

## SECTION 05 50 13.13 – METALLIZING AND COATING HYDRAULIC STRUCTURES

### 1.01 <sup>A7</sup>SUMMARY:<sup>A7</sup>

- A. <sup>A7</sup>**Scope:**<sup>A7</sup> This Section contains the performance and prescriptive specifications for metallizing and coating hydraulic structures of the locks complexes. <sup>A11</sup>Metallizing and coating shall be required for hydraulic structures which cannot be effectively protected by corrosion control coatings in accordance with Section 09 96 00 (*Corrosion Control Coatings*) and galvanic cathodic protection in accordance with Section 26 42 00 (*Cathodic Protection*).<sup>A11</sup>

1. The objective of metallizing and coating is to obtain a 40-year service life of the protective coating system applied on hydraulic structures, minimizing the need for outages to perform coating maintenance work.
2. <sup>A5</sup>The coating system applied on top of the metallizing protects the metallizing from reacting chemically with the environment. The metallizing provides passive barrier protection to the metal substrate should breaks develop in the coating system<sup>A5</sup>.

- B. (Reserved)

- C. **This Section includes:** Metallizing and coating [requirements for structures which cannot be effectively protected with coatings and cathodic protection](#).

<sup>A5</sup>D <sup>A5</sup>. **Related Sections:**

- 01 81 19 (*Lock Gates*).
- 01 81 23 (*Valves*).
- 09 96 00 (*Corrosion Control Coatings*).

### 1.02 [REFERENCES:](#)

- A. **American National Standards Institute (ANSI) Standard:**

Z535.1-2002                      Safety Color Code

- B. **American Society for Testing and Materials (ASTM) International Standards:**

B 117-2007	Practice for Operating Salt Spray (Fog) Testing Apparatus
C 633-2001	Adhesion or Cohesive Strength of Flame-sprayed Coatings
D 344-2004	Relative Hiding Power of Paints by the Visual Examination of Brush-outs
D 522-2001	Mandrel Bend Test of Attached Organic Coatings
D 660-2005	Evaluating Degree of Checking of Exterior Paints
D 661-2005	Evaluating Degree of Cracking of Exterior Paints

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| D 714-2006   | Evaluating Degree of Blistering of Exterior Paints   |
| D 772-2005   | Evaluating Degree of Flaking (Scaling) of Exterior Paints  |
| D 867-1981 (R1986)   | Pumice Pigment   |
| D 870-2002   | Water Resistance of Coatings Using Water Immersion   |
| D 1653-2003  | Water Vapor Transmission of Organic Coating Films  |
| D 2247-2002  | Water Resistance of Coatings in 100% Relative Humidity   |
| D 2583-2007  | Indentation Hardness of Rigid Plastics by Means of Barcol Impressor  |
| D 2794-2004  | Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)  |
| D 3363-2005  | Film Hardness by Pencil Test   |
| D 4060-2007  | Abrasion Resistance of Organic Coatings by the Taber Abrasive  |
| D 4214-2007  | Evaluating Degree of Chalking of Exterior Paint Films  |
| D 4417-2003  | Field Measurement of Surface Profile of Blast Cleaned Steel  |
| D 4541-2002  | Pull-off Strength of Coatings Using Portable Adhesion Testers  |
| D 5162-2001  | Discontinuity (Holiday) Testing of Nonconductive Protective Coatings on Metallic Substrates                        |
| G 8-2003   | Cathodic Disbonding of Pipeline Coatings   |
| <br><b>C. American Welding Society (AWS) Publications:</b>                 |  |
| C 2.18-1993  | Guide for the Protection of Steel with Thermal Sprayed Coatings of Aluminum, Zinc, and Their Alloys and Composites |
| <br><b>D. Military Specification:</b>                                      |  |
| MIL-W-6712C  | Wire, Metallizing  |
| <br><b>E. National Association of Corrosion Engineers (NACE) Standard:</b> |  |
| RP 0188-1999   | Discontinuity (Holiday) Testing of Protective Coatings   |
| <br><b>F. The Society for Protective Coating (SSPC) Publications:</b>      |  |
|  | Steel Structures Painting Manual, Volume 2, Systems and Specifications, Seventh Edition: 1995                      |

PA 2-2004	Measurement of Dry Coating Thickness with Magnetic Gages
97-07	The Inspection of Coatings and Linings, a Handbook of Basic Practice for Inspectors, Owners, and Specifiers.
Vis 1-2002	Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs)

### 1.03 <sup>A7</sup>REQUIREMENTS:<sup>A7</sup>

- A. <sup>A7</sup>**Corrosion Protection Requirements:**<sup>A7</sup> The Contractor shall design and apply corrosion control coatings that will protect hydraulic structures and appurtenant metal surfaces from corrosion and deterioration caused by the environment and service. <sup>A5</sup>Where the surfaces to be protected cannot be metal sprayed because the physical design restricts the use of current thermal spray equipment, the surfaces shall be protected by a coating system that will provide an equivalent service life. In this case, the coating system shall comply with all the requirements of this Section, except that the metal surface to be coated shall undergo surface preparation to white metal SSPC SP 5 and the anchor profile shall be adequate for the coating system to be applied.<sup>A5</sup> <sup>A11</sup>(Deleted text)<sup>A11</sup>
1. Use a thermal spray metallic coating appropriate for the service environment directly applied on the prepared metal surface, in accordance with ANSI/AWS C 2.18.
  2. Use a low-viscosity sealer to fill the pores of the metal coating. The sealer shall be compatible with the metallizing material. The fineness of grind of pigments in the sealer shall not interfere with the sealing of the pores and shall be a minimum of 5.
  3. Use coatings appropriate for a tropical, coastal marine environment, which will as a minimum withstand 5,000 hours without corrosion in salt spray cabinet as tested in accordance with ASTM B 117.
  4. Use coating systems with sufficient number of coats to minimize direct contact of the metallizing with the environment.
- B. <sup>A7</sup>**Adherence Requirements:**<sup>A7</sup>
1. Design metallizing and coating systems that will show adhesion of the thermally sprayed metal coating complying with the requirements of Subparagraph 1.03 C.1. In addition, metallized coupons (prepared in the same manner as that used on the hydraulic structure) shall pass the ½ inch diameter mandrel 180° bend test with minor or no cracking, but no disbanding or delamination, as per ASTM D 522.
  2. Adhesion of coatings on metallized surfaces shall be a minimum of 500 psi, tested in accordance with ASTM D 4541.

3. Schedule and apply coatings to avoid any type of surface contamination, including salts, water, dust, oil or grease, which may affect adherence of the metal spray coatings or corrosion control coatings.
4. Compatibility between coats of different materials. In general, primers, intermediate coats and finish coats shall be from the same manufacturer.
5. Coatings after application shall not show any adhesion-related failures such as blisters, peeling or flaking or intercoat delamination. Applied coatings shall not show visible evidence of entrapped solvents or humidity between the substrate and primer or between coats. Blistering shall be evaluated in accordance with ASTM D 714. Flaking shall be evaluated in accordance with ASTM D 772.
6. Surface anchor profile of blast cleaned surfaces to be metallized shall be in the range of 75-100 microns, as measured in accordance with ASTM D 4417, Method C. Surfaces requiring abrasive blast cleaning shall be cleaned to degree specified in accordance with the corresponding surface preparation specification and visual standard SSPC Vis 1-89. Use a blasting media compatible with the metallizing material and application process to be used.

C. <sup>A7</sup>**Integrity Requirements:**<sup>A7</sup>

1. Thermal spray metallizing shall have a minimum tensile strength of 800 psi for Zinc or of 1500 psi for Aluminum. Adhesion and cohesive tests of metal sprayed coatings shall be in accordance with ASTM D 633<sup>A5</sup>.<sup>A5</sup>
2. Finished coatings shall be free from mud-cracking, wrinkling, cracking, chalking and other coating failures or deterioration. Use surface preparation, pretreatment, primers, intermediate coats, and finish coats that will, as a system, meet the requirements for the environment and service.

D. <sup>A7</sup>**Thickness Requirements:**<sup>A7</sup> <sup>A5</sup>Metallizing thickness and coating thickness shall be appropriate for the environment and service and shall provide corrosion protection to the substrate for the service life and level of maintenance specified.<sup>A5</sup>

E. <sup>A7</sup>**Chemical Resistance Requirements:**<sup>A7</sup> Provide coatings with chemical resistance adequate for the environment in which the metal is to perform its service. As a minimum, corrosion control coatings shall be resistant to:

1. Acids from acid rain or fog which may form from electrical thermal generation, vehicular and ship exhaust.
2. Alkalis from salts in the coastal environment
3. <sup>A5</sup>Coatings that are used in the same areas with fuels and oils, grease, or other lubricants and that may be subject to splash or spillage shall be resistant to hydrocarbons.<sup>A5</sup>
4. Coatings used in tank interiors shall be resistant to continuous immersion in the type of liquids contained.

5. Sealers and coatings used on zinc, galvanized steel, or aluminum shall have adequate adhesion on such surfaces, and shall not be subject to saponification.
6. Coatings in underwater service shall have excellent alkali resistance and excellent resistance to cathodic disbondment, as measured in accordance with ASTM G 8.

**F. Water Resistance Requirements:**

1. Coatings shall have low water permeability. Water vapor transmission rate shall not exceed 0.25 perms when tested in accordance with ASTM D 1653.
2. Coatings shall have an excellent humidity resistance, as tested by either humidity cabinet in accordance with ASTM D 2247.
3. Coatings used on underwater steel shall be suitable for continuous immersion in fresh or salt <sup>A5</sup>water and <sup>A5</sup> shall be resistant to ionic passage, moisture vapor transfer, and to osmosis. Water immersion resistance shall be no less than 3000 hours as tested in accordance with ASTM D 870.

**G. Flexibility Requirements:**

1. Coatings applied on metals exposed to thermal expansion and contraction, or bending, shall be adequate for such service. Such coatings shall pass the mandrel bend test performed in accordance with ASTM D 522.
2. Coatings after full cure and exposure to the actual service environment shall show no signs of cracking, as evaluated by ASTM D 661.

**H. <sup>A7</sup>Temperature Resistance Requirements:<sup>A7</sup>** Design and apply corrosion control coating systems that will meet performance requirements in the full temperature range of the service environment.

**J. <sup>A7</sup>Abrasion Resistance Requirements:<sup>A7</sup>** Floor coatings shall be resistant to the expected foot or wheel traffic.

**K. <sup>A7</sup>Slip Resistance Requirements:<sup>A7</sup>** Floor coatings shall contain non-skid pigments to produce slip resistance for foot and wheel traffic. Non skid pigments conforming to ASTM D 867 shall be added to the coating material in a proportion recommended by the coating manufacturer.

**L. <sup>A7</sup>Hardness Requirements:<sup>A7</sup>**

1. Each coating system after full cure shall have sufficient hardness to sustain its integrity under the expected service and operational environment.
2. The hardness shall not be less than that stated in the manufacturer technical documentation, as measured by the pencil hardness test per ASTM D 3363 or the Barcol hardness test per ASTM D 2583.

3. For coatings where abrasion is a concern, the hardness shall not be less than that stated in the manufacturer technical documentation as measured by the Taber wheel abrasion test per ASTM D 4060.
- M. <sup>A7</sup>**Impact Resistance Requirements:**<sup>A7</sup> Coatings that will be subject to impact shall pass ASTM D 2794.
- N. **Durability Requirements:** Design and apply corrosion control coatings that have a minimum service life without maintenance, of 20 years in fully or intermittently submerged fresh water, brackish water and seawater, and of 10 years in atmospheric or Splash Zone exposure.
1. <sup>A7</sup>**Weathering:**<sup>A7</sup> Design and apply coatings that have superior weathering resistance, and resistance to degradation from ultraviolet radiation.
  2. Apply corrosion control coatings and thermally sprayed coatings on metal substrate surfaces that have been properly prepared, to the degree required by the coating or metallizing material to be applied, in accordance with the surface preparation standards found in the SSPC Steel Structures Painting Manual, Systems and Specifications:
    - a. SSPC SP1 Solvent Cleaning
    - b. SSPC SP2 Hand Tool Cleaning
    - c. SSPC SP3 Power Tool Cleaning
    - d. SSPC SP5 White Metal Cleaning
    - e. SSPC SP10 Near White Metal Cleaning
- P. <sup>A7</sup>**Uniformity Requirements:**<sup>A7</sup> Apply corrosion control coatings in such a manner as to produce a protective, continuous film of uniform thickness and consistency.
- Q. <sup>A7</sup>**Service Life:**<sup>A7</sup> Design and apply corrosion control coatings which will extend the service life of the metallized hydraulic structures and appurtenances with minimal coatings maintenance. The service life of the metallizing and coating system shall be a minimum of 40 years for exterior, atmospheric exposure, intermittent underwater immersion exposure in fresh and salt water, and continuous underwater immersion exposure in fresh and salt water in a tropical, coastal marine environment.
- R. <sup>A7</sup>**Dielectric Strength Requirements:**<sup>A7</sup> Coatings for underwater service shall have a high dielectric strength and shall be free from porosity or holidays (an area left uncovered during the application of paint) as tested in accordance with NACE RP 0188 and ASTM D 5162.
- S. <sup>A7</sup>**Appearance Requirements:**<sup>A7</sup>
1. Finished coatings shall not show evident contamination by dust or abrasives, brush marks or fibers, runs or sags, dry overspray, holidays or missed spots, spattering or cratering.

2. Corners and edges, welds, plate overlaps, hardware, and other irregular surfaces shall show complete covering by coatings.
  3. Finished coatings shall be free from pinpoint rusting, checking, discoloration, chalking and other coating failures. Chalking shall be evaluated in accordance with ASTM D 4214. Checking shall be evaluated in accordance with ASTM D 660.
- T. <sup>A7</sup>**Health and Environmental Protection Requirements:**<sup>A7</sup> Design corrosion control coating systems that will minimize impact on health and the environment.
1. **Solvents:** Use high build, high solids coatings or solvent-free coatings that will emit only small quantities of solvents to the atmospheres. Do not use coating solvents or cleaning solvents which are in the ACP prohibited list. See Section 01 35 23 (*Health and Safety Requirements*).
  2. **Contents:** Use coatings which do not have ingredients which are considered carcinogenic or dangerous to human health or the environment. Do not use coatings that contain lead and other heavy metals. Do not use coating materials that when removed would be considered hazardous or toxic waste. See Section 01 35 23 (*Health and Safety Requirements*).
  3. <sup>A7</sup>**Safety Requirements:**<sup>A7</sup> Restrict the use of cleaning and coating materials which constitute a fire/explosion hazard during application. See Section 01 35 23 (*Health and Safety Requirements*).
- U. **Maintenance Requirements:**
1. Design and apply coating finishes that will prevent dirt pickup and that may be low pressure water washed without damaging the coating.
  2. Use coatings which may be touch-up repaired without requiring complete removal or complicated surface preparation.
  3. Standardize corrosion control coatings systems for metal items in the same environment and service. Where possible, use the same corrosion control coating system in both Locks Complexes.
- V. **Color Requirements:** Colors shall be as approved by the <sup>A5</sup>Employer's Representative.<sup>A5</sup> Color <sup>A5</sup>designations <sup>A5</sup>used for safety purposes shall be in accordance with ANSI Z535.1.
1. For corrosion protection of metals in exterior locations, design and apply coating finishes that will retain color and gloss during <sup>A5</sup>the <sup>A5</sup>required service life.
  2. Design and apply coating finish materials with complete hiding characteristics. <sup>A5</sup>If required, <sup>A5</sup>hiding shall be evaluated in accordance with ASTM D 344.

## 1.04 <sup>A7</sup>DESIGN CRITERIA/SYSTEM DESCRIPTION AND PERFORMANCE:<sup>A7</sup>

### A. General Requirements:

1. Use a thermal spray coating material appropriate for the service environment, work site environment, and operating environment. Protect feedstock wires from corrosion by the environment during transportation and temporary storage. Use one of the following:
  - a. **Zinc Wire:** Use only zinc wire which is minimum 99.5% pure, conforming to AWS, Class W-Zn-1.
  - b. **Aluminum Wire:** Use only aluminum wire which is minimum 99% pure and conforming to Military Specification MIL-W-6712.
  - c. **Zinc/Aluminum Alloy Wire:** Use only an alloy made of 85% zinc and 15% aluminum. Do not use a combination of aluminum and zinc wires with simultaneous coil feed.
2. <sup>A7</sup>**Corrosion Control Coating System:**<sup>A7</sup> Design and [apply a corrosion control coating system on all metallized surfaces](#).
  - a. Design and apply a corrosion coating system on top of the metallizing, for corrosion protection [of the metallizing](#), appropriate for the service environment, work site environment, and operating environment.
  - b. In general, select a generic coating system material that has superior performance for the service and operating environment, with proven record of such performance and industry-wide acceptance.
3. Use an impermeable coating with high dielectric strength on the contact surfaces between:
  - a. Dissimilar metals
  - b. Metal surfaces in contact with porous materials
4. Use a thick, slow drying, impermeable coating with high dielectric strength on the contact surfaces between metals in close contact with each other, to fill in the gaps and avoid water entrance in the crevices.

B. Metal surface preparation and coating materials application shall be in accordance with manufacturer instructions.

### C. Protection of metals prior to coating:

1. Metals to be metallized and metallized surfaces to be coated shall be protected from corrosion by the environment until such time as the surface is completely protected by the approved coating system.
2. Protection from corrosion by the environment shall include protection by shelter, adequate storage provisions, or other covering of the metals from rain, dew, other sources of moisture, soil, dust, dirt, or salts in the wind, which may injure the metal during its temporary storage prior to construction, installation, and painting.



Surfaces that have been cleaned, pretreated, or otherwise prepared for painting shall be given a coat of the specified first-coat material as soon as practicable after such preparation has been completed; but in any event, prior to any deterioration of the prepared surface.

3. Hand and power tools, and blast cleaning abrasives used for metal substrate surface preparation shall not leave incrustations or embedded materials that may lead to dissimilar metal corrosion, or surface contamination that may cause improper adherence of the primer or first applied coat.

## 1.05 <sup>A7</sup>**SUBMITTALS:**<sup>A7</sup>

### A. **After Award:**

1. <sup>A7</sup>**Certifications:**<sup>A7</sup> Certifications and documentation of experience of contractor or subcontractor personnel that will perform the arc spray metallizing and coating work. Certifications from a recognized, independent testing laboratory, of compliance with the requirements of this Section and of the service life of the metallizing and corrosion control coating systems.
2. <sup>A7</sup>**Coating Systems:**<sup>A7</sup> For each different type of coating system to be used, the Contractor shall submit a coating system schedule identifying the surfaces to be coated. Each coating system shall include metal substrate surface preparation, metallizing, and coating schedule (sealer, primer coat, intermediate coats, and finish coats), individual coating thickness and overall thickness, and color. Coating thickness shall be as measured by SSPC PA 2.
3. <sup>A7</sup>**Documentation:**<sup>A7</sup> The Contractor shall submit descriptive literature and technical data and application instructions for each type of material, including blasting abrasive material, solvents, metallizing wire, sealers, primers, and coatings proposed for use on the project, with its batch number and date of manufacture, and an updated copy of its "MATERIAL SAFETY DATA SHEET" (form OSHA-174). See Section 01 35 23 (*Health and Safety Requirements*). Technical data shall include the ASTM laboratory test methods and corresponding results.

## 1.06 <sup>A7</sup>**QUALITY ASSURANCE:**<sup>A7</sup>

- A. Metallizing shall be performed by AWS American Welding Society or ASM American Society for Metals certified metal sprayers or approved equivalent.
- B. Metal surface preparation and coating application shall be performed by <sup>A5</sup>personnel who have been certified by the SSPC (the Society for Protective Coatings) or an approved equivalent organization.<sup>A5</sup>
- C. <sup>A5</sup>The quality assurance inspections, by the Contractor, shall be performed by coating inspectors who have been certified by NACE (the National Association of Corrosion Engineers) or an approved equivalent organization.<sup>A5</sup>
- D. In general, field testing shall be minimized. Testing, if required, shall be performed by <sup>A5</sup>qualified <sup>A5</sup>laboratories. Laboratory testing results printed in the commercial product technical documentation and/or certified by the coating manufacturer shall be accepted in

lieu of field testing.

- E. Inspection of work under this Section shall in general be done in accordance with SSPC handbook "The Inspection of Coatings and Linings".
- F. Non destructive tests shall be preferred to destructive tests. Where destructive tests are performed, the Contractor shall repair the damaged area in a manner consistent with the original coating system requirements.
- G. Equipment used for field testing shall be calibrated against calibrated laboratory testing equipment, and standard references, in accordance with the equipment manufacturer recommendations.

**END OF SECTION**