleanliness.” Determine the SP5 condition by use of SSPC-Vis 1. In the event of a conflict between the pictorial standard and the written definition the written definition shall prevail. Abrasive blast cleaned surfaces shall have a dense, uniform pattern of sharp, angular depressions and ridges, between 3.5-5.0 mils.

Surface preparation is defined as complete when all remedial repairs have been performed and the piece is accepted by both QC and MassDOT QA.

Verification of the profile height will be performed in accordance with ASTM D 4417 Method C.

Manual Blasting shall have a minimum of one profile depth measurement every 10 to 20 ft², of blasted surface.

Automated Blasting shall have a minimum of two profile depth measurements every 100 ft². When acceptable results are obtained on three consecutive days in which testing is conducted, the test frequency may be reduced to two spot readings for every 1,000 ft² providing the preparation method remains unchanged. If unacceptable results are encountered during testing or the preparation method has changed in any way, testing will revert back to a frequency of two tests per every 100 ft², until acceptable results are once again achieved over a three day period.

Profile replica tape shall be filed with the project inspection records. The Engineer with the use of a surface profile comparator will randomly inspect angularity of the profile.

The use of steel shot is not permitted.

**TSC AND COATING APPLICATION**

**Storage, Testing and Sampling**

The Contractor shall provide protection from the elements and insure that the paint is not subjected to temperatures outside the manufacturer’s recommended extremes.

Before the Contractor will be permitted to use any paint, the material provided for application shall have been sampled, tested and approved in accordance with Section M7. MassDOT’s Research and Materials Laboratory needs a minimum of fourteen days after the receipt of samples to test and approve.

**Mixing and Thinning**

Before the paint is applied, each component shall be mechanically mixed to ensure the pigment is completely dispersed. Mixing of components shall be accomplished by mechanical mixing, boxing or hand mixing of components will not be allowed. Any special precautions or requirements for mixing by the manufacturer shall be followed. Paint shall be kept thoroughly mixed in spray pots or containers during application. The pot life shall not be exceeded or attempts made to extend pot life with the addition of solvent.

If it is necessary for any reason to thin paint it will be done in the presence of the Engineer, in accordance with the manufacturer's recommendations. Thinning must be performed using a measuring cup marked in ounces or milliliters. Other methods, such as eyeballing, are not acceptable. Thinner shall be supplied from and recommended by the same manufacturer as the paint system.

For multi component paints, the mixing of half or partial kits is not allowed. If the need for small quantities of paint is anticipated, the contractor should order materials accordingly.

**Application**

Prior to the application of any coating material, the Engineer’s approval must be obtained. All surfaces painted prior to the Engineer’s approval, shall require the complete removal of the coating applied.

**Thermal Sprayed Coating**

Apply the TSC within six hours after the final abrasive blast cleaning is performed. If the steel is blast cleaned and remains unmetalized for longer than six hours, or if cleaned steel exhibits evidence of rustback, blast clean it again prior to metalizing. Remove abrasive residue and dust from the surface. Apply the metalizing only after the MassDOT – Highway Representative has accepted the prepared surface.

**Bend Testing for Evaluation of the TSC**

Conduct bend tests of applied TSC each day prior to production application. Unless otherwise directed by the MassDOT - Highway, each day that TSC will be applied, conduct bend testing before beginning the production work. For each TSC applicator, blast clean five carbon steel coupons measuring 0.05 inches in thickness, 2 inches width, and between 5 and 8 inches in length. Use the same equipment and abrasive used for the production work. Have each applicator apply the TSC to five coupons in accordance with the requirements of this Section to dry film thickness between 8 and 15 mils. Conduct 180o bend testing on all five coupons using the appropriate mandrel in accordance with the requirements and acceptance criteria of SSPC-CS 23. Minor cracks that cannot be lifted from the substrate with a knife blade are acceptable. If lifting on any of the coupons is possible, modify the surface preparation/TSC process until acceptable results are achieved before proceeding with the production work.

Apply the TSC in accordance with the requirements of the material supplier, this specification, approved procedures and SSPC-CS 23.

The completion of TSC is defined as after the spraying of TSC is complete and all remedial repairs have been performed and the piece is accepted by both QC and MassDOT QA.

Touch-up of bare steel and/or TSC damage shall be done with organic zinc rich primer. The total area subject to repair shall be no more than .50 % of the total square foot of the piece requiring repair. The dry film thickness of the applied coating shall be a minimum of 5 mils. Surface preparation for all repair areas shall be as specified in, “Surface Preparation and Abrasives” paragraph 3. The maximum individual repair shall be limited to 1 square foot. Areas larger than 1 square foot shall be re-blasted and the TSC applied in accordance with this document.

Sealer Coat

Apply the seal coat to the TSC after the MassDOT – Highway Representative has accepted the TSC. The seal coat shall be thin enough when applied to penetrate into the body of the TSC and seal the porosity. Added thickness to porous TSC should not be measurable. Typically the seal coat is applied at a spreading rate resulting in a theoretical 1.5 mils dry film thickness. Apply the seal coat in accordance with the manufacturer’s instructions as soon as possible after the application of the TSC but in no case greater than 6 hours. Verify that the TSC surface is clean and dry prior to the application of the sealer. If grease, oil, or similar contaminants become deposited on the TSC, remove them in accordance with SSPC-SP 1 prior to the application of the seal coat.

Paint

Applied coatings shall not exhibit, runs, sags, holidays, wrinkling, pinholes, nap hair, topcoat gloss or color variations, or other film discontinuities.

Repair of unacceptable areas that involve removal of the coating system or part of it, shall require surface preparation and coating equal to that specified. Repair procedures used for any unacceptable coating shall be those supplied by the contractor and approved by the Engineer.

Application of full coats of paint shall be accomplished by spray equipment. Spray equipment shall meet the requirements of the coating manufacturer and be in proper working order.

Application by brush and roller will be allowed for limited access areas. Brushes and roller covers recommended by the coating manufacturer shall be used. Areas brushed and rolled will have a uniform thickness and be free of defects and excessive coating thickness.

All coating shall be applied according to the latest manufacturer’s data sheet or approved recommendations. The maximum recoat times of the primer, intermediate and finish coats shall not be exceeded.

Application of coatings shall not be done when the relative humidity is above 85% or when the surface temperature of the steel is less than 5°F above the Dew Point. Paint shall not be applied when the surface temperature is below 50°F or when the surface temperature is above 110°F.

If requested by the Engineer the Contractor shall provide written instructions from the coating manufacturer indicating the length of time that each coat must be protected from cold or inclement weather (e.g., exposure to rain) during its curing or drying period.

Paint shall not be applied when, in the Engineer’s judgment, conditions are or will become unsatisfactory for application and proper cure. All changes as to the application parameters other than specified must be the manufacturer’s and presented in writing and approved by the Engineer. Ambient conditions should be closely monitored so that proper cure/drying is achieved prior to recoat. In no case shall a succeeding coat of paint be applied before the previous coat has cured/dried sufficiently for recoat as per manufactured data sheet.

If required, contaminated surfaces shall be cleaned in accordance with SSPC- SP 1 Solvent Cleaning method 4.1.1.

Measurement of the ambient conditions shall be done in accordance with ASTM, E 337 Test Method for “Measuring Humidity with a Psychrometer” (the Measurement of Wet and Dry bulb Temperatures).

When the primer has cured sufficiently for recoat, all bridge components to be painted shall receive a full intermediate coat.

When the intermediate coat has cured sufficiently for recoat, all bridge components to be painted shall receive the finish coat.

**Coating Thickness**

Apply the shop and field coats to the dry film thicknesses as specified.

1. Determine the cumulative dry film thickness of each coat using a magnetic dry film thickness gage in accordance with SSPC-CS 23 and SSPC-PA 2 with the following exceptions:
	1. Take readings on each 100 square-foot increment of the surface.
	2. The minimum specified thickness of the TSC must be achieved at each individual spot measurement location (i.e., the 20 percent under run allowed by SSPC-PA 2 is not permitted for the metalizing).
2. If the thickness of any coat (TSC, seal coat, intermediate coat or top coat) is less than specified, apply additional material in accordance with the manufacturer’s instructions and this Section before applying the next coat. Before applying additional TSC, visually confirm that there is no evidence of oxidation or contamination on the surface.
3. Thickness of applied TSC greater than the contract specified shall be reported to the MassDOT-Highway QA inspector in writing prior to the end of the shift. The thickness of the applied TSC shall not be more than 120% of the specified range for the zone specified.
4. Application of TSC to faying surfaces that require a slip rating shall not be more than the maximum thickness specified in the environmental zone chart for each zone included in the materials section of this specification.
5. The minimum adhesion value of the unsealed TSC shall be the average of 3 spot reading resulting in an average of 700psi for each 500 sq/ft.

**Access for MassDOT - Highway Inspection**

Provide safe access and sufficient time for MassDOT - Highway inspections for any and all phases of the work, including but not limited to surface preparation, the application of each coat (including field coat), and for an inspection of the completed system.

**Quality Control Documentation**

Copies of Quality Control daily inspection and testing documents will be provided to the MassDOT – Highway Representative within 24 hours.