

## **SECTION 09 96 56**

### **EPOXY COATINGS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section includes:
1. This specification covers products and specialty equipment manufactured by Warren Environmental & Coatings, LLC, hereafter referred to as Warren.
  2. Specification also details product application requirements and procedures, including surface preparation, mixing, application, material handling and storage, qualification of Application Contractor, and application quality control.

##### **1.2 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
1. D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
  2. D638 - Standard Test Method for Tensile Properties of Plastics
  3. D695 - Standard Test Method for Compressive Properties of Rigid Plastics
  4. D790 - Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
  5. D2200 (SSPC VIS1) - Pictorial Surface Preparation Standards for Painting Steel Surfaces
  6. D2240 - Standard Test Method for Rubber Property - Durometer Hardness, Type D
  7. ASTM D4262 – Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
  8. D4414 - Standard Practice for Measurement of Wet Film Thickness by Notch Gages
  9. D4417 - Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
  10. D4541 - Standard Test Method for Pull-off Strength of Coatings Using a Portable Adhesion Tester
  11. D7234-19 - Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Tester
  12. D6132 - Non-destructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gage
- B. American National Standards Institute (ANSI)
1. ANSI/NSF 61 – Drinking Water Systems Components Health Effects
- C. NACE - The published standards of National Association of Corrosion Engineers (NACE International), Houston, TX.
1. NACE No. 6/SSPC-SP 13 Surface Preparation of Concrete
  2. NACE SP0188-2006 - Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
- D. SSPC – The published standards of the Society of Protective Coatings, Pittsburg, PA
1. SSPC-SP 13/NACE No. 6 Surface Preparation of Concrete
- E. ICRI – The published technical guidelines of the International Concrete Repair Institute, Inc.
1. Technical Guideline No. 310.2R-2013 Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair
- F. National Association of Pipe Fabricators (NAPF):
1. NAPF 500-03: Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings
  2. NAPF 500-03-04: Abrasive Blast Cleaning for Ductile Iron Pipe
  3. NAPF 500-03-05: Abrasive Blast Cleaning for Cast Ductile Iron Fittings

### 1.3 SYSTEM DESCRIPTION

- A. Service conditions include but are not limited to wastewater and wastewater gases in gravity sewers and force mains, potable water, stormwater, industrial process water, seawater, cooling water, or other liquids that are destructive to adjacent contact surfaces. Non immersion applications include transportation tunnels and shafts subject to corrosion caused by vehicle or equipment exhaust gases and water vapor or condensation.
- B. Structures include manholes, basins, wet wells, clarifiers, digesters, tanks, piping, tunnels, shafts, penstocks, canals, dams, channels or any other liquid conveyance or storage structure subject to corrosive liquids and gases.
- C. Substrates include concrete, brick, mortar, ferrous metals including iron and steel, galvanized steel, aluminum, rock, wood, and fiberglass.
- D. Industries served include but are not limited to water and wastewater treatment plants, food processing plants, power generation including hydroelectric plants and nuclear facilities, Navy vessels, marine applications including piers and pilings, and chemical or film production facilities.
- E. Application methods include hand spraying or spin casting utilizing Warren's patented plural component mixing and spraying equipment, or Warren supplied epoxy cartridges. Other application methods include troweling, brushing, rolling, or pouring, as required to achieve desired single coat thickness.

### 1.4 SUBMITTALS

- A. Product Technical Data Sheets
- B. Safety Data Sheets (SDS)
- C. Additional data as required by contract documents including third party test results and user references.
- D. Shop Drawings/Submittals

### 1.5 QUALITY ASSURANCE

- A. Manufacturer: Minimum 25 years' experience producing 100% solids epoxy coatings.
- B. Applicator:
  - 1. Manufacturer approved applicator trained and experienced in the installation and use of Warren epoxy and proprietary plural component 100% solids epoxy spray equipment and thoroughly knowledgeable in surface preparation and testing required to verify proper installation.
  - 2. Each applicator supervisor or foreman, spray rig operator and spray technicians must have a current training certificate verifying successful completion of Warren applicator training.
  - 3. All other field technicians shall have a thorough knowledge of cleaning, injection grouting, surface prep, application and testing of 100% solids epoxy coatings.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling, and Unloading
  - 1. Following the manufacturer's recommendations.
  - 2. Protective coating materials are to be handled according to their material safety data sheets.
- B. Acceptance at Site
  - 1. Products to be delivered to site in sealed, labeled, and unopened containers.
  - 2. Labels to include name, type, code, coverage, surface preparation, drying time, color, clean up procedure, and mixing and reducing instructions.
  - 3. Remove unacceptable products immediately.
- C. Storage and Protection
  - 1. Materials are to be kept dry, protected from weather, stored under cover, and stored between 32°F and 120°F. Do not store near flame or heat.

2. Coating materials shall be used within the manufacturer's recommended shelf life. Storage and Mixing: Coating materials shall be stored under the conditions recommended by the Product Data Sheets and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings from different manufacturers shall not be mixed together.
3. Storage and Mixing: Coating materials shall be stored under the conditions recommended by the Product Data Sheets and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings from different manufacturers shall not be mixed together.

## **PART 2 - PRODUCTS AND APPLICATION EQUIPMENT**

### **2.1 MANUFACTURER: WARREN ENVIRONMENTAL & COATINGS, LLC**

Address: 137 Pine Street, Middleborough, MA 02346

Phone: (508) 947-8539

Website: [www.warrenenviro.com](http://www.warrenenviro.com)

Email: [info@warrenenviro.com](mailto:info@warrenenviro.com)

### **2.2 MANUFACTURER SHALL MAINTAIN ISO 9001 CERTIFICATION**

### **2.3 PRODUCTS**

#### **A. 301-14 High Performance Epoxy – Wastewater and other non-potable water service**

100% solids, solvent free, zero VOC, structurally enhancing epoxy proven safe for aquatic life. Epoxy tested in accordance with ASTM E729 – Acute Toxicity Tests on Test Materials with Fishes, Macroinvertebrates, and Amphibians with 100% survival of test organisms.

Acute Toxicity Test EPA EPA-821-R-02-012 Method 2007.0 - 100% survival rate of test organisms

Acute Toxicity Test EPA EPA-821-R-02-012 Method 2007.0 - 100% survival rate of test organisms

Can be applied in a single coat up to - 500 mils (1/2")

Tensile Strength (ASTM D638) - 7,191 psi

Compressive Strength (ASTM D695) - psi - No new data

Flexural Strength (ASTM D790) - 11,448 psi

Flexural Modulus @ 0.100" (ASTM D790) - psi - No new data

Tensile Elongation at Break (ASTM D638) - 6.9 %

Shore D Hardness (ASTM D2240) - 87.2

#### **B. 301-01NSF 61 listed epoxy for potable water contact**

Acute Toxicity Test EPA EPA-821-R-02-012 Method 2007.0 - 100% survival rate of test organisms

#### **C. The monolithic lining system shall be continuously bonded to all brick, mortar, concrete, and pipe inside the structure.**

#### **D. The system shall effectively seal the interior surfaces of the structure to prevent any penetration or leakage of groundwater (infiltration).**

## **PART 3 - EXECUTION**

### **3.1 PRE-COAT INSPECTION**

- A. All structures to be coated shall be readily accessible to the Application Contractor
- B. Appropriate actions shall be taken to comply with local, state, and federal regular and other applicable agencies with regard to the environment, health, and safety.
- C. Active flows shall be diverted with flow through plugs or bypass pumping, as required to ensure that the liquid flow is maintained away from the surfaces to be coated.

### **3.2 PREPARATION FOR COATING**

- A. General: Surfaces to receive protective coatings shall be prepared as indicated prior to application of coatings. The CONTRACTOR shall examine surfaces to be coated and shall correct surface defects before the application of any coating material.
- B. Protection of Surfaces Not to be Coated: Surfaces that are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.
- C. Care shall be exercised not to damage adjacent WORK during blasting operations. Spraying shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent WORK or adjoining property occurring from blasting or coating operations.
- D. Protection of Painted Surfaces: Cleaning and coating shall be coordinated so that dust and other contaminants from the preparation process will not fall on wet, newly coated surfaces.

### **3.3 ENVIRONMENTAL REQUIREMENTS**

- A. No coating work shall be performed under the following conditions:
  - 1. Surface or ambient temperatures exceed the manufacturer's recommended maximum or minimum allowable.
  - 2. Dust or smoke laden atmosphere.
  - 3. Substrate and ambient temperatures are less than 5°F above the dew point and are decreasing. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce, Weather Bureau psychrometric tables. Elcometer 319 Dew Point meter or equal may also be used.

### **3.4 SURFACE PREPARATION**

- A. Concrete/Masonry:
  - 1. The NACE/SSPC Joint Surface Preparation Standards for concrete surface preparation are incorporated and made part of this specification. All references to SSPC-SP-13/NACE No. 6, designate the definitions and other requirements in these documents. The International Concrete Repair Institute (ICRI) No. 310.2R-2013 Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair shall be used to visually evaluate the concrete surface profile
  - 2. In accordance with ASTM D4262, test to determine the pH of the concrete surface after the surface has been thoroughly blasted and cleaned. If the pH is below 6.5 apply ammonia or bleach to raise the pH. One pH test shall be performed every 200 square feet or less, and at locations determined by the Inspector.
  - 3. Coating Pipe Penetrations: A 1/4-inch wide by 1/4-inch-deep saw cut shall be made around the circumference of the pipe as it penetrates the concrete. Prior to the coating application, the saw cut shall be dried and vacuumed to remove all dust and residue.

4. Coating Floor/Wall Joints: A 1/4-inch wide by 1/4-inch-deep saw cut shall be made on the vertical and horizontal concrete surfaces around the perimeter of the floor. The saw cut shall be 2 inches from the joint on both sides. Prior to the coating application, the saw cut shall be dried and vacuumed to remove all dust and residue.
  5. Concrete, concrete block masonry surfaces, and deteriorated concrete surfaces to be coated shall be cleaned to remove existing coatings, laitance, and deteriorated concrete, and to roughen the surface equivalent to a minimum of CSP 4 in accordance to ICRI No. 310.2 Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays Concrete Surface Profile.
  6. Surfaces shall be clean and as recommended by the coating manufacturer before the coating system is applied.
- B. Metallic Surfaces:
1. General: Metallic surfaces shall be prepared in accordance with the CSM requirements and applicable portions of the SSPC surface preparation specifications. The following minimum requirements shall apply unless specified otherwise:
  2. Blast particle size shall be selected by the CONTRACTOR to produce the specified surface profile.
  3. All weld splatter, slag and sharp metal burrs shall be removed by grinding or other approved means.
  4. The minimum permissible surface preparation for immersed and/or intermittently immersed ferrous metal substrates shall be SSPC-SP10/NACE No. 2.
  5. Blast cleaning requirements for ductile iron or cast iron substrates, galvanized steel and non-ferrous substrates shall apply unless specified otherwise by CSM(s):
  6. All ductile or cast-iron surfaces to be coated shall be abrasive blast cleaned per NAPF 500-03-04 to a clean, gray uniform metal appearance free of variations in color and loose materials.
  7. Non-ferrous metals such galvanized steel, aluminum and stainless steel shall be sweep/brush blasted and cleaned per SSPC-SP 16 to produce a clean surface with complete removal of all corrosion products and contaminants.
  8. Remove all traces of grit, dust, dirt, rust scale, corrosion products and/or embedded abrasive from substrate by a combination of vacuum cleaning, compressed air and/or sweeping in accordance with ISO 8502-3 for a rating of 2, or better, before application of coatings.
  9. Acceptable surface preparation must produce a metal surface pH of 6.0 to 9.0 to be confirmed by surface pH testing.
  10. If after surface preparation, the surface pH remains below 6.0, perform additional water blasting or cleaning until additional pH testing indicates an acceptable pH level.
  11. Preparation of carbon steel surfaces shall be based upon comparison with SSPC-VIS1 (ASTM D2200).
  12. Surface cleanliness of prepared substrates shall be inspected after surface preparation, and prior to application of any coating materials. If steel surfaces are repaired, they shall be re- inspected for surface cleanliness and preparation prior to application of the coating system
  13. If, between final surface preparation work and coating system application, contamination of the prepared and cleaned metallic substrates occurs, or if the prepared substrates' appearance darkens or changes color, re-cleaning by water blasting or abrasive blast cleaning shall be required until the specified degree of cleanliness is reclaimed.
- C. Fiberglass Reinforced Plastic (FRP) Surfaces:
1. Pressure wash to remove dust, dirt, contaminants, and other materials.
  2. Prepare surfaces by sanding and/or sweep (brush) blasting to establish uniform surface roughness and to remove any gloss from the resin in the FRP.
  3. Remove existing coatings as specified, that are delaminating and/or do not satisfy CSM requirements for bond strength, performance and/or other performance properties.
  4. Vacuum clean to remove all loose dust, dirt, and other materials.
  5. Solvent clean using clean white rags and allow solvent to completely evaporate prior to application of any coating materials.
- D. Chlorinated Polyvinyl Chloride (CPVC) and Polyvinyl Chloride (PVC) Surfaces:
1. Pressure wash to remove dust, dirt, contaminants, and other materials.
  2. Prepare surfaces by sanding and/or sweep (brush) blasting to establish uniform surface roughness.

3. Remove existing coatings that are delaminating and/or do not satisfy CSM requirements for bond strength, performance and/or other performance properties.
4. Vacuum clean to remove all loose dust, dirt, and other materials.
5. Solvent clean using clean white rags and allow solvent to completely evaporate prior to application of any coating materials.

### 3.5 APPLICATION OF COATINGS

- A. Areas where reinforcing steel has been exposed or removed, shall be repaired by replacing spent rebar with new rebar to match existing. All new rebar will be embedded in 1 inch of epoxy mastic.
- B. Repair materials shall meet the specifications of this Section. The materials shall be trowel or spray applied to utilize the proper equipment to the specified surfaces. The material thickness shall be specified by the Engineer according to the Owner's requirements and manufacturer's recommendations.
- C. The repair mastic and epoxy topcoat must share the same epoxy matrix to ensure a bonded weld at the molecular level to prevent migration of bacteria and sewer gases throughout the monolithic system.
- D. All surfaces shall be inspected during and after preparation and before application of the monolithic surfacing system. Any evidence of remaining contamination or laitance shall be removed by high-pressure water, abrasive blast, or other approved method before proceeding with applying the monolithic surfacing system.
- E. The epoxy coatings shall be placed and cured in a single application.
- F. Application procedures shall conform to the recommendations of the structural epoxy manufacturer, including material handling, mixing, and environmental controls during the application, safety, and equipment.
- G. The equipment shall be specially designed to accurately ratio and apply the specified materials and shall be regularly maintained and in proper working order.
- H. The specified materials must be applied by manufacturer-approved workmen.
- I. All specified surfaces will be coated with the structural epoxy system to provide a minimum total thickness of 250 mils for rehabilitated structures and 125 mils for new concrete structures. The epoxy liner shall be monolithic with proper sealing of connections to all unsurfaced areas and shall be placed and cured in one application.

### 3.6 FIELD INSPECTION AND TESTING

- A. Film Thickness Testing: During application, a wet film thickness gage meeting ASTM D4414 – Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages or by other acceptable means, shall be used to ensure minimum specified thickness during application.
- B. Inspection Devices: The CONTRACTOR shall furnish inspection devices in good working condition to detect holidays and adhesion.
- C. Measurement of bond strength of the system to the substrate shall be made at agreed upon locations. Bond strength can be measured following ASTM D7234 for concrete and masonry, or ASTM D4541 for metal. Any areas detected to have less than 300 psi, or 80% substrate failure bond strength shall be evaluated by the Engineer. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area, and repairs shall be made by the Application Contractor in strict accordance with the manufacturer's recommendations.
- D. Holiday Testing: Following NACE SP0188-2006, the CONTRACTOR shall test for continuity all coated surfaces. Areas that contain discontinuities shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions.

### END OF SECTION