

CURED IN PLACE MANHOLE REHABILITATION

PART 1 – GENERAL

This section covers the lining and rehabilitation of sanitary and storm water collection systems with the use of a cure-in-place composite epoxy-fiberglass-liner combination.

1.1 DESCRIPTION OF WORK

- A. It shall be the responsibility of the Contractor to make sure that the Cured-in-Place Manhole (CIPM) Liner completely seals the manhole, shelf, pipe inlet and outlets, and the lid ring frame in a monolithic method, as required, or as shown on the plans, and that no holes, cracks or seams in the liner are left unsealed, which would allow gases or fluids to flow behind the CIPM Liner.
- B. Furnish all labor, materials, equipment, and incidentals required to supply and install a protective CIPM Liner as required or as shown on the plans.
- C. The CIPM Liner shall be designed and installed to protect concrete, brick and other manhole surfaces from corrosion. The CIPM liner product shall be designed to stop infiltration, root intrusion, and further deterioration in the manhole. The interior surfaces to be protected shall include the walls, shelves, pipe junctions and the lid ring frame, as per the contract requirements.

1.2 REFERENCED SPECIFICATIONS

The CIPM Protective Liner System shall be manufactured and installed in compliance with the listed minimum values of the applicable ASTM testing requirements.

ASTM D-638	Tensile Strength and Tensile Modulus
ASTM D-695	Compressive Strength
ASTM D-790	Flexural Strength and Flexural Modulus
ASTM D-2240	Hardness

1.3 SUBMITTALS

- A. The Contractor shall submit the suppliers warranty for all materials furnished under this section. The Contractor shall submit their licensed installer certification as the applicator under this section.
- B. Upon timely request, the Contractor shall submit the manufacturer's certification of testing, with the accompanying test data, showing epoxy resin bonding strength of over 6,000 psi when tested with 10,000 psi concrete test cylinders in a butted resin bonding test. This testing must demonstrate no epoxy bonding detachment prior to the failure of the concrete.

1.4 WARRANTY

- A. The manufacturer of the CIPM lining material shall, upon request, furnish an affidavit attesting to successful use of their materials as a lining for concrete and brick structures in wastewater conditions recognized as corrosive or otherwise detrimental to concrete.
- B. The lining must be repairable at any time during the life of the structure. The lining shall be flexible, and have an elongation sufficient to bridge up to a 1/4-inch settling crack, without damage to the lining. The liner shall be able to bridge expansion cracks that may occur. Supplier shall warrant the performance of the CIPM Liner for 10 years and shall include 5 years warranty for materials and labor to repair or replace any failing conditions of the liner in the structure.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. In structures up to 14 feet in depth (depending on contractors determination of specific local conditions), the liner shall be a three-layered composite system (see table 1 below) with a total pre-saturated fabric weight of 44-ozs. per square yard. Layer #1 will be not less than 12-oz. structural fiberglass impregnated with a modified epoxy resin and bonded to the existing substructure. Layer #2 is to be a 20-oz. material bonded to layer #1 and layer #3. Layer #3 consists of not less than a 12-oz. structural fiberglass saturated with epoxy and bonded to the concrete, forming a smooth interior wall to the host structure.
- B. In structures greater than 10 feet and up to 20 feet deep (depending on contractors determination of specific local conditions), a three-layered

composite system (see table 1 below) with a total pre-saturated fabric weight of 56-ozs. per square yard. Layer #1 is 18-oz. structural fiberglass impregnated with a modified epoxy resin and bonded to the existing substructure. Layer #2 is to be a 20-oz. synthetic material bonded to layer #1 and layer #3. Layer #3 will consist of 18-oz. structural fiberglass saturated with epoxy and bonded to the concrete, forming a smooth interior wall to the host structure.

- C. In large structures deeper than 20 feet, or with site conditions requiring the highest strength, the CIPM will utilize a three-layered composite system (see table 1 below) with a total pre-saturated fabric weight of 68-ozs. per square yard. Layer #1 will be a 24-oz. structural fiberglass impregnated with modified epoxy resins and bonded to the existing substructure. Layer #2 shall be a 20-oz. special synthetic material bonded to layer #1 and layer #3. Layer #3 will consist of a 24-oz. structural fiberglass saturated with epoxy and bonded to the concrete, forming a smooth interior wall to the host structure.
- D. The design guide above is intended as a general manhole guide for the liner products, and is not intended to limit the manufacturer's and/or the authorized installer's judgment to use a heavier liner in determining the appropriate thickness and type of liners for individual structures based upon the specific conditions encountered in each structure. Any variation of the above described liner thickness requirement by the manufacturer or authorized installer will not affect the warranty requirement.
- E. The CIPM Lining System shall be applied by a qualified licensed applicator/installer. Applicator/installer shall be trained in handling and application of the materials, and will custom fit the liner to the manhole in order to protect the concrete and brick surfaces from sewer gases.

2.2 PHYSICAL PROPERTIES

TABLE 1, Test Property Values

Materials Section	Paragraph A	Paragraph B	Paragraph C
Pre-Saturated Fabric Weight	44 Ounces/sy	56 Ounces/sy	68 Ounces/sy
ASTM-D-790			
Flexural Strength	10,000 psi	12,000 psi	15,000 psi
Flexural Modulus	600,000 psi	700,000 psi	800,000 psi
ASTM-D-695			
Compressive Strength	6,500 psi	7,400 psi	8,000 psi
Compressive Modulus	800,000 psi	700,000 psi	800,000 psi
ASTM-D-638			
Tensile Strength	7,000 psi	9,000 psi	11,500 psi

Tensile Modulus	750,000 psi	950,000 psi	1,050,000 psi
Average Liner Thickness	0.10 inch	0.12 inch	0.15 inch
CIPM Liner Material Content			
Resin	79%	72%	69%
Filler	6%	6%	5%
Fiberglass	15%	22%	26%
ASTM-D-2240			
Hardness	82 shore D	82 Shore D	82 shore D
Epoxy Bond Strength	6,000 lbs.	6,000 lbs.	6,000 lbs.
Engineered Life Expectancy	50+ Years	50+ Years	50+ Years
Installation Warranty	5 Years	5 Years	5 Years
Product Warranty	10 Years	10 Years	10 Years

Upon request, the manufacturer shall provide written certification that the CIPM liner to be used meets or exceeds the above requirements, and also certify that the CIPM liner material has passed a 14-day concentrated chemical immersion testing with less than a 2.1% average weight gain.

PART 3 – INSTALLATION

3.1 CIPM INSTALLATION

- A. The Contractor shall remove all existing manhole steps. The metal portion of all steps will be removed flush with the manhole wall surface, and any remaining holes are to be patched flush prior to applying the CIPM rehabilitation system. The final coated surface shall have a smooth uniform appearance with no discoloration.
- B. Prior to patching severe defects in the manhole, all loose and deteriorated material shall be removed and disposed of by the contractor. The bench areas shall be repaired as determined by the installer. The prepared surface of the shelves shall be smooth and shall be sloped to allow for all bench areas to drain to the pipe invert.
- C. Manhole wall and shelf repair shall include plugging, and/or patching as necessary, with specified grout, plugging or patching compounds.

- D. All active hydrostatic water leakage shall be stopped within four (4) inches of where the liner will end around pipes or the shelf area in accordance with manufacturer's instruction.
- E. All surfaces of the host structure are to be cleaned with a high-pressure sprayer having an operating pressure of at least 3,000-psi. After pressure cleaning, surface is to be cleaned with degreaser or other solvents as needed to remove any film or residue on the surface (not needed on new structures). Structure shall then be pressure rinsed with clean water.
- F. All cracked or disintegrated material shall be removed from the area to be patched exposing a sound substrate. Patches shall be allowed to cure according to the manufacturer's specifications before continuing with the CIP manhole rehabilitation process.
- G. All incoming laterals and sewer main line openings shall be properly trimmed and grouted with hydraulic or Portland type II cement forming a radiused fillet (not less than a 6 inch radius) between the structure wall and each pipe. Such application of grout shall extend at least four inches from the outlet onto the wall area making a smooth transition for the liner connection to the pipe openings.
- H. Shelves and walls shall be repaired or refinished as appropriate using chemical grout, hydraulic cement or Portland type II cement. Shelf areas and floors shall be lined with the CIPM Liner System materials saturated with the epoxy resin and placed in the bottom to extend approximately three inches up the wall section, so as to overlap with the liner wall section. The CIPM Liner shall be made longer than the structure to overlap and reinforce the bench transition area.

3.2 FINAL ACCEPTANCE

- A. Liner material and components shall have been custom fabricated to fit the specific configuration of each structure prior to the commencement of the liner installation. Liner shall be of the type that allows rehabilitation of concentric, eccentric or flat top manholes without removing manhole ring, top section, flattop, or corbel.
- B. The installation of the approved liner system shall be in strict accordance with the manufacturer's written instructions. Contractor may submit alternate thick-nesses as per the manufacturer's recommendations. The work shall include re-grouting all inlet and outlet lines and benches, as needed, including all preparation, installation, curing and finish operations for the complete rehabilitation process. The liner shall be installed and cured-in-place via a pressurization blower system with steam heat injection, or a similar process. The curing process shall be completed within four hours of the time by-pass

pumping or inlet line plugging begins. Inlet and outlet lines must be reopened within one hour from the time the curing process is completed.

- C. The CIPM lining of the structure shall result in a monolithic structure, bonded to the contours of the existing manhole structure. The liner shall be adequately bonded to the interior structure surface, and be water tight from the ring and cover area to the transition area where the shelf and invert channel connects, including sealing the manhole wall and shelf areas.

END OF SECTION