



**SPECIAL PROVISIONS
FOR
THERMAL SPRAY METALLIZING OF STRUCTURAL STEEL**

**ALLAMAKEE COUNTY
STP-009-9(84)--2C-03**

**Effective Date
August 1, 2023**

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

159009.01 DESCRIPTION.

A. Scope.

1. This work consists of furnishing all materials, equipment, labor, and other essentials necessary to accomplish the surface preparation and application of thermal spray metallizing (zinc metallizing or Zm) to structural steel, and the application of either a two-coat paint system comprised of an epoxy sealer coat (S) and a urethane topcoat (U) over the metallizing, forming the ZmSU Coating System; or a three-coat paint system comprised of an epoxy sealer coat (S), an epoxy intermediate coat (E) and an epoxy top/build coat (+E) over the metallizing, forming the ZmSE+E Coating System. The limits of work and where each of the ZmSU Coating System and the ZmSE+E Coating System are to be utilized are as noted in the plans.
2. For shop surface preparation, metallizing and paint application, the work shall be conducted inside a permanent facility, enclosure, or building, with four walls to grade and a roof to provide an environment that is not subject to outdoor weather conditions and/or blowing dust.
3. Field application shall be limited to touch up of damage to the shop applied metallizing and paint and painting of surfaces not fully coated in the shop, such as the exterior of bolted connections.

B. Qualifications, Experience and Technical Advisor.

1. The Contractor performing the metallizing and painting shop work shall have an AMPP-QP 3 and AMPP-QP 6 Certification, or an AISC Complex Coatings Endorsement-Enclosed (CCE-1) certification. Field painting contractors shall be certified to AMPP-QP 1. The certification(s)

shall remain current throughout the duration of the contract.

2. The Contractor performing the metallizing and painting shop work shall have satisfactorily performed a minimum of three previous projects involving abrasive blast cleaning, metallizing, and paint application. At least one project within the past 2 years shall have involved a bridge or similar industrial type application of at least 200 feet in length. The suitability of the Contractor's qualifications and prior experience will be considered by the Engineer before granting approval to proceed.
3. Shops shall have areas available for specific operations, such as: receiving and lay down for steel to be coated; pre-cleaning of items to be coated; surface preparation; coating application; drying and curing of coated items; storage of coating materials.
4. There shall be shop and field procedures or processes in place to record specifications and revisions and to clarify ambiguous or incomplete specifications.
5. There shall be a procedure for informing quality control and production personnel of job/shop/field procedures to meet requirements of these special provisions.
6. **Contractor Quality Control (QC).**

The Contractors shall have a written quality control program, submitted in accordance with the requirements of Article 159009.03, A. The programs shall contain, but not be limited to, the following:

- a. The qualifications of QC staff, including training records and experience.
- b. The authority of QC staff and reporting lines in the firm organization chart.
- c. Standards and specifications used by QC staff for inspection purposes.
- d. Inspection reports and other records documenting compliance with project requirements.
- e. Inspection equipment and calibration standards used by QC staff and calibration procedures. Equipment shall include the following at a minimum:
 - 1) Psychrometer or comparable equipment for measurement of dew point and relative humidity, including weather bureau tables or psychrometric charts
 - 2) Surface temperature thermometer
 - 3) SSPC VIS 1
 - 4) Surface profile replica tape and spring micrometer or electronic micrometer designed for use with replica tape; or electronic profilometer designed for measuring blast profile.
 - 5) Blotter paper for compressed air cleanliness checks
 - 6) Type 2 Electronic Dry Film Thickness Gage
 - 7) Calibration standards for dry film thickness gage
 - 8) Bend test coupons and bend test mandrel
 - 9) Adhesion testing instrument
 - 10) Companion panels for adhesion testing (if that option is selected)
 - 11) Suitable Personal Protective Equipment shall be provided to the Engineer during shop visits.
- f. Procedure for QC staff to advise the shop foreman, in writing, of non-conforming work.

7. Technical Advisor.

- a. The Contractor shall obtain the services of a technical advisor employed by the coating manufacturer to assist the Engineer and the Contractor during this work.
- b. The technical advisor shall be a qualified representative, approved by the Engineer and shall be at the shop and field site prior to the opening of the coating containers.
- c. Contractor to consult with the technical advisor for instruction in the proper mixing of components and application of the materials.
- d. Contractor to arrange for the technical advisor to remain at the shop and field site until

the Engineer is satisfied that the Contractor's personnel have mastered the proper handling, mixing and application of the materials.

8. Schedule and Approval.

- a. Submit a schedule to the Engineer for surface preparation and painting or metallizing at least 30 days prior to beginning work. Schedule shall include and accommodate hold points and notification periods.
- b. At least 10 days prior to painting or metallizing, notify the Engineer.
- c. Do not paint or metallize steel until approval to proceed is given by the Engineer.

9. Metallizing Qualifications.

Present and maintain the following documentation:

- a. Applicators shall be certified to meet the requirements of ANSI/AWS C2.16/C2.16M and shall have a minimum of 1 year experience performing thermal sprayed metallizing. Results of thickness, bend and tensile bond test shall be included with each applicator's certification. Do not begin thermal spraying until the Engineer has approved in writing the thermal spray operators who will be performing the actual work.
- b. Certification that the zinc (99.99%) or 85/15 zinc/aluminum metallizing wire, as applicable, meets the requirements for purity and composition.
- c. Certification that the abrasive blast medium conforms to specifications.
- d. Certification that the epoxy seal coat, the epoxy intermediate coat, the epoxy top/build coat, and the urethane topcoat meet the requirements for composition.

C. REFERENCE LIST.

The Contractor shall maintain the following regulations and references on site for the duration of the project:

American Society of Testing Material

- ASTM D4285, Standard Test Method for Indicating Oil or Water in Compressed Air
- ASTM B833, Standard Specification for Zinc and Zinc Alloy Wire for Thermal Spraying (Metallizing) for the Corrosion Protection of Steel
- ASTM D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

The Association for Materials Protection and Performance (AMPP) (formerly SSPC)

- SSPC-AB 1, Mineral and Slag Abrasives
- SSPC-AB 2, Cleanliness of Recycled Ferrous Metallic Abrasives
- SSPC-AB 3, Ferrous Metallic Abrasives
- SSPC-PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements
- SSPC-PA 17, Procedure for Determining Conformance to Steel Profile/Surface Roughness/Peak Count Requirements
- SSPC-QP 1, Standard Procedure for Evaluating the Qualifications of Industrial/Marine Painting Contractors (Field Application to Complex Structures and Other Metal Components)
- SSPC-QP 2, Standard Procedure for Evaluating the Qualifications of Industrial/Marine Painting Contractors (Removal of Hazardous Coatings from Structures)
- SSPC-QP 3, Certification Standard for Shop Application of Complex Protective Coating Systems
- SSPC-QP 6, Standard Procedure for Evaluating the Qualifications of Contractors Who Apply Thermal Spray (Metallizing) for Corrosion Protection of Steel and Concrete Structures
- SSPC-SP 1, Solvent Cleaning

- SSPC-SP 3, Power Tool Cleaning
- SSPC-SP 5/NACE No. 1, White Metal Blast Cleaning
- SSPC-SP 10/NACE No. 2, Near-White Metal Blast Cleaning
- SSPC-SP 11, Power Tool Cleaning to Bare Metal
- SSPC-SP 12/NACE No. 5, Surface Preparation and Cleaning of Metals by Water Jetting Prior to Recoating
- SSPC-VIS 1, Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
- SSPC-VIS 5, Guide and Reference Photographs for Steel Surfaces Prepared by Wet Abrasive Blast Cleaning
- SSPC-Guide 15, Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates
- SSPC-CS 23.00/AWS C2.23M/NACE No. 12, Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel

American National Standards Institute/American Welding Society

- ANSI/AWS C2.25/C2.25M, Specification for Thermal Spray Feedstock – Wire and Rods
- ANSI/AWS C2.16/C2.16M, Guide for Thermal Spray Operator Qualification Programs

Metallizing wire and coating manufacturer's application instructions, SDS and product data sheets.

159009.02 MATERIALS.

A. Metallizing Wire.

1. The zinc wire (99.99%) and the 85/15 zinc/aluminum metallizing wire shall comply with ASTM B833 or ANSI/AWS C2.25/C2.25M. Only one wire composition (zinc or zinc/aluminum) shall be used for the entire project.
2. The same metallizing wire manufacturer shall be used for the entire project. Metallizing wire produced by different manufacturers shall not be co-mixed. Material shall be delivered in original, labeled packaging, bearing manufacturer's name and brand name, type of material, and lot number.

B. Paint (Clear Epoxy Seal Coat, Epoxy Intermediate Coat, Epoxy Top/build Coat and Urethane Topcoat) Materials.

1. All paint materials over the entire bridge structure, including thinners, shall be supplied from the same manufacturer. Manufacturer's product data sheets, application instructions, and material safety data sheets for all products shall be on the worksite and readily accessible.
2. The two-coat paint system comprised of an epoxy sealer coat (abbreviated to 'S') and a urethane topcoat (abbreviated to 'U') over the zinc metallizing (abbreviated to 'Zm'). The two-coat paint system together with the zinc metallizing forms the ZmSU Coating System. The clear epoxy seal coat material to be applied over the metallizing shall be selected from one of the manufacturer's products in Table 1 below. The urethane topcoat materials to be applied over the clear epoxy sealer material shall be selected from paint products listed in Table 2 below and shall be from the same manufacturer as the clear epoxy seal coat.
3. For the three-coat paint system comprised of an epoxy sealer coat (abbreviated to 'S'), an epoxy intermediate coat (abbreviated to 'E') and an epoxy top/build coat (abbreviated to '+E') over the zinc metallizing (abbreviated to 'Zm'). The three-coat paint system together with the zinc metallizing forms the ZmSE+E Coating System. The clear epoxy seal coat material to be applied over the metallizing shall be selected from one of the manufacturer's products in

Table 1 below. The epoxy intermediate coat and the epoxy top/build coat shall be selected from Table 3 below and shall be of the same manufacturer as the clear epoxy seal coat.

4. Material shall be delivered in sealed containers with the manufacturer's name, brand name, type of material, and batch numbers clearly identified.
5. Topcoat color is to be Federal Standard color 16493, with underlying coats in contrasting colors. The topcoat color shall be produced in the same color and gloss throughout the duration of the contract. The allowable variation in color is ± 1.0 Delta E (ASTM D2244) and gloss is ± 5 units (ASTM D523).

Table 1 – Clear Epoxy Seal Coat Materials

Manufacturer	Clear Seal Coat
Carboline Company	Rustbond Penetrating Sealer DFT – See Note 1 Below
International Paint	Interbond 600 DFT – See Note 1 Below
Sherwin-Williams Company	Macropoxy 920 Pre-Prime Penetrating Sealer DFT – See Note 1 Below

Note 1: Apply the clear epoxy seal coat to achieve a theoretical dry film thickness of 1.0 to 1.5 mils. The intent of the sealer coat is to saturate and cover the surface of the metallizing rather than to build a film thickness; therefore, dry film thickness measurements of the clear epoxy seal coat are not required.

Table 2 –Urethane Topcoat Materials

Manufacturer	Urethane Topcoat
Carboline Company	Carbothane 133 (HB, LV or VOC) DFT – 3 mils to 6 mils
International Paint	Interthane 870UHS DFT – 3 mils to 6 mils
Sherwin-Williams Company	Acrolon 218 HS DFT – 3 mils to 6 mils

Table 3 –Epoxy Intermediate Coat and Top/build Coat Materials

Manufacturer	Epoxy Intermediate Coat and Top/build Coat
Carboline Company	Carboguard 893 DFT – 3 mils to 6 mils
International Paint	Intergard 475HS DFT – 4 mils to 8 mils
Sherwin-Williams Company	Macropoxy 646 DFT – 5 mils to 10 mils

C. Abrasive Blast Media.

1. Abrasive blast media shall be clean and free of any contaminants, including detrimental amounts of water-soluble, solvent-soluble, acid-soluble or any other similar soluble materials. Blast media shall be in conformance with requirements of SSPC-CS 23.00/AWS C.2.23M/ NACE No. 12, Table 2, “Blasting Media and Mesh Size Found suitable for TSC’s on Steel Substrates”.
2. Mineral and slag abrasives shall meet the requirements of SSPC-AB 1 and steel grit shall meet the requirement of SSPC-AB 3.

D. Compressed Air.

Compressed air used during all work operations shall be clean, dry, and free from oil residues, when tested according to ASTM D 4285. The cleanliness of the compressed air shall be tested once per shift for each compressor system in use. Records of compressed air cleanliness tests shall be available for review. Sufficient freedom from oil and moisture is confirmed if soiling or discoloration is not visible on the paper. If the air is not clean and dry, operations using that compressed air system shall be stopped and corrective action taken to correct the problem. All work performed since the last satisfactory test shall be thoroughly examined and reworked as needed at no additional cost to the Department.

159009.03 CONSTRUCTION.

A. Submittals.

All documents are to be submitted and reviewed electronically in accordance with project requirements. Hardcopies of documents will not be processed. Do not begin metallizing or painting until the submittals, except the Inspection Reports, are accepted by the Engineer.

1. Product Data.

Manufacturer’s technical data sheets including the following information for each paint:

- a. Volume Solids
- b. VOC
- c. DFT range
- d. DFT maximum
- e. Substrates
- f. Surface preparation
- g. Profile
- h. Storage temperature
- i. Primers
- j. Topcoats
- k. Application equipment, including touchup

- l. Weight per gallon
 - m. Volume Nonvolatile Matter
 - n. Mixing
 - o. Thinners
 - p. Thinning maximum
 - q. Sweat-in-time
 - r. Pot life
 - s. Application schedule - Minimum surface/air temperatures and humidity, Maximum surface/air temperatures and humidity
 - t. Drying schedule – Dry to handle, Dry to topcoat, Maximum recoat
 - u. Viscosity
 - v. Pigment Content
- 2. Metallizing Data.**
- a. Proposed method for metallizing welded areas, if any.
 - b. Proposed abrasive blast media material data and proposed blasting equipment, include material safety data sheets.
 - c. Proposed testing instruments for checking surface profile, ambient conditions, surface cleanliness, air cleanliness, coating thickness, tensile bond and bend test.
 - d. Qualifications of proposed thermal spray operators.
 - e. Certification and experience of thermal spray operators.
 - f. Certification of purity, including chemical composition of each lot of wire.
 - g. Certification that the abrasive conforms to SSPC-AB 1 for mineral and slag abrasive or SSPC-AB 3 for ferrous metallic abrasives.
 - h. Product data on metallizing wire and metallizing spray application equipment gun. Include certification that surface meets the Class B slip coefficient.
 - i. Field touch-up procedures for metallized coatings.
 - j. Written application instructions from the paint manufacturer that address use with thermal spray coatings.
- 3. Batch Data.**
- a. Epoxy and urethane paint Material Batch Certifications.
 - b. Prior to delivery of any new batch of epoxy and urethane paints, furnish the Engineer with a material test report from the paint manufacturer certifying that the material supplied is equivalent in formulation, color and gloss to the batch originally tested and approved, in accordance with requirements of this Specification Section and these Specification Notes.
 - c. Furnish the following certified test results for each batch:
 - 1) Viscosity.
 - 2) Percentage total solids by weight.
 - 3) Weight per gallon.
 - 4) Total nonvolatile volume.
 - 5) Pigment content.
- 4. Samples.**
- a. Submit to the Engineer for approval the specified topcoat color.
 - b. On 12 inch by 12 inch hardboard or metal panels, two samples of each paint and coating material. If more than one application method is to be used, submit two samples of each paint and coating material for each application method.
 - c. Identify each sample as to manufacturer, color name and number, location, and application.

5. Shop Metallizing and Painting Contractor Qualifications.

Provide three reference projects including project description, location, and client contact information. Provide AMPP-QP 3 and AMPP-QP 6 Certification, or an AISC Complex Coatings Endorsement-Enclosed (CCE-1) certification. Certification to be current at the time of bidding and throughout the entire project. Confirm that the Contractor has all of the equipment needed to do the cleaning and painting work, and has areas available for specific operations, such as: receiving and laydown for steel to be painted; pre-cleaning of items to be painted; surface preparation; coating application; drying and curing of painted items; and storage of paint materials. Include a statement that ample protected storage capacity is available to allow for the proper curing of the epoxy seal coat prior to application of intermediate and topcoats.

6. Field Painting Contractor Qualifications.

Provide evidence of AMPP-QP 1 certification. Certification to be current at time of bidding and throughout the entire project. Confirm that the Contractor has all of the equipment needed to do the cleaning and painting work, including containment materials.

7. Quality Control (QC) Personnel Qualifications.

Provide evidence of AMPP (formerly SSPC) Bridge Coatings Inspector (BCI) Level 2 or AMPP (formerly NACE) Certified Coatings Inspector (CIP Level 2 Certification) certification. The personnel performing the QC tests shall be trained in all tests, inspections, and instrument use required for the inspection of surface preparation, metallizing and paint application. Documentation of training shall be provided. The QC personnel shall be solely dedicated to quality control activities and shall not perform any production work. QC personnel shall take the lead in all inspections, but applicators shall perform wet film thickness measurements during application of the coatings, with QC personnel conducting random spot checks. The designated Quality Control inspector shall be onsite full time during any operations that affect the quality of the system (e.g., surface preparation, metallizing application, paint application, and final inspection at project completion). The Contractor shall not replace the QC personnel assigned to the project without advance notice to the Engineer, and acceptance of the replacement(s), by the Engineer.

8. Shop and Field Contractor Plans and Programs.

Provide plans and programs addressing all requirements as follows:

- a. Quality Control (QC) Plans and Programs (Shop and Field Contractor). Provide Quality Control programs as identified in AMPP-QP 1, AMPP-QP 3, AMPP-QP 6 and AISC Complex Coatings Endorsement-Enclosed (CCE-1), as applicable. Include test frequencies for each inspection, and a copy of the inspection report form(s) that will be completed daily. The inspection report form(s) shall contain the information to record the results of the quality control tests and inspection and shall note the following at a minimum:
 - 1) Ambient conditions.
 - 2) Surface preparation (solvent cleaning, abrasive blast cleanliness, surface profile depth, etc.).
 - 3) Metallizing application (specified materials used, bend test, continuity and coverage, adhesion, dry film thickness).
 - 4) Verification that the MISTIC test ID number for the paint system has been issued.
 - 5) Paint Application (specified materials used, continuity and coverage, dry film thickness, freedom from overspray, dry spray, pinholes, skips, misses, etc.).
- b. Surface Preparation, Metallizing and Painting Plan with Hold Points (Shop and Field Contractor). Identify the methods of surface preparation and types of equipment to be used for solvent cleaning, abrasive blast cleaning, pressure washing, power tool cleaning, and chloride remediation. The plans shall include hold points for Quality Assurance by the Engineer. At a minimum, hold points shall be established for solvent cleaning, surface preparation, surface profile, and surface condition prior to metallizing.

Contractor shall provide the Engineer with a minimum 4 hour notification in advance of the hold point. If 4 hour notification is provided and the work is ready for inspection at that time, the Engineer will conduct the necessary observations. If the work is not ready at the appointed time, unless other arrangements are made, an additional 4 hour notification is required. Permission to proceed beyond a hold point without a QA inspection by the Engineer will be at the sole discretion of the Engineer and will only be granted on a case-by-case basis. Provide manufacturer's written procedure for paint application that includes instructions for correcting insufficient and/or excessive dry film thickness. Plan shall include paint and metallizing repair and paint and metallizing touch-up procedures and a paint and metallizing touch up and paint and metallizing repair decision matrix. Identify trade names of the materials that will be used, including the material for spot priming field fasteners, and provide product data sheets and safety data sheets (SDS). Provide written certification that expendable abrasives and recyclable steel grit abrasives meet the requirements of SSPC-AB 1 and AB 3, respectively, and the recycled abrasives meet the requirements of SSPC-AB 2.

- c. Shop Shipping and Handling Plan. Submit a written plan outlining the precautions that will be taken for the protection of the finished surface during shipping and handling. Include the steps to be taken, such as insulating padding, wood dunnage, load securing strapping, binding apparatus, etc.
- d. Surface Preparation, Metallizing and Painting Inspection Access Plan. Identify the means of access that will be used by the Contractor QC personnel for ongoing inspections and by the Engineer during Quality Assurance (QA) observations.
- e. Field Containment Plan. Address project-specific conditions and determine the type and extent of containment needed to control and contain paint droplets and metallizing spray, spills, overspray, etc., and other project debris. Provide drawings of proposed containment plans.
- f. Worker Protection/Safety Program. Provide a comprehensive written safety program for the protection of all Contractor and Subcontractor personnel from project hazards.

9. Inspection Reports.

Submit one copy of each daily inspection report to the Engineer before work resumes the following day.

B. Test Areas (Sections).

1. Prior to proceeding with production work on the project, the Contractor shall prepare test sections of at least 10 square feet. More than one test section may be needed to represent the various design configurations of the structure. The test section(s) shall be blast cleaned, metallized and painted in accordance with the requirements specified herein using the same equipment, materials and procedures that will be used for the production.
2. During the blast cleaning, metallizing, and painting of the test section(s), in the presence of the Engineer, the Contractor shall perform all quality control tests and inspections required by this specification including complete documentation. In addition, the Contractor shall allow sufficient time for the Engineer to perform any or all quality assurance tests and inspections desired.
3. Production work shall not proceed until the Engineer agrees that the blast cleaning, metallizing, and painting work, along with the quality control testing, inspection, and documentation are acceptable.
4. No additional compensation will be paid for the preparation of the test section(s).

C. Surface Preparation.

1. The contractor shall notify the Engineer 24 hours in advance of beginning surface preparation operations.
2. Remove slag, flux deposits, weld splatter and surface irregularities such as slivers, tears, fins and hackles; follow AWS guidelines. Grind any resulting burrs smooth, including burrs around holes, if any. Do not remove any welding material that will weaken weld strength.
3. Break sharp edges such as those created by flame cutting and shearing. The surface of flame-hardened steel shall be removed by grinding to the extent necessary to achieve the specified profile on subsequent abrasive blast cleaning.
4. Clean all surfaces to be coated to remove oil, grease and other soluble contaminants in accordance with SSPC-SP 1. All steel to be metallized shall be blast cleaned in accordance with SSPC-SP 5 with an abrasive that produces sharp/angular surface profile as specified. Use SSPC VIS 1 to evaluate the degree of cleaning. For welds, edges and holes, prepare surfaces to the same standard and profile as the surrounding steel.
5. Use sharp, angular expendable abrasives or steel grit abrasives that are dry and free of oil, grease, dirt and other deleterious contaminants. The use of steel shot is not permitted for any blast cleaning. Mineral and slag abrasives shall comply with the requirements of SSPC-AB 1. Steel grit abrasive shall comply with SSPC-AB 3. If metal abrasives are recycled, they shall comply with SSPC-AB 2. The abrasive shall be checked at least daily for oil, grease and water-soluble (salt) contamination in accordance with SSPC-AB 2. The absence of oil and grease shall be confirmed using the oil content test. Absence of water-soluble contaminants shall be determined by conductivity and shall not exceed 1000 microSiemens per centimeter.
6. Final surface preparation that exposes bare steel shall not be performed under damp environmental conditions, or when the surface temperature is less than 5° F above the dew point temperature of the surrounding air.
7. The steel surface profile shall be 3.5 to 4.5 mils in depth. Measure the surface profile of each structural steel element, e.g. beam, angle, plate, at two locations paying special attention to areas that may have been shielded during the blasting. Measure the surface profile using "Testex Replica Tape" in accordance with ASTM D 4417.
8. All surface preparation residues, dirt, dust, etc. shall be removed from the surface to be metallized by vacuuming, brushing, or blowing off with clean, dry compressed air.

D. Metallizing.

1. Only contractors meeting the requirements of Article 159009.01, B, shall be used for the application of metallizing in the shop or field.
2. Prepared surfaces shall meet the requirements of SSPC-SP 10 immediately prior to metallizing. Any surface which shows visible contamination or rust bloom shall be re-blasted before metallizing application. At least one layer of the metallized coating shall be applied within 4 hours of blasting and the surface shall be completely coated to the specified thickness within 8 hours of blasting.
3. All dust and surface preparation residue on steel surfaces shall be removed prior to metallizing.
4. The quality of surface preparation and cleaning of surface dust and debris shall be accepted by the Engineer prior to metallizing.

5. The Engineer has the right to reject any work that was performed without adequate provision for QA observations to accept the degree of cleaning. Rejected metallizing work shall be removed and replaced at no additional cost to the Contracting Authority.
6. Metallizing shall be performed in accordance with SSPC-CS 23.00/AWS C2.23M/NACE No. 12.
7. Apply the metallizing using a suitable electric arc wire type metallizing gun.
8. **Environmental Conditions for Metallizing Application.**

Metallizing shall be applied under the following conditions unless the metallizing wire manufacturer's recommendations are otherwise. In the event of conflict, submit a written request to the Engineer for resolution.

 - a. Clean and dry surface.
 - b. Air and Surface Temperature - 40° F to 110° F.
 - c. Dew Point - Surface temperature at least 5° F greater than the dew point.
 - d. Relative Humidity - less than 90%.
9. The metal coating shall be applied to a thickness of 8.0 to 12.0 mils, applied in several crossing passes. The sprayed metal shall overlap on each pass of the gun to ensure uniform coverage.
10. After spraying, the surface shall be completely and uniformly coated, free of lumps and loosely adherent, spattered metal.
11. The metal coating shall not crack or spall when subjected to the bend test. Companion test coupons shall be sprayed using the same parameters as the work. Coupons shall be bent 180 degrees on a mandrel with mandrel diameter based on coating thickness per SSPC-CS 23.00/ AWS C.2.23M/NACE No. 12, Table 4, "Bend Test Cracking Threshold". If the panels fail, the metallizing represented by the panels shall be removed and replaced.
12. The 99.99% zinc metal coating shall have a minimum tensile bond strength of 500 psi. 85/15 zinc/aluminum metal coating shall have minimum tensile bond strength of 700 psi. Testing shall be performed with a portable adhesion tester in accordance with ASTM D 4541. Metallizing that fails the bond test shall be removed and replaced.
13. As an additional bond test, the Engineer may cut through the coating with a sharp chisel at a shallow angle. If upon cutting, any part of the coating can be lifted from the surface, the bond shall be deemed unacceptable, and the metallizing removed and replaced.
14. Inspect the metal coating for thickness by means of an SSPC-PA 2 Type 2 magnetic thickness gauge. Inspection shall follow as closely as possible after completion of application. For flat surfaces a measurement line shall be used, and for complex geometries a measurement spot shall be used. Measure one line or spot for each 100 to 200 square feet of metallizing in accordance with SSPC-CS 23.00/AWS C2.23M/NACE No. 12.
15. Metallized surfaces which have been rejected shall have defective sections blasted clean of all metallized metal prior to re-spraying, except that where the rejection is due solely to insufficient thickness of coating, additional sprayed metal may be added if the surface is completely dry, clean, dust free and free of visible contamination.
16. If the metallizing thickness is greater than 150% of the specified thickness, the metallizing shall be completely removed, the surface blast cleaned, and the metallizing applied to the proper thickness.

E. Paint Application over Metallizing.

1. Do not apply the epoxy seal coat until the metallizing has been accepted by the Engineer. The metallizing shall be dry and free of any visible oxidation at the time of application. Visible oxidation shall be removed.
2. The metallizing shall be coated with one of the manufacturer's clear epoxy seal coat materials shown in Table 1 of this Specification within 8 hours of metallizing application. Mix and apply the epoxy seal coat material in accordance with manufacturer's technical product information. Do not apply epoxy intermediate coat or the urethane or epoxy topcoat until the epoxy seal coat has sufficiently dried and cured in accordance with the manufacturer's technical product information.
3. The urethane finish coat materials shall be applied in strict accordance with the requirements specified in Article 2408.02, Q, of the Standard Specifications.
4. The top of top flanges embedded in concrete are to be metallized and shall receive the epoxy penetrating sealer only.
5. Faying surfaces are to be metallized and the epoxy penetrating sealer held back from faying surfaces.
6. Fasteners shall be prepared and painted in accordance with Article 2408.02, Q, 2, b, 5, of the Standard Specifications after bolting.

F. Touch-Up of Completed Coating System.

1. The Contractor shall repair all damaged and/or unacceptable areas of the completed coating systems (all metallizing and paint layers) prior to shipment as defined below. The same process shall be followed for the repair of shipping, handling, and erection damage.
2. Damage to the metallizing and/or paint that does not expose the substrate shall be prepared by solvent cleaning in accordance with SSPC-SP 1 followed by power tool cleaning in accordance with SSPC-SP 3 to remove loose material. For the repair of damaged metallizing that exposes the substrate, the surface shall be spot blast cleaned in accordance with SSPC-SP 10. If blast cleaning cannot be performed, as authorized by the Engineer, the damage shall be spot power tool cleaned to SSPC-SP 11.
3. The metallizing and/or paint surrounding each repair area shall be feathered for a distance of 1 to 2 inches to provide a smooth, tapered transition into the existing intact material. The surrounding intact paint shall be roughened to promote adhesion of the repair coats.
4. Damage to metallizing that extends to the substrate shall be repaired. For metallizing it is critical that all remnants of sealer or paint have been removed from the porosity of the metallizing before applying new metallizing or an adhesion failure can occur. If it is no longer feasible to apply metallizing, spot-apply an organic zinc rich primer. After priming, apply the same paint coats used on the surrounding steel. If the damage does not expose the substrate, only the effected paint coat(s) shall be applied.

159009.04 METHOD OF MEASUREMENT.

None.

159009.05 BASIS OF PAYMENT.

The cost of surface preparation and application of ZmSU Coating System and ZmSE+E Coating System to structural steel is incidental to the contract price for the items that have structural steel designated for metallizing as listed in the contract documents. This cost includes:

- Labor, materials, and equipment to complete the surface preparation and application of ZmSU Coating System and ZmSE+E Coating System according to this specification.
- Costs to recoat or repair the coating systems after erection.