REGIONAL CONSTRUCTION STANDARDS

SIXTH EDITION

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Multi-Layer Polymer Lining Systems
As Publication Update 6.14)

October 29, 2020

IX. MANHOLE/STRUCTURE PROTECTIVE COATING POST INSTALLATION CERTIFICATION

(Submit prior to Substantial Completion)

Project Name _____

Owner _____

Contractor _____

Agreement No. _____

Applicator _____

Company Name: _____

Address: _____

_____

Telephone: _____

I certify that the coating system identified below was installed in conformance with the manufacturer's recommendations at the conditions listed below.

_____ _____

Applicator Date

This applicator is certified by _____, Coatings Manufacturer, located at

_____

(Address)

and approved in the proper application of the specified coating system. The materials and workmanship for Type B (80 mil) coatings systems are warranted for a period of five (5) years from the date of Substantial Completion of the project. **The materials and workmanship for 500 mil Multi-Layer Polymer Lining Systems are warranted for a period of ten (10) years from the date of acceptance of the rehabilitated manhole. Warranties for Type B (80 mil) coating systems and 500 mil multi-layer lining systems are considered Performance Warranties that cover prevention of corrosion and elimination of infiltration.**

_____ _____

Coatings Manufacturer Authorized Representative/Title Date

Coating System:_____

(Use Separate Form For Each Coating System Applied)

Date Applied	Manhole/ Structure Number	Actual Substrate Conditions			Ambient Air Conditions		Min/Max Recoat	Dry Film Thickness	
		CSP Rating	Temp. (°F)	Moisture (Yes/No)	Temp. (°F)	Humidity (%)	(Hrs/Hrs)	(Avg)	(Min)

Domestic Sewage	100

[1] Cotton seed, corn, or mineral oil
[2] As per ASTM D543

6. Other Materials: No other material shall be used with the above mixes without prior approval or recommendation from the manufacturer.

7. The manufacturer shall warrant that the products are produced in conformity with its standard specifications or formulations within recognized tolerances, free of adulteration or contamination, and that the product will perform in accordance with representations in the manufacturer's literature and technical data sheets when properly applied in strict conformance with the printed instructions on container and prescribed in technical data instructions and when applied to a properly prepared surface.

HA. Manhole Rehabilitation using Multi-Layer Polymer Lining System (Polyurea and Polyurethane)

1. The monolithic Multi-Layer Polymer Lining System shall consist of Moisture Barrier (Polyurea), Surfacer (High Density Polyurethane Foam) and Final Corrosion Barrier (Polyurea) to provide a broad range of chemical resistance and prevent infiltration. The coating system coverage shall be a minimum final thickness of 500 mils.

2. The Multi- Layer Polymer Lining System shall have a 10-Year Performance Warranty that prevents corrosion and stops infiltration.

3. The Multi-Layer Polymer Lining System shall have the following minimum requirements:

Test	Property	Results
ASTM D412-06	Tensile Strength (psi)	2250
ASTM D412-06	Elongation (%)	269
ASTM D2240-05	Hardness (Shore D)	56
ASTM D624-00	Tear Strength (pli)	428
ASTM D522-13	Flexibility (1/8" Mandrel)	PASS

4. Chemical Resistance, Bond Strength and Hydrostatic Pressure: The Multi-Layer Polymer Lining System shall be tested in accordance with the CIGMAT Protocol by the University of Houston Department Of Civil Engineering. The specific objectives of the CIGMAT testing are as follows: (a) to evaluate the applications and performance of coatings on concrete and clay brick surfaces under a hydrostatic pressure of 15 psi (34.7 feet of water); (b) to evaluate the acid resistance of the coated concrete and clay bricks with and without holidays; and (c) to determine the bonding strength of the coating material to concrete and clay bricks over a period of time. The Multi-Layer Polymer Lining System shall pass:

   a. The dry and wet application tests to include bond strength and hydrostatic testing for infiltration at 15 psi (34.7 feet water).
   b. Coated concrete and clay bricks, dry and wet, holiday – chemical resistance test (with and without holidays) in 3% and 30% sulfuric acid solutions after six months.

The Multi-Layer Polymer Lining System shall provide chemical resistance and shall not deteriorate when subjected to chemical substances customarily present in wastewater, and shall present little or no visible damage at 25° C to concentrations of chemical solutions as listed below:

Chemical Solution	Concentration (%)
Tap Water (pH 6-9)	100
Domestic Sewage	100
Nitric Acid	50
Phosphoric Acid	50
Motor Oil	-
Sodium Hypochlorite	10
Ammonium Hydroxide	50
Methanol	100

5. Multi-Layer Polymer Lining System shall be SpectraShield® or approved equal.

I. Cured in Place Manhole Liners

1. The liner design and selection of materials shall be suitable for all the specified design conditions and shall meet the minimum requirements outlined in Table 200-5.21.6. Thicker liners may be required based on design conditions. The liner shall be custom-designed to fit each manhole and the basis of design shall be submitted to the Owner in accordance with Section 822.1.2. It is the Contractor's responsibility to supply a CIPM liner that is most suitable for the existing conditions and that meets the requirements of this specification. Contractor shall assume groundwater at grade for all sites for the purposes of liner thickness design unless otherwise instructed by the Owner.

2. The cured in place liner shall provide a minimum service life of 25 years.

TABLE 200-5.21.6
Minimum Liner Physical Properties

Manhole Depth (grade to invert)	Minimum Liner Thickness(1) (inch) ASTM D5813	Minimum Pre-Saturated Fabric Weight (ounces)	Minimum Flexural Modulus of Elasticity (psi) ASTM D790	Minimum Compressive Strength (psi) ASTM D695	Chemical Resistance Testing in accordance with ASTM F1216 Appendix X2
0 to 10 ft	0.117	56	1,000,000	11,000	PASS
10.1 to 15 ft	0.117	56	1,000,000	11,000	PASS
15.1 to 20 ft	0.158	68	1,000,000	11,000	PASS
(1) Minimum liner thickness includes only the strength portion of the liner. Non-structural layers are not included in minimum thickness requirements.					

J. Calcium Aluminate Cementitious Manhole Liner

1. The calcium aluminate cementitious liner shall be made with calcium aluminate

application of the system shall be fully compatible with the system.

L. Multi-layered Polymer Lining System

1. The Multi-Layer Polymer Lining System shall provide a continuous monolithic lining with uniform thickness of a minimum of 500 mils throughout the manhole interior. If the thickness of the Multi-Layer Polymer Lining System is not uniform or is less than specified it shall be repaired or replaced at no additional cost to the Owner.

2. The applicator shall be approved and trained by the manufacturer and shall furnish all labor, equipment and materials for applying the Multi-Layer Polymer Lining System. All aspects of the installation shall be in accordance with the manufacturer's recommendations.

3. The applicator shall confirm that the surface has been properly prepared in accordance with the manufacturer's recommendations and the surface is suitable for installation of the liner system.

4. The Multi-Layer liner application shall be comprised of:

   a. Moisture barrier (minimum of 40 mils) - Modified Polymer (Silicone modified polyurea) sprayable, solvent free, two-component polymeric, moisture/chemical barrier – approx. 8 seconds hardening time.
   b. Surfacer (minimum of 400 mils) - Polyurethane/Polymeric blend foam low viscosity two-component - approx. 20 - seconds hardening time.
   c. Final corrosion barrier (minimum of 60 mils) - Modified polymer (Silicone modified Polyurea). - approx. 8 seconds hardening time
   d. Total thickness of multi-layer liner system shall be a minimum of 500 mils.

5. Curing – Structures may be returned to service upon completion of the liner application.

2.3 LINER AND COATING ACCEPTANCE AND TESTING

A. The Owner may enter the manholes to inspect the benching, invert channels, manhole wall/pipe connections, surface preparation, and other parts of the Work. The Contractor shall provide forced air ventilation, gas monitors and detectors, harnesses, lights, etc. for the Owner to enter the manhole and perform the inspection in complete accordance with OSHA requirements at no additional cost to the Owner.

B. The finished manhole surface shall be continuous and as free as commercially practicable from significant defects. Any defects which will affect, in the foreseeable future, or warranty period, the integrity or strength of the manhole shall be repaired at the Contractor's expense, in a manner mutually agreed upon by the Owner and the Contractor.

C. There shall be no cracks, voids, pinholes, uncured spots, dry spots, lifts, delaminations or other type defects in the liner. If any defects are discovered after liner has been installed, it shall be repaired or replaced in a satisfactory manner within 72 hours and at no additional cost to the Owner. This requirement shall apply for the entire guarantee period.

D. Active infiltration through the lining system be zero.

c. Pull off test in accordance with ASTM D4541 with a minimum acceptable pull strength of 250psi. The failure point of the pull must located within the substrate not within the coating thickness.

4. Multi-Layer Polymer Lining System (Polyurea and Polyurethane)

a. Visually verify the absence of leaks.

b. Holiday detection test: A holiday detection test shall be performed in accordance with subsection 2.4.C.2 of Section 802 - Sanitary Gravity Sewer Systems following application of the final coat.

c. Adhesion test: A minimum of 10% of the manholes coated shall be tested for adhesion/bond of the Moisture barrier (initial layer - minimum of 40 mils) to the substrate. Follow manufacturer's guidance to isolate adhesion test locations. Testing shall be conducted in accordance with ASTM D7234 as modified herein. Owner's representative shall select the manholes to be tested. A minimum of three 50 mm dollies shall be affixed to the coated surface at the manhole cone section, mid-section, and at the bottom barrel section of the manhole. The adhesive used to attach the dollies to the coating shall be rapid setting with tensile strengths in excess of the coating product and permitted to cure in accordance with manufacturer recommendations. The coating and dollies shall be adequately prepared to receive the adhesive. Failure of the dolly adhesive at a tension less than 400 psi shall be deemed a non-test and require retesting. Prior to performing the pull test, the coating shall be scored to the substrate by mechanical means without disturbing the dolly or bond within the test area. The three adhesion pulls shall exceed 400 psi or concrete failure with more than 50% of the subsurface adhered to the coating. Should a structure fail to achieve three successful pulls as described above, additional testing shall be performed at the discretion of the Owner. Any areas detected to have inadequate bond strength shall be evaluated by the Owner. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area, and repairs shall be made by Contractor. Test areas shall be recoated upon completion of the tests with all three layers of the Multi-Layer Polymer Lining System.

2.4 MANHOLE STEP REMOVAL

The Contractor shall remove all steps. Removal shall consist of neatly cutting steps flush with the wall prior to any lining installation. The Contractor shall be responsible for proper disposal of steps.

2.5 MANHOLE FRAME AND COVER REPLACEMENT

A. Excavation and site restoration in paved and unpaved areas shall be in accordance with Divisions 3, 5, and 6 of these *Regional Construction Standards* to a minimum of established pre-construction conditions.

B. The Contractor shall remove and dispose of the existing manhole frames and covers, as specified in the Contract Documents. It shall be the responsibility of the Contractor, at no additional cost to the Owner, to repair any damage to the chimney or corbel caused by the removal of the existing manhole frame.