DESCRIPTION

This work shall consist of furnishing all materials and equipment necessary and to apply metalizing in accordance with the contract documents and as directed by the DCES.

Qualification of Metalizing Contractor

The metalizing contractor performing the work shall document previous experience in providing surface preparation for metalizing and metalizing application services in the shop and field, with a minimum history of three (3) successfully completed projects of similar complexity. The contractor shall be certified per the requirements of SSPC-QP 3.

The contractor shall submit experience and qualification records of all personnel performing the work.

Qualification of Thermal Spray Technicians and Personnel

The thermal spray technicians shall be qualified in accordance with ANSI/AWS C2.16 with a minimum passing adhesion of 700 psi, and must hold a certificate of satisfactory completion of training from the equipment manufacturer. The equipment used for qualification shall be equivalent to that used in production.

Each metalizing shift shall have at least one metalizing supervisor, meeting the thermal spray technician requirements, and who will additionally have a minimum of three years documented satisfactory metalizing experience on similar projects.

An SSPC certified Quality Control Supervisor shall be on the thermal spray company’s staff and shall provide a Quality Control Plan to the DCES prior to the onset of work. The Quality Control Supervisor shall meet the requirements of Thermal Spray Supervisor as per SSPC-QP 6. Additionally, the Quality Control Supervisor shall have a minimum of five (5) years experience with satisfactory performance in abrasive blast cleaning of steel surfaces according to SSPC-SP 10 and shall have performed similar duties on two successful metalizing projects.

Codes and Standards

The provisions set forth in the latest issue of the following codes and standards shall apply unless otherwise indicated in the contract documents:

ASTM D 4285, Method for Indicating Oil or Water in Compressed Air.
ASTM D 4417, Test Method for Field Measurement of Surface Profile of Blasted Steel.
NACE Standard RP0287, Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape.
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ANSI/AWS C2.16, Guide for Thermal-Spray Operator Qualification
SSPC-CS 23.00/AWS C2.23M/NACE No. 12, Specification for the Application of Thermal Spray Coatings (Metalizing) of Aluminum, Zinc, and their Alloys and Composites for the Corrosion Protection of Steel.
SSPC-AB 1, Mineral and Slag Abrasives.
SSPC-AB 2, Specification for Cleanliness of Recycled Ferrous Metallic Abrasives.
SSPC-AB 3, Ferrous Metallic Abrasives.
SSPC-PA 1, Shop, Field, and Maintenance Painting of Steel.
SSPC-PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
SSPC-QP 3, Standard Procedure for Evaluating Qualifications of Shop Painting Applicators
SSPC-QP 6, Standard Procedure for Evaluating the Qualifications of Contractors Who Apply Thermal Spray (Metalizing) for Corrosion Protection of Steel and Concrete Structures
SSPC-SP 1, Solvent Cleaning
SSPC-SP 10/NACE No. 2, Near-White Blast Cleaning.
SSPC-SP 11, Power Tool Cleaning to Bare Metal
SSPC-VIS 1, Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning.

Quality Control Plan

Prior to the start of work, the Contractor’s QC Supervisor shall provide a written quality control plan and submit it to the DCES for approval. The plan shall include the procedure to be followed and equipment to be used for all processes outlined herein, including surface preparation and metalizing and seal coat application. The plan shall include a method of adhesion testing, thickness measuring, bend test protocol, testing frequency, and MSDS sheets for material utilized on the project. The plan shall outline the quality assurance procedures and any safety precautions that must be followed by workers and inspectors. No work shall commence until the DCES has approved the plan.

Job Reference Standard (JRS)

A job site pass/fail Job Reference Standard, representative of the work to be performed, shall be prepared by the metalizing applicator. The JRS will be used to evaluate the suitability of the application process. The JRS shall be made on a steel plate approximately 18 in. x 18 in. x 0.25 in. and shall be made with the actual equipment and process parameters and procedures (surface preparation, metalizing, sealing, and testing) that shall be used for the contracted work. The JRS shall be made in similar environmental conditions as the work to be performed. Thickness measurements and adhesion tests shall be performed on the JRS per this specification. The JRS
will be deemed unsatisfactory if any of the measurements or test results is less than the values indicated herein.

Metallographic testing shall be performed, in accordance with ASTM E1920 and ASTM E2109, on a JRS meeting the requirements of this section. Porosity of the metalized coating shall be less than 10% with less than 5% air inclusions in the film, and shall be fully bonded to the substrate with no air pockets between the coating and substrate. There shall be no interconnected porosity to the substrate for the contract specified thickness, intended technique of application, number of passes, and thickness applied per pass.

For steel assemblies exhibiting acute angles between structural members to be metalized in the shop after assembly, a similarly scaled steel, blasted mockup must be put together emulating the angles encountered. This mockup shall be metalized by the coating applicator, disassembled and adhesion testing shall be performed on the metalizing in the acute angle, per these specifications. If the mockup fails the adhesion test, the applicator shall change the application technique and/or adjust equipment to obtain proper adhesion results, thickness measurements and appearance requirements in acute angles.

**Job Control Record (JCR)**

The Contractor shall keep a Job Control Record, detailing the essential job information and the in-process quality control checkpoints required by this standard. The JCR shall include information on safety precautions, and the equipment, parameters, and procedures for surface preparation, thermal spraying, and sealing. Failure to perform production work in a manner consistent with the JCR guidelines will be cause for rejection.

**MATERIALS**

**A. METALIZING**

Certified alloy wire is required, and shall be composed of 85% zinc and 15% aluminum by weight. Wire shall meet the requirements of ASTM B-833 Standard Specification for Zinc and Zinc Alloy Wire for Thermal Spraying (Metalizing) for the Corrosion Protection of Steel. The Contractor shall submit a certificate with results of testing for chemical analysis to the DCES, for each lot of wire used on the job. The Contractor shall obtain written certification from the manufacturer of the alloy and will provide the certifications for each lot of wire a minimum of five business days prior to commencement of metalizing.

The metalizing 85/15 alloy shall have a minimum tensile bond of 700 psi.

**B. ABRASIVE FOR BLAST CLEANING**

Blast media shall be angular steel grit, angular aluminum oxide, or angular crushed slag, evaluated per SSPC-AB 3 for new abrasive material, and shall be capable of producing an angular anchor tooth profile. If abrasive material is to be recycled, the abrasive material shall be
evaluated prior to each reuse per the requirements of SSPC-AB 2. Use of silica sand, steel shot, or any other abrasives that result in a round surface profile is prohibited.

C. SEALER
Sealer shall be UV resistant and be a urethane or epoxy polyamide penetrating sealer, type as recommended by the supplier for use on metalized surfaces. The sealer shall be VOC compliant for use in New York State. Sealer shall be of such viscosity to penetrate pores in metalized coating.

D. SUBMITTALS

The metalizing applicator shall submit the detailed procedures for surface preparation, metalizing application, and application of sealer coat, conforming to these specifications. The procedures shall detail the equipment, application process, in-process quality control, and Job Control Record to be used for the contract work. The information shall include:

1. Detailed procedures for surface preparation, thermal spraying, seal coating, and the in-process quality control checkpoints.
2. Equipment (surface preparation, thermal spraying, seal coating, and the in-process quality control) to be used and for which the detailed procedures apply.
3. Product Data and MSDS sheets for sealer.
4. Blasting media, thermal spray feedstock materials, and seal coat product.
7. Job Control Record.
9. Certification of Class B slip coefficient and creep resistance. The certification shall include the written test results, including the thickness range required to meet the certification. Certification of Class B slip and creep resistance is not required for metalized to metalized faying surfaces meeting the requirements of this specification.

This information shall be submitted at least 10 work days prior to the schedule start of the Job Reference Standard (JRS).

CONSTRUCTION DETAILS

A. SURFACE PREPARATION

Prior to blast cleaning, steel surfaces shall be Solvent Cleaned in accordance with SSPC-SP 1, Solvent Cleaning, to remove all visible oil, grease, dirt, salt, and other contaminants. Then, all surfaces to be metalized shall be cleaned to SSPC-SP 10, Near-White Blast Cleaning, standards. All cleaning and coating shall be performed at the same facility. Surface finish and cleanliness shall be confirmed according to SSPC-VIS 1 standards. In the event of a dispute, the written SSPC SP-10 standard will take precedence.
Unacceptably hard surfaces, as defined by section 602 of the NYSDOT Steel Construction Manual, shall be removed by grinding, machining, or approved heat treating procedures, prior to abrasive blasting.

The substrate shall have an angular anchor tooth profile of 3 to 5 mils. Surface Profile measurements shall be made using X-course profile tape and a micrometer, as outlined in ASTM D4417. “Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel/NACE Standard RP0287, Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape.” Spot measurements shall be made approximately every 2000 ft² for automated blasting or 200 ft² for manual blasting. Take three measurements for each spot in an area approximately 1.5 in². Average the measurements and record in the Job Control Record.

Compressed air shall be free of oil and water and shall meet ASTM D4285, method for Indicating Oil or Water in Compressed Air. Utilize a compressed air system capable of delivery at the nozzle of 125 cfm at 120 psi. To minimize any contamination, use an oil/water separator on the airline. 120 psi of compressed air maintains the proper atomization of the molten wire producing the optimum spray pattern.

**B. SYSTEM REQUIREMENTS**

Only certified spooled metalizing wire, which is properly drawn, spooled and packaged, shall be used.

The metalizing equipment shall be set up, calibrated, and operated according to the manufacturer’s instructions and technical manuals or the metalizing applicator’s refinement thereto and as validated by the Job Reference Standard.

Spray parameters shall be set for spraying the specified thermal spray material and, at a minimum, be validated with the bend test. A bend test shall be satisfactorily performed at the beginning of crew and shift change.

A copy of the spray parameters used shall be attached to the Job Control Record.

**C. SUBSTRATE CONDITION**

The steel surface temperature shall be at least 5°F above the dew-point.

For flame spraying, preheat the initial starting area to a minimum of 250°F to prevent condensation of moisture in the flame onto the substrate. Validate preheating and non-preheating requirements with a tensile bond measurement and a bend test.

Time between the completion of the final anchor-tooth blasting (or final brush blasting) and the completion of the thermal spraying shall be no greater than six hours for steel substrates. In high-humidity and damp environments, shorter holding periods shall be used. If rust bloom or a
degraded coating appears at any time within the six-hour window, the procedure outlined in Section F, Surface or Coating Degradation shall be followed.

Extension of Time of Application

In low-humidity environments or in enclosed spaces using industrial dehumidification equipment, it will be possible to retard the oxidation of the steel and hold the surface finish for more than six hours. The metalizing applicator, with the approval of the DCES, can validate a holding period greater than six hours by determining the acceptable temperature-humidity envelope for the work enclosure by spraying and analyzing bend coupons and tensile-bond coupons.

A 1-mil to 2-mil flash coat of the metalizing may be applied within six hours of completing surface preparation to extend the holding period for up to four further hours beyond the complete application of the flash coat. The final metalizing thickness, however, shall be applied within four hours of the completion of the application of the flash coat provided the metalizing can be maintained free of contamination.

Validate the use of the flash TSC holding period with a tensile-bond measurement and a bend test.

- Clean and abrasive blast a representative job area and three bend-test coupons.
- Apply a flash metalizing to the representative job area and the three bend coupons.
- Wait the delay period in representative environmental conditions and apply the final metalizing thickness.
- Perform adhesion test and bend test on coupons.
- Flash metalizing and holding period are acceptable if the tensile bond and the bend test are satisfactory.

D. METALIZING

The applied 85/15 alloy metalizing thickness shall be a minimum of 12 mils, with a tolerance of 0 and + 4 mils. For each coated component, the applied thickness shall be measured using a SSPC PA2 type 2 fixed probe gauge properly calibrated per certified coating thickness calibration standards, and measurements shall be recorded in the Job Control Report (JCR). Use a measurement line to measure the peaks and valleys of the metalizing, taking the average value of five readings along a line at 1.0 in. intervals. For complex geometries and geometric transitions, use a measurement spot approximately 1.5 square inches, and do not measure the peaks and valleys of the metalized coating. Record all measurements in the JCR. If upon inspection, and prior to sealer application, the metalizing thickness is less than the above stated requirements, the applicator shall apply additional metalizing to meet the thickness requirements.

No coating shall be applied unless the following conditions are met:

- The receiving surface shall be clean and absolutely dry.
- The surface temperature and ambient air temperature are as recommended by the coating equipment’s manufacturer, except in no case shall coating work be performed when surface and ambient air temperatures are less than 40°F.
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• The receiving surface temperature shall be at least 5°F above the dew point.
• The relative humidity shall not exceed 85%.

All coating applied in violation of these conditions shall be completely removed, and the affected surface cleaned and recoated in accordance with the stated requirements at no additional cost to the State.

Any staining that does occur shall be removed in a manner that does not cause damage to the seal or metalized coatings, at no cost to the State.

Surface Roughness: Surface roughness of the metalized coating shall be less than 4 mils in order to avoid unfilled valleys and low areas in the film.

E. SEALER

Sealer shall be applied and cured according to the paint manufacturer’s instructions for use with metalizing, or as directed by the Engineer.

The seal coat shall be thin enough to penetrate into the body of the metalizing and seal the interconnected surface porosity. Typically the seal coat is applied at a spreading rate resulting in a theoretical 1.5 mil dry-film thickness.

Sealer shall be applied as soon as possible after thermal spraying, but shall be applied within eight hours after application of metalizing. If a sealer cannot be applied within eight hours, it shall be verified that the metalizing (a) has not been contaminated by visual inspection (10x), and (b) is dust-free (10x) using the clear cellophane tape test per ISO 8502-3 before applying the sealer.

If moisture is present or suspected in the pores of the metalizing, the steel shall be heated to 250 °F to remove the moisture prior to seal coat application. When possible, the steel shall be heated from the reverse side of the metalizing to minimize oxidation and contamination of the metalizing prior to sealing.

During application of the seal coat, it shall be visually validated that there was complete coverage of all intended areas. Companion steel coupons positioned near the metalizing shall receive a seal coat as well. The wet and dry film thicknesses of the seal coat on these companion coupons shall be used to verify that the correct thickness of seal coat is being applied to the metalizing. Measurements shall be recorded in the JCR.

The sealer shall not be applied to faying surfaces prior to assembly. Faying surfaces of all bolted connections shall be masked prior to application of the seal coat. Touch-up field sealant shall be applied after assembly of the connection.

F. SURFACE OR COATING DEGRADATION
If rust bloom, blistering or a degraded coating appears at any time during the application of the metalizing, the following procedure applies:

1. Stop spraying.
2. Mark off the satisfactorily sprayed area.
3. Call the Thermal Spray Inspector/Foreman to observe and evaluate the error.
4. Report the deficiency to the purchaser and record the deficiency.
5. Repair the unsatisfactory area by removing the degraded metalizing, re-blast to a minimum near-white metal finish (SSPC-SP 10 standard), and returning to the specified anchor tooth profile depth.
6. Recoat the blasted area as per this specification.
7. Record the actions taken to resume the job in the JCR.

G. FIELD REPAIRS

The only field work allowed to be done under this item is touch-up work after all steel erection and all concrete placement has been completed. All areas requiring field repairs shall be clearly marked. All the requirements of this specification shall apply to field coating material with the following modifications:

1. All dirt, grease and other foreign matter shall be removed in accordance with SSPC-SP 1, Solvent Cleaning. Clean the damaged area of all loose and cracked coating by power tool to bare metal in accordance with SSPC-SP 11, Power Tool Cleaning to Bare Metal.
2. Roughen the damaged area and the surrounding 2 inches to produce a suitable anchor for the coating. All repaired areas shall be tested for proper anchor tooth profile in accordance with ASTM D4417 and as per this specification.
3. All damage to the coating system shall be corrected by the contractor in accordance with the requirements of this specification and to the satisfaction of the Engineer at no additional cost to the State.
4. The overlap of thermal spray edges shall be tested for proper adhesion at each repair location in accordance with this specification.

H. ADHESION TEST

Random adhesion testing shall be performed for each coated component, utilizing self aligning portable pull-off adhesion testing equipment, in accordance with ASTM D 4541 standards. The minimum tensile bond value shall be 700 psi.

Use adhesive recommended by the instrument manufacturer, or equivalent. Attach adhesive manufacturer’s instructions to the job control record.

One portable tensile-bond measurement shall be made every 500 ft². If the tensile bond is less than the contract specification, additional tensile bond measurements shall be made to identify the limits or boundaries of the degraded metalizing. The degree of added testing that is necessitated by coating deficiencies will be solely determined by the State, and shall be performed at no additional cost to the State. Any degraded metalizing shall be removed and reapplied as per Section F, Surface or Coating Degradation. The tensile force shall be measured...
to 700 psi. The tensile force shall then be reduced and the tensile fixture removed without damaging the metalizing.

I. BEND TEST

Conduct a bend test at the beginning of each work shift or crew change:
1. Use carbon steel coupons of approximate dimensions 2 in. x 4 in. to 8 in. x 0.050 in.
2. Surface preparation according to contract specification.
3. Spray 12-mil to 15-mil thick metalizing in crossing passes, laying down approximately 3 to 4 mils for each pass.
4. Bend coupons 180° around a 0.5-in. diameter mandrel.
   a. Bend test passes if there is no cracking or only minor cracks with no spalling or lifting (by a knife blade) from the substrate.
   b. Bend test fails if the coating cracks with lifting (by a knife blade) from the substrate.

Bend test shall be performed on coupons without sealant coats.

J. WEATHER CONSIDERATIONS:

Thermal spraying in low-temperature environments (below freezing):

Substrate shall meet the surface temperature and holding period specified in Section C, Substrate Condition. No moisture or condensation is permissible on the surface during surface preparation and thermal spraying.

Qualify metalizing period with a tensile-bond measurement and a bend test. Meet the tensile bond and metallographic requirements specified herein.

METHOD OF MEASUREMENT

This work will be measured on a lump sum basis.

BASIS OF PAYMENT

The lump sum price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.

Note: “nn” denotes a serialized pay item.

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572.00020201 Metalizing, Type 2
572.00020301 Metalizing, Type 3
572.00020401 Metalizing, Type 4
572.00020501 Metalizing, Type 5
572.00020601 Metalizing, Type 6