

SECTION 02500 – CERAMIC EPOXY LINING – DUCTILE IRON PIPE AND FITTINGS

(As provided by Tnemec Company, Inc.)

GENERAL

1.1 SUMMARY

1. This Section includes surface preparation and shop application of Series 431 Perma-Shield PL, a high-performance polyamine ceramic epoxy lining for use in the interior ductile iron pipe and fittings for sewage applications.
2. The lining material shall be an amine cured epoxy containing at least 20% by volume of ceramic hollow microspheres.

1.2 REFERENCES

A. ASTM International, (ASTM)

1. ASTM B 117-99(2007) – Standard Practice for Operating Salt Spray (Fog) Apparatus
2. ASTM C 413-01(2006) – Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
3. ASTM C 868-02(2008) – Standard Test Method for Chemical Resistance of Protective Linings
4. ASTM D 149-09 – Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
5. ASTM D 870-09 – Standard Practice for Testing Water Resistance of Coatings Using Water Immersion
6. ASTM D 1653-03(2008) – Standard Test Methods for Water Vapor Transmission of Organic Coating Films
7. ASTM D 2370-98(2002) – Standard Test Method for Tensile Properties of Organic Coatings
8. ASTM D 2240-05 – Standard Test Method for Rubber Property—Durometer Hardness
9. ASTM D2583-07 – Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
10. ASTM D 2794-93(2004) – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
11. ASTM D 4400-99(2007) – Standard Test Method for Sag Resistance of Paints Using a Multinotch Applicator
12. ASTM D 4060-07 – Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
13. ASTM D 4541-09 – Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

14. ASTM G 8-96(2003)e1 – Standard Test Methods for Cathodic Disbonding of Pipeline Coatings
 15. ASTM G 95-07 – Standard Test Method for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method)
- B. British Standard, (BS)
1. BS EN 598:2007+A1:2009 – Ductile Iron Pipes, Fittings, Accessories and Their Joints for Sewerage Applications – Requirements and Test Methods
- C. NACE International, (NACE)
1. NACE SP0188-2006 – Standard Practice for Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
 2. NACE TM0174-2002 – Laboratory Methods for the Evaluation of Protective Coatings and Lining Materials in Immersion Service
- D. SSPC: The Society for Protective Coatings, (SSPC)
1. SSPC-PA2 – Paint Application Specification No. 2: Measurement of Dry Coating Thickness with Magnetic Gages.
- E. Standard Practice for the Rapid Evaluation of Coatings and Linings by Severe Wastewater Analysis Test, (S.W.A.T.)
- F. Unless otherwise specified, references to documents shall mean the documents in effect at the time of receipt of Bids. If referenced documents have been discontinued by the issuing organization references to those documents shall mean the replacement documents or the last version of the document before it was discontinued.

1.3 QUALITY ASSURANCE

- A. Manufacturer’s Qualifications: Provide products from a company specializing in manufacture of high-performance epoxy coatings with a minimum 10 years experience.
1. Materials shall be products of a single manufacturer or items standard with manufacture of specified coating materials.
 2. Submit manufacturer's certification that coatings comply with specified requirements and are suitable for intended application.
- B. Applicator’s Qualifications: Engage a single installer approved by the manufacturer with a minimum of three years experience performing this type of lining installation and with documented skill and successful experience in the installation of ceramic epoxy lining to interior of ductile iron pipe and fittings.
1. Submit name and qualifications to Engineer.
 2. Submit proof of acceptability of applicator by manufacturer to Engineer.

1.4 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01200 entitled "Submittals", the applicator shall submit all required information as specified herein.
- B. Shop Drawings: Submit for approval prior to commencing any Work:
 - 1. Product Data Sheet
 - 2. Material Safety Data Sheet
 - 3. Performance Testing Reports: Copies of test data for the entire physical, chemical, and permeation properties listed herein and as outlined within this Section.
 - 4. Installation Instructions: Manufacturer's written installation instructions for the materials specified in this Section.
 - 5. Copies of specifications, technical information, and general recommendations from the coating manufacturer for the specified material.
 - 6. Qualifications Data: Submit qualifications in accordance with Article 1.3, above:
 - a. Manufacturer
 - b. Applicator
- C. Application Reports: Submit at the completion of Work
 - 1. Daily Reports: Include surface preparation, substrate conditions, ambient conditions application procedures, lining materials applied, material quantities, and material batch number(s).

1.5 PRODUCT STORAGE, HANDLING AND APPLICATION

- A. Coating materials shall be handled, stored and applied in accordance with the manufacturer's recommendations.

1.6 WARRANTY

- A. Protective Lining Manufacturer shall warranty its products as free from material defects for a minimum period of three (3) years. Provide associated Warranty Certificate.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. To define requirements for materials, size, and design, this specification lists specific products manufactured by Tnemec Company, Inc. of Kansas City, Missouri. Materials specified herein are cited as minimum standard of quality which will be acceptable.
- B. Tnemec Series 431 Perma-Shield PL modified polyamine ceramic epoxy lining
 - 1. Generic Type: Polyamine Ceramic Epoxy
 - 2. Properties:

- a. Solids by Volume: 100 percent
 - b. Hazardous Air Pollutants: Zero
 - c. Ceramic Hollow Microspheres: 20 percent by volume (no silica fume, fly ash, or alumina dust)
 - d. Pigment Volume Concentration: Less than 22 percent
 - e. Coal-Tar Content: Zero
 - f. Dry Film Thickness:
 - 1) 40 mils (nominal)
 - 2) 60 mils maximum
3. Performance Criteria:
- a. Abrasion: (ASTM D4060-07, CS-17 wheel, 1,000 grams) – 76 mg loss. (BS EN 598:2007+A1:2009, 50,000 cycles) – 0.6 mils loss
 - b. Adhesion: (ASTM D 4541) – Not less than 1,860 psi.
 - c. Severe Wastewater Analysis Test: (150°F, 500 ppm H₂S, 4000 ppm NaCl, 10% H₂SO₄, EIS Permeation Analysis) – Initial impedance of 11.2 (log-z). No blistering, cracking, checking or loss of adhesion. Reduction in electrical impedance of 0.5 after 28 days exposure.
 - d. Cathodic Disbondment: ASTM G 8 (1.5 V) Classification Group A. No more than 0.000 inch (0.00 mm) disbonded equivalent circle diameter.
 - e. Chemical Resistance: (ASTM C 868-02, 25 percent sulfuric acid, 100 degrees F, 100 days – (NACE TM0174-2002, 6 months continuous immersion, 50 percent sulfuric acid, 13 percent sodium hypochlorite, 5 percent sodium hydroxide, 75 degrees F – No effect.
 - f. Dielectric Strength: (ASTM D 149-09) – greater than 600 volts per mil
 - g. Hardness: (ASTM D 2240): Shore D hardness of 79. (ASTM D 3363).
 - h. Immersion: 140°F (60°C) De-ionized Water Immersion. No blistering, cracking or delamination of film after 5,000 hours continuous immersion.
 - i. Impact: (ASTM D 2794-04) – No visible cracking or delamination after 160 inch-pounds (18.0 J) direct impact.
 - j. Salt Spray (ASTM B 117-09): No blistering, cracking, rusting or delamination of film. No rust creepage at scribe after 1,000 hrs.
 - k. Sag Resistance (ASTM D 4400-09) – Not less than 90 mils WFT
 - l. Water Absorption (ASTM-01(2006) – 0.0 percent water absorption
 - m. Water Vapor Transmission (ASTM D 1653-03(2008) Method B, Wet Cup, Condition C) – 1.25 g/m² per 24 h water vapor transmission and 0.09 perms water vapor permeance

C. No substitutions allowed

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. All ductile iron pipe and fittings shall be delivered to the application facility without asphalt, cement lining, or any other lining on the interior surface.
- B. All surfaces shall be inspected and pre-cleaned with suitable solvent to remove all traces of grease, oil, asphalt and other soluble contaminants. Abrasive blast all surfaces with fine abrasive

to remove all loose annealing oxides, rust, dirt and other foreign matter. Only slight stains and tightly adhering oxides are allowed to remain on the surface. Any area where rust reappears before application shall be reblasted. Any dust or other contaminants remaining after blasting shall be removed with dry, oil free compressed air or by vacuum cleaning. A surface profile depth (anchor pattern) of at least 3.0 mils (76.2 microns) is required (Reference ASTM D 4417, Method C).

- C. The surface shall be coated within eight hours of surface preparation.

3.2 APPLICATION

- A. The lining shall be applied by an approved applicator with successful history of applying ceramic epoxy linings to the interior of ductile iron pipe and fittings.
- B. Within 8 hours of surface preparation, the interior shall be coated with the following dry film thicknesses (DFT).
 - 1. Pipe Interior: 40 mils
 - 2. Fittings Interior: 40 mils
 - 3. Push-on Joints: 6-10 mils
 - 4. Mechanical Joints: Extend lining from spigot end to edge of gauging ring.

3.3 CUTTING PIPE

- A. Cutting shall be done in a neat manner, without damage to the pipe or the lining. Use wheel cutters when practicable. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the ends of the pipe shall be dressed with a power grinder to remove all sharp edges. The cut ends of push on joint pipe shall be suitably beveled.

3.4 HANDLING

- A. Series 431 Perma-Shield PL lined pipe and fittings must be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, cables or other devices shall be placed inside the pipe and fittings for lifting, positioning, or laying. The pipe shall not be dropped or unloaded by rolling. Care should be taken not to let the pipe strike sharp objects while swinging or being off loaded. Ductile iron pipe should never be placed on grade by use of hydraulic pressure from an excavator bucket or by banging with heavy hammers. Only nylon straps or similar lifting devices are to be used.

3.5 INSPECTION

- A. Inspection:
 - 1. All ceramic epoxy lined pipe and fittings visual examined for film defects, including any runs, sags, and debris in the film. Repairs shall be made in accordance with the manufacturer's instructions.
 - 2. All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic dry film thickness gauge. The thickness testing shall be in accordance with SSPC-PA2 film thickness rating.
 - 3. The interior lining of all pipe and fittings shall be tested for holidays, pinholes, and discontinuities in accordance with NACE SP0188. All holidays shall be properly repaired

in accordance with the manufacturer's instructions and retested at no additional cost to the Owner.

4. Each pipe joint and fitting shall be marked with the date of application of the ceramic epoxy lining system and with its numerical sequent of application on that date.

- B. Certification: The pipe or fitting manufacturer shall supply a certificate attesting to the fact that the applicator met the requirements of this Specification, and that the material was applied as required by the Specification.

3.6 COATING REPAIR

- A. Repairs and touch-up shall be performed in accordance with the manufacturer's recommended repair and touch-up procedures.
- B. All field cut ends shall be repaired and sealed prior to the installation.

END OF SECTION