

SECTION 02604

MANHOLE REHABILITATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Manhole Preparation
- B. Spin or Sprayable Cement Mortar Liner
- C. Spin or Spray-Applied Epoxy Liner
- D. Manhole Testing
- E. Cleanup
- F. Warranty

1.2 RELATED SECTIONS

- A. Section 01150 - Measurement and Payment
- B. Section 02600 - Wastewater Flow Control
- C. Section 02730 - Sanitary Sewer Cleaning and Inspection

1.3 REFERENCES

- A. American Society of Testing and Materials (ASTM)
- B. American National Standards Institute (ANSI)

1.4 SUBMITTALS

- A. Shop drawings and product data in accordance with Section 01300 - Submittals

1.5 MEASUREMENT AND PAYMENT

- A. Refer to Section 01150 – Measurement and Payment

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials used for manhole rehabilitation shall be pre-approved by the Engineer prior to the bid.

- B. The installer shall warrant and save harmless the **County** and the Engineer against all claims for patent infringement and any loss thereof.
- C. The **Contractor** shall handle and store all materials, mixing, environmental controls during application, safety & equipment per manufacturer recommendation. and shall dispose of all wastes in accordance with applicable regulations.
- D. Each lining system shall be designed for application over wet (but not active running water) surfaces without degradation of the final product and the bond between the product and the manhole surfaces.
- E. All Work shall be performed in strict observance of OSHA regulation, especially those related to confined space entry.
- F. The **Contractor** shall notify the local fire department and **County** and obtain approval and hydrant meter before using fire hydrants for water needs.
- G. Notice of work to affected properties required one week prior to beginning work.

2.2 EQUIPMENT

- A. The required equipment shall consist of chemical pumps, chemical grout containers, injection packers, hoses, valves, and any other miscellaneous equipment required to seal the manhole. The chemical injection pumps shall be equipped with pressure meters to provide for monitoring pressure during the chemical sealant injection process. If necessary, fluid by-pass lines equipped with pressure regulated by-pass valves will be incorporated into the system.

2.3 MATERIALS FOR STOPPING ACTIVE LEAKS IN CONCRETE AND MASONRY MANHOLES

- A. The following materials shall be used for stopping active leaks in concrete and masonry manholes:
 - 1. A premixed fast-setting, volume-stable waterproof cement plug consisting of hydraulic cement, graded silica aggregates, special plasticizing and accelerating agents. It shall not contain chlorides, gypsums, plasters, iron particles, aluminum powder or gas-forming agents, or promote the corrosion of steel it may come in contact with. Set time shall be approximately 1 minute. Ten-minute compressive

strength shall be approximately 500 psi. Only Waterplug, Bonsol, Madewell ML-10, Permacast-Dry Plug, - Patch, Sauereisen instaplug No. F-180 or equal will be allowed.

2. An elastomeric polyurethane resin-soaked method, using dry twisted jute oakum, or resin-rod with polyurethane resin (water activated).

2.4 MATERIALS FOR PATCHING, REPOINTING, FILLING, AND REPAIRING NONLEAKING HOLES, CRACKS, AND SPALLS IN CONCRETE AND MASONRY MANHOLES

- A. The **Contractor** shall use a premixed non-shrink cement-based patching material consisting of hydraulic cement, graded silica aggregates, special plasticizing and accelerating agents, which has been formulated for vertical or overhead use. It shall not contain chlorides, gypsums, plasters, iron particles, aluminum powder, or gas-forming agents or promote the corrosion of steel it may come into contact with. Set time (ASTM C-191) shall be less than 30 minutes. One-hour compressive strength (ASTM C-109) shall be a minimum of 200 psi and the ultimate compressive strength (ASTM C-109) shall be a minimum of 5000 psi. Bond strengths (ASTM C-882 Modified) shall be a minimum of 1700 psi.

2.5 SPIN OR SPRAYABLE CEMENT MORTAR LINER

- A. Sprayable cement mortar liner shall be Mainstay ML-72 by Madewell Products Corporation, Permacast MS10000 or equal approved by the Engineer.
- B. The Sprayable Cement Mortar based liner material shall be used to form a structural enhanced monolithic liner covering all interior surfaces of the manhole including benches. The finished liner shall conform to the minimum requirements listed below:

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>RESULTS</u>
Tensile Strength	ASTM C-190	575 psi 28 Days
Compressive Strength	ASTM D-109	6,190 psi 28 Days
Flexural Strength	ASTM C-78	800 psi 28 Days
Uniaxial Tensile Bond Strength	ACI503R	145 psi

Appendix A

- B. **Cleaning:** 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. Cleaning shall be with a 3500 PSI min. hydroblast equipment. 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. The Engineer's inspector shall determine if cleaning is adequate.
- C. **Flow Control:** The **Contractor** shall be responsible for plugging or diverting the flow of wastewater as needed for manhole rehabilitation. Wastewater flow control shall be performed as specified in Section 02600 - Wastewater Flow Control.
- D. **Stopping Infiltration:**
1. The **Contractor** shall use hydraulic cement to stop infiltration at each identified point of leakage into the manhole.
 2. 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 which extend through the manhole wall. Grout 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. Hoses shall be attached to the injection devices from an injection pump. A mixture of manhole chemical sealant 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.
 4. Once the injection of the chemical sealants has 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.
- E. **Patching:** Loose material shall be removed from the area to be patched, exposing a sound sub-base. Holes or voids around steps, joints or pipes, spawled areas, and cavities shall be patched and missing mortar repaired using a non-shrink 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 1/2 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.

- F. 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 recommendations.
- G. All incoming or outgoing pipes shall be plugged or otherwise protected during liner application to prevent clogging. Manhole steps shall be thoroughly cleaned after spraying. If manhole steps must be removed during liner installation, the **Contractor** shall not replace the steps. No separate measurement or payment will be made for removal of the manhole steps, same being considered an integral part of the Work.
- H. The frame and cover shall be removed, as directed by the Engineer, and the surface of the manhole cone or adjustment thoroughly cleaned. A new bed of cement mortar shall be placed on the cleaned surface and the frame reset to grade, and the exterior cemented as needed.

3.2 SPIN OR SPRAYABLE CEMENT MORTAR LINER

- A. The **Contractor** shall perform all Work in strict accordance with all applicable OSHA regulations. 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. All personnel shall have a certification of training.
- B. Prior to entering manholes, an evaluation of the atmosphere will be conducted to determine the presence of toxic, flammable vapors, or possible oxygen deficiency. The evaluation shall be in accordance with local, state, and federal safety regulations.
- C. The installation of the sprayable cement mortar liner shall be in strict accordance with the manufacturer's written instructions,

including handling, mixing, environmental controls during application, safety, and equipment.

- D. All specified surfaces will be lined with the surfacing system to provide the minimum total thicknesses of 1". The cured surfacing shall be monolithic with proper sealing connections to all surface areas and shall be placed and cured in conformance with the recommendations of the surfacing system manufacturer.
- E. The finished invert surfaces shall be smooth, free of ridges, and will be sloped in the direction of flow. Special care shall be used to ensure a smooth transition between the new manhole invert and intersecting pipeline inverts such that flow will not be impaired.
- F. The flow through the manhole shall be re-established as soon as practical and following the liner manufacturer's recommendation for appropriate curing.
- G. The liner shall be installed by a trained experienced technician who has been approved by the manufacturer. Appropriate personal protection equipment shall be utilized.

3.3 SPIN OR SPRAY APPLIED EPOXY LINER

- A. Application procedures shall conform to the recommendations of the monolithic surfacing system manufacturer, including material handling, mixing, environmental controls during application, safety, and equipment.
- B. The equipment shall be specially designed to accurately ratio and apply the specified materials and shall be regularly maintained and in proper working order.
- C. The specified materials must be applied by an approved installer of the surfacing system.
- D. All specified surfaces will be lined with the surfacing system to provide the minimum total thicknesses of 125 mils. The cured surfacing shall be monolithic with proper sealing connections to all surface areas and shall be placed and cured in conformance with

the recommendations of the surfacing system manufacturer. Epoxy must be applied to uncured concrete mortar to ensure a composite liner.

- E. Specially designed spray and/or spincast application equipment shall be used to apply each component of the system.
- F. During application a wet film thickness gauge, meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used to ensure a monolithic coating film and minimum uniform thickness during application.

3.4 MANHOLE TESTING

- A. All rehabilitated manholes and manhole inserts shall be tested by the **Contractor** using the vacuum test Method, following the manufacturer’s recommendations for proper and safe procedures. Vacuum testing of manholes and structures shall be performed after curing of linings and installation of inserts. Any leakage in the manhole or structure, before, during, or after the test shall be repaired.
- B. All pipes for vacuum testing entering the manhole shall be installed at the top access point of the manhole. A vacuum of 10 inches of mercury (Hg) (5.0 psi) shall be drawn on the manhole, and the times shall be measured for the vacuum to drop to 9 inches of mercury (Hg) (4.5 psi). Manholes will be considered to have failed the vacuum test if the time to drop 1 inch of mercury is less than what is shown in the following table:

Vacuum Test Timetable

Manhole Diameter- Inches

<u>Depth-Feet</u>	<u>48 inches</u>	<u>60inches</u>	<u>72inches</u>	<u>96inches</u>
4	10 sec. 19sec.		13 sec.	16 sec.
8	20sec. 38 sec.	26 sec.		32 sec.
12	30 sec. 57 sec.		39 sec.	48 sec.
16	40 sec. 76 sec.		52 sec.	64 sec.

20	50 sec.	65 sec.	80 sec.	
	95 sec.			
+Each 2' sec.	+5 sec.	+6.5 sec.	+8.0 sec.	+9.5

- C. Manhole depths shall be rounded to the nearest foot. Intermediate values shall be interpolated. For depths above 20 feet, add the values listed in the last line of the table for every 2 feet of additional depth.
- D. If the manhole or structure fails the vacuum test, the **Contractor** shall perform additional repairs and repeat the test procedures until satisfactory results are obtained.
- E. After the manhole rehabilitation or manhole insert work has been completed, the manhole shall be visually inspected by the **Contractor** in the presence of the engineer and the Work shall be accepted if found satisfactory to the Engineer. The finished surface shall be free of blisters, “runs” or “sags” or other indications of uneven lining thickness. No evidence of visible leaks shall be allowed.

3.5 CLEANUP

- A. After the installation work has been completed and all testing acceptable, the **Contractor** shall cleanup the entire project area. All excess material and debris not incorporated into the permanent installation shall be disposed of by the **Contractor**. The work area shall be left in a condition equal to or better than prior condition. Disturbed grassed areas shall be seeded or sod placed as directed by the Engineer at no additional cost to the County. Site restoration shall be performed in accordance with Section 02924 - Site Restoration.

3.6 WARRANTY

- A. The **Contractor** shall guarantee his work for a warranty period of five (5) years from the date of acceptance. If, at anytime during the warranty period, any leakage, cracking, or other discontinuity is identified, the **Contractor** shall make repairs at no additional cost to the County.

****END OF SECTION****