

Section 2573

Manhole Coatings/Rehabilitation

PART 1: General

1.1 *General Description of Work –*

- 1.1.1 Provide all materials, equipment, labor and incidentals for the installation and testing of the manhole rehabilitation lining product.
- 1.1.2 The manhole shall consist of spray applying a cement-based or cement/epoxy composite material to the walls, inverts, and benches of the existing sanitary sewer manhole.
- 1.1.3 The manhole rehabilitation product shall cure to a water tight system and a minimum thickness as described herein.

1.2 *References – Standards referenced in this Section are listed below:*

ASTM C-109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
ASTM C-293	Standard Test Method for Flexural Strength of Concrete
ASTM D-638	Standard Test Method for Tensile Properties of Plastic
ASTM D-790	Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
NACE SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE RP0274	High Voltage Electrical Inspection of Pipeline Coating Prior to Installation

- ##### 1.3 *Qualifications –* The Contractor shall have a minimum of three years of continuous experience installing the product proposed for this project. Additionally, the Contractor shall have successfully completed projects using the proposed product on projects of the same size and installation conditions as this project. The Contractor shall provide experienced crews using the product proposed and installed under the same installation conditions as this project.

1.4 *Delivery, Storage, and Handling –*

- 1.4.1 Store materials to prevent physical damage and in accordance with manufacturer's recommendations.
- 1.4.2 Protect materials during transportation and installation to avoid physical damage and in accordance with manufacturer's recommendations.

1.5 *Quality Control* –

1.5.1 No change of material, design values, or procedures may be made during the course of the Work without the prior written approval of the Engineer.

1.5.2 All test results shall be provided by an independent, certified ISO 17025 testing facility.

1.6 *Warranty* – All lining work shall be fully guaranteed by the Contractor for a **period of 5 years** from the date of Final Acceptance unless otherwise stipulated in writing by the Owner prior to the date of Conditional Acceptance. During this period, all defects discovered by the Owner or Engineer shall be addressed by the Contractor in a satisfactory manner at no cost to the Owner. The Owner may conduct independent inspections, at its own expense, of the lining Work at any time prior to the completion of the guarantee period.

1.7 *Submittals* –

1.7.1 Submit manufacturer's product data for design mix with installation instructions for proprietary materials including reinforcement and forming accessories, admixtures, joint materials, hardeners, curing materials and others as requested by Engineer.

1.7.2 Submit 2 copies of laboratory test or evaluation reports for concrete materials and mix designs as requested by Engineer.

1.7.3 Submit 2 copies of Contractor Certification and Material Certification as requested by Engineer.

1.7.4 Submit documentation of post construction testing as requested by Engineer.

PART 2: Products

2.1 *Design Requirements* –

2.1.1 *Cement-Based Rehabilitation* –

2.1.1.1 The work consists of rehabilitation of sanitary sewer manholes by spray applying a proprietary pre-blended mixture of acid-resistant calcium aluminate cement-based material to the walls, inverts, and benches of sanitary sewer manholes, resulting in a monolithic liner with a minimum thickness of 1/2-inch (500 mils).

2.1.1.2 The thickness shall be increased in accordance with the manufacturer's recommendations to account for the dimensions and existing condition of the manhole and to withstand the forces arising from the manhole's specific depth and service conditions including groundwater hydrostatic pressures and traffic loading.

2.1.1.3 Where the level of the water table is not known, it shall be assumed that the water table level is equal to the grade elevation surrounding the manhole being rehabilitated.

2.1.1.4 The water used for the rehabilitation process shall be clean and potable.

- 2.1.1.5 No other material shall be used or added to mixture without prior approval by the Owner.
- 2.1.1.6 The applicator, approved and trained, shall furnish all labor, equipment and materials for installing the lining over brick, tile, pre-cast concrete, or concrete block manholes, new or used, using approved equipment.
- 2.1.1.7 The installation shall be in accordance with the Contract Specifications along with manufacturer's recommendations.
- 2.1.1.8 Where the manufacturer's installation and testing recommendations are more stringent than the following Contract Specifications, the manufacturer's recommendations shall control.
- 2.1.1.9 The material shall be a proprietary pre-blended mixture of acid-resistant calcium aluminate cement, chemically-active aggregates, and other additives specifically selected for special properties specifically designed for sanitary sewer applications.

2.1.1.10 *Physical Properties –*

Minimum Density at Placement	145 ± 5 pcf
Minimum Compressive Strength, ASTM C-109	7,000 psi at 28 days
Minimum Flexural Strength, ASTM C-293	1,100 psi at 28 days

- 2.1.1.11 The liner mix shall be made with manufacturer's recommendations for sanitary sewer manhole applications

Approved Products
CEMTEC Silatec CAM
PERMAFORM CR-9000
QUADEX ALUMINALINER
SEWPERCOAT 2000 HS REGULAR
STRONG-SEAL HIGH PERFORMANCE MIX

2.1.2 *Epoxy/Cement Composite Rehabilitation –*

- 2.1.2.1 The work consists of rehabilitation of sanitary sewer manholes by spray applying an epoxy/cement composite liner to the walls, inverts, and benches of sanitary sewer manholes, resulting in a monolithic liner. The cement-based liner applied to the manhole surfaces shall have a minimum thickness of 1/2-inch (500 mils) and the composite liner shall be completed with the application of an epoxy-based material at a minimum thickness of 0.125 inches (125 mils).

- 2.1.2.2 The thickness shall be increased in accordance with the manufacturer's recommendations to account for the dimensions and existing condition of the manhole and to withstand the forces arising from the manhole's specific depth and service conditions including groundwater hydrostatic pressures and traffic loading.
- 2.1.2.3 Where the level of the water table is not known, it shall be assumed that the water table level is equal to the grade elevation surrounding the manhole being rehabilitated.
- 2.1.2.4 The water for the rehabilitation process shall be clean and potable.
- 2.1.2.5 No other material shall be used or added to mixture without prior approval by the Owner.
- 2.1.2.6 The applicator, approved and trained, shall furnish all labor, equipment and materials for installing the lining over brick, tile, pre-cast concrete, or concrete block manholes, new or used, using approved equipment.
- 2.1.2.7 The installation shall be in accordance with the following Contract Specifications along with manufacturer's recommendations.
- 2.1.2.8 Where the manufacturer's installation and testing recommendations are more stringent than the following Contract Specifications, the manufacturer's recommendations shall control.
- 2.1.2.9 The material shall be a proprietary pre-blended epoxy/cement composite system specifically designed for sanitary sewer applications
- 2.1.2.10 The cementitious portion of the system shall be a proprietary pre-blended mixture of corrosion resistant cement, select aggregates, chemical admixtures, and other additives specifically selected for special properties and shall be formulated to ensure a tenacious bond with the protective epoxy topcoat portion.
- 2.1.2.11 The epoxy topcoat portion of the system shall be a proprietary 100% solids epoxy material creating a continuous, impermeable corrosion-resistant barrier.
- 2.1.2.12 The liner mix shall be made with manufacturer's recommendations for sanitary sewer manhole applications.

Approved Products
CEMTEC Silatec CAM and Dura-Plate 5900
DINJER CMS-10K and SG MASTIC
PERMACAST MS 10,000 and COR-GARD 501
QUADEX ALUMINALINER and RAVEN 405

PART 3: Execution

3.1 Preparation –

- 3.1.1 **Safety** – The Contractor shall perform all Work in strict accordance with all applicable OSHA regulations. Each method of manhole rehabilitation in this section requires some degree of manhole entry by workers. Particular attention is drawn to those safety requirements regarding confined space entry and respiratory protection from airborne particulate materials during cleaning and product mixing and application.
- 3.1.2 The Contractor shall place covers over invert before prepping. All concrete and masonry surfaces to be rehabilitated shall be cleaned prior to applying any lining system. All grease, oil, laitance, coatings, loose bricks, mortar, unsound brick or concrete and other foreign materials shall be completely removed. Methods such as wet or dry sandblasting, concrete cleaners, degreasers, or mechanical means may be required to properly clean the surface. All surfaces on which these methods are used shall be thoroughly rinsed, scrubbed, and neutralized to remove cleaning agents and their reactant products. Debris resulting from cleaning shall be removed from the manhole and not allowed to be carried downstream.
- 3.1.3 The Contractor shall be responsible for plugging or diverting the flow of wastewater as needed for manhole rehabilitation. Diverting the sanitary sewage to perform the required rehabilitation shall be incidental to the manhole rehabilitation.
- 3.1.4 The NACE/SSPC Joint Surface Preparation Standards for concrete surface preparation are incorporated in 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) Technical Guideline #03732, Guide to Surface Preparation of Concrete to Receive Sealers, Coatings and Polymer Overlays shall be used to visually evaluate the concrete surface profile.
- 3.1.5 Create a minimum surface profile for the system specified in accordance with the methods described in ICRI No. 03732 to achieve profile CSP-3 to CSP-5, or as specified by manufacturer's recommendations.
- 3.1.6 Concrete surface defects, such as deteriorated concrete or masonry, hollow areas, bugholes, honeycombs, cracks and voids shall be filled flush and true with the specified structural lining compound in accordance with ICRI Technical Guide No 03730 "Guide for Selecting Application Methods for the Repair of Concrete Surfaces". Fins, trowel marks, and all protrusions or rough edges shall be removed.
- 3.1.7 **Stopping Infiltration –**
 - 3.1.7.1 The Contractor shall use hydraulic cement to stop infiltration at each identified point of leakage into the manhole. If the flow of water into the manhole is too great for stoppage utilizing hydraulic cement, the Contractor shall drill holes at each point of leakage that extend through the manhole wall. Chemical sealant injection devices shall be placed into the drilled holes in a manner to provide a watertight seal between the holes and the injection device.
 - 3.1.7.2 Hoses shall be attached to the injection devices from an injection pump. A mixture of manhole chemical sealants shall then be pumped until material refusal is

recorded on the pressure gauge of the pumping unit. The Contractor shall ensure that excessive pumping pressures do not develop that may cause damage to the manhole walls.

3.1.7.3 Once the injection of the chemical sealants have been completed, the injection packers shall be removed and the holes shall be filled and troweled flush with the surface of the manhole wall using a fast-set non-shrinking grout.

3.1.7.4 Excessively leaking manholes requiring chemical sealants will be considered additional manhole preparation. The Contractor must notify and receive approval from the Owner before additional preparation begins. Additional manhole preparation without approval from the Owner will be considered incidental to the Work. Payment for this item shall be at unit price bid only after the event that normal leak stoppage methods are not effective and it is approved by the Owner.

3.1.8 Loose material shall be removed from the area to be patched exposing a sound sub-base. Holes or voids around steps, joints or pipes, spilled areas, and cavities caused by missing or broken brick shall be patched and missing mortar repaired using a nonshrink patching mortar conforming to the requirements of this section. Cracks not subject to movement and greater than 1/16 inch in width shall be routed out to a minimum width and depth of ½ inch and patched with nonshrink patching mortar conforming to the requirements of this section. Bench repair and patching of walls is considered incidental to manhole preparation for liner application.

3.1.9 All manholes which have exposed cured-in-place or deformed/reformed pipe segments in the manhole invert channel shall require the use of a concrete bonding adhesive prior to the spray application of the cementitious manhole liner. The bonding agent shall be any synthetic emulsion specifically formulated for bonding new concrete to existing surfaces. The bonding agent shall be mixed and applied in accordance with manufacturer's recommendation.

3.2 *Spraying* –

3.2.1 Environmental conditions shall be monitored with proper equipment. Contractor shall provide a daily coating report that includes work performed, surface preparation, surface conditions, surface and profile measurement, ambient conditions, application information and batch numbers (if applicable).

3.2.2 The surface prior to spraying shall be damp without noticeable free water droplets or running water. Material shall be spray applied to a minimum uniform thickness to insure that all voids and crevices are filled and a smooth.

3.2.3 The application of the liner shall provide a monolithic liner of a minimum of ½". The liner shall be applied to the invert, bench and wall and shall all be equal in thickness as determined by the water table and the product manufacturer. The manhole invert and bench shall be smooth and sloped in the direction of the flow. The manhole bench shall have a gradual slope to the invert. The invert transition to the pipe shall be smooth and shall not impair the flow.

3.2.4 No application shall be made when ambient temperatures are less than 40oF and when freezing is expected within 24 hours unless specific recommendations are made by the manufacturer.

- 3.2.5 A minimum of 4 hours cure time or more as required by the product manufacturer shall be allowed before returning to active flow. A minimum of an additional two (2) hours of cure time shall be added if the rehabilitated manhole is subject to flows from force mains.
- 3.3 *Inflow Dish* – Inflow dishes shall be required in every manhole being rehabilitated and installed in accordance with the manufacturer’s recommendations.
- 3.4 *Acceptance* –
- 3.4.1 Two standard samples shall be taken from each day’s work with the date, location and job recorded for each sample. The samples shall be sent to an established, local, and reputable commercial testing laboratory that has been approved by the Owner to determine if lining materials meet minimum requirements specified herein. The cost to perform these tests shall be incidental to the manhole rehabilitation.
- 3.4.2 Vacuum Testing shall be in accordance with Section 2570 Gravity Sewer Collection System and witnessed by ECUA inspector.
- 3.4.3 Contractor may be required to perform adhesion tests using a pull-off adhesion tester after product has sufficiently cured. At a minimum, two (2) tests shall be performed on the manhole floor (invert) and three (3) tests shall be performed on the manhole walls. Adhesion (pull) tests shall be performed in accordance with ASTM D4541 test standards.
- 3.4.4 Spark Testing shall be performed on all Composite Cement and Epoxy System rehabilitated manholes.
- 3.4.4.1 Rehabilitated manholes shall be tested by the Contractor using high-voltage holiday detection equipment (“spark tester”) following the published standards of the National Association of Corrosion Engineers (NACE International), SP0188-2006, to detect cracks, pinholes, thin spots, etc. An induced holiday shall be made on the coated surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at the particular area. The cost to perform these tests shall be incidental to the manhole rehabilitation.
- 3.4.4.2 The spark tester shall be initially set at 100 volts per one (1) mil of film thickness applied but may be adjusted as necessary or as recommended by the protective coating manufacturer to detect the induced holiday. All detected holidays shall be marked by abrading the protective coating with grit paper or other hand tooling methods and repaired.
- 3.4.4.3 All touch-up/repair procedures shall follow the protective coating manufacturer’s recommendations. All defects shall be promptly repaired and reinspected until satisfactory results are obtained.
- 3.4.5 Minimum requirements of the corrosion protection coatings and/or lining system are that it be free of the following:
- 3.4.5.1 Uncured Material
- 3.4.5.2 Inadequate Thickness
- 3.4.5.3 Pinholes

- 3.4.5.4 Blisters
 - 3.4.5.5 Delamination
 - 3.4.5.6 Foreign Matter
 - 3.4.5.7 Unspecified Materials
- 3.4.6 If test results indicate noncompliance with the specification, the following corrective action may be required of the Contractor:
- 3.4.6.1 Remove non-compliant systems or components.
 - 3.4.6.2 Replace system or components in 3.4.6.1
 - 3.4.6.2.1 Repair area shall be a minimum size of 4" by 4" square or 2 inches larger than area being repaired, whichever is larger.
 - 3.4.6.2.2 If there are more than 5 repairs per any 3 vertical feet, the complete epoxy layer must be removed and re-applied.
 - 3.4.6.3 Assume the testing expenses.