

SECTION 02738

MANHOLE REHABILITATION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Scope:

1. This section covers repair, structural restoration and rehabilitation of existing manholes as required to eliminate leakage into the structures and provide protection against biogenic corrosion by providing a structural, monolithic liner on the manhole inside walls.
2. Construction Photographs: The Contractor shall provide the City with preconstruction and post construction digital photo files of the manholes indicated for rehabilitation. Provide a list correlating the photo file number with manhole's approximate location. All photographs shall have sufficient detail of the interior of each manhole to reveal conditions of existing defects and rehabilitated features.

B. Process Description:

1. Manhole structural restoration is achieved by spraying the manhole walls and bench surfaces with cementitious materials (mortar) to create a monolithic wall with no joints. This process provides a uniform minimum thickness of 1/2" in depth, forming an impervious, monolithic liner with physical properties that exceed those of the existing structure. The system consists of three primary components; (1) materials consisting of pre-blended, fiber-reinforced mortar, (2) specialized equipment designed to mix and convey the material, and (3) proper application techniques.
2. The mortar must be designed for this particular use and shall have:
 - A minimum tensile strength of 500 psi (ASTM C 496)
 - A minimum 28 days flexural strength of 600 psi (ASTM C78)
 - A minimum 28 days compressive strength of 5000 psi (ASTM C109)
 - A minimum 28 days bond strength of 2300 psi (ASTM C 882)
3. The equipment must be specially designed to mix, pump and spray the wet mortar in a uniform controlled manner.
4. The applicator, approved and trained by the manufacturer, shall furnish all labor and equipment and materials for applying a corrosive resistant cementitious material to form the structural liner. All aspects of the installation shall be in accordance with the manufacturer's recommendation and per the following specifications which includes:
 - a. The removal of any loose and unsound substrate.
 - b. Cleaning of the area to be sprayed with high pressure water.

- c. The repair and filling of voids.
 - d. The repair and sealing on the inverts and benches.
 - e. The elimination of active infiltration prior to making the application.
 - f. Finally, the spay application of an acid resistant cementitious material to form a structurally enhanced corrosion resistant monolithic liner.
- C.** Supplying all labor, materials, equipment and apparatus not specifically mentioned herewith or noted on the plans, but which are incidental and necessary to complete the work specified.

1.02 JOB CONDITIONS

- A.** The Contractor shall conduct operations and schedule cleanup in a manner to cause the least possible obstruction and inconvenience to traffic, pedestrians and to adjacent property owners or tenants.

1.03 SUBMITTALS

- A.** A list of locations and references for other projects in which the products was used shall be furnished to the Engineer prior to commencing work.
- B.** The Contractor shall submit the manufacturer documents containing product (mortar and water-stop patching compound) technical information, ASTM test results and certification, application procedures and specifications for approval.
- C.** The Contractor shall submit a plan for bypassing sewage around the work area and facilities where sewage flows must be interrupted to carry the work. The plan shall be reviewed by the engineer and shall be acknowledged as acceptable before any work is started.

1.04 REQUIREMENTS

- A.** The installer, whether the Contractor or a subcontractor, shall be a certified installer of the lining system. The installer's personnel shall be adequately trained in maintenance and operation of the required installation equipment, as certified by the lining manufacturer. A letter from the manufacturer of the lining system, verifying the certification of the installer required to be on-site during installation, shall be submitted to the City.
- B.** Prior to the installation of the lining system, the host structure shall be prepared to produce a concrete surface suitable for application and adhesion of the specified lining system. Cleaning and surface preparation shall include the inspection of the host structure for any damage or leaks, and the removal of any protrusions on the surface of the host structure that could interfere with the installation of the lining system. Any damage or leaks shall be reported to the Engineer. Cleaning methods may include high pressure water cleaning at a minimum of 34.5MPa (5,000 psi), abrasive blast, or a method recommended by the manufacturer of the lining system, or another cleaning method submitted to the Engineer for approval. The Contractor shall protect the host structure from damage by the cleaning equipment, water and air pressure. Flow bypassing, if required by the lining system, shall be as specified under Section 02740.

- C. Debris from the cleaning operation shall not be allowed to enter the sewer system. The Contractor shall furnish, install and remove any necessary debris containment devices while maintaining sewer flow. The Contractor shall remove and dispose of all debris collected from the cleaning operation. If reinforcing steel is exposed, either before or after removing deteriorated concrete, it shall be thoroughly cleaned to remove all contamination and rust particles. Immediately after the cleaned reinforcing steel is inspected and accepted by the Engineer, the Contractor shall place a protective coating on the exposed reinforcing steel. The protective coating shall be approved by the Engineer in accordance with the manufacturers' specifications.

PART 2 - PRODUCT

2.01 MATERIALS

- A. Cementitious material (i.e. spray-able mortar) shall be SewperCoat as manufactured by Kerneos Aluminate Technologies or SP15 Spray Mortar as manufactured by ThoRoc or Strong-Seal MS-2A as manufactured by Strong-Seal Systems Group or Drycon - SM as manufactured by IPA Systems Inc. or approved equal. Polyurethane coating material shall be Utilithane 1600 Polyurethane Coating as manufactured by Prime Coatings Incorporated or SprayShield by Sprayroq or approved equal. Epoxy coating material shall be Raven 405 manufactured by Raven Lining Systems or approved equal. The minimum liner shall be 3mm (125 mils) thick.

	Polyurethane	Epoxy Primer
Tensile Strength ASTM D 638, Type IV, MPa (psi) (min)	13.8 (2,000)	41.4 (6,000)
Elongation at Break, % ASTM D 638, Type IV	40	5
Wear Resistance, mg. wt. Loss Taber abrasion, ASTM D4060	60 ¹	100 ¹
Hardness, Shore D, Durometer ASTM D 2240	55	75
Tear Resistance, kg/mm (ppi) ASTM D 624	2.7 (150)	N/A
Peel Strength, Concrete, g/mm (pli) ASTM D 903	125 (7) ²	125 (7) ²
Weight Change ³	± 1.5%	± 1.5%

- B. Other applicable crack repair materials such as patching material, infiltration control material, and grouting material shall be obtained from the same manufacturer of the mortar for consistency in material used.

2.02 EQUIPMENTS

- A. Progressive cavity pumps are preferred because of their ability to provide a consistent volume of material to the spray head. High-pressure cleaning system and water storage tank are also required. A water metering system should be provided on the equipment to allow the application to properly control the volume of water added.

PART 3 - EXECUTION

3.01 SANITARY SEWER MANHOLE WALL REPAIR

- A.** Comply with all relevant provisions of the Safety and Health Regulations for Construction, promulgated by the Secretary of Labor, as set forth in Title 29 C.F.R., and with all provisions of the California Occupational Safety and Health Act of 1973.
- B.** Specific attention is directed to OSHA safety rules, regulations and precautions to be taken by the Contractor before entering sanitary sewer manholes, and sanitation structures with respect to physical and chemical hazards which may be present.
- C.** Manhole walls shall be sealed where shown or specified, or as directed by the Engineer. Rehabilitation of the manhole walls shall be accomplished by applying a structural, spray-able repair mortar coating to the original surface plane or a minimum of 0.5 inch. The manufacturer's recommendations shall be strictly followed for the entire operation including cleaning and preparing the manhole walls, storing and preparing the products, and sealing the manholes. The product must be specifically formulated for use in the sewer system and bear the manufacturer's certification that it will fulfill the requirement described herein when applied in accordance with the manufacturer's recommendations.
- D.** Prior to the sealing operation, the manhole walls shall be thoroughly cleaned using a high pressure water blast with a minimum nozzle pressure of 2,500 psi or higher as required to remove all surface debris and loose materials. All cracks, openings, active water infiltration, and deteriorated joints in the manhole walls shall then be repaired in accordance with the sealing product manufacturer's recommendations.
- E.** Where occur, seal crack openings greater than 1/8 inch on inside of existing manholes by chipping out a minimum depth and width of 3/4" to provide mechanical key for mortar.
- F.** Where occur, remove any loose bricks or pieces of brick, mortar or concrete and fill all voids and joints with mortar.
- G.** Where occur, seal all active water infiltration using rapid setting, water stop patching compound manufactured for this purpose.
- H.** Sealing manhole walls shall mean that the entire wall surface and the base are sealed with the new mortar coating. The manhole wall seal shall extend from the top of the cone to the base. This seal will include the area where the walls join the base and the location where the pipes enter and exit the manhole, even if through the manhole base.
- I.** Solid debris resulting from required preparatory operations shall be prevented from entering the sewer pipe and shall be removed from the manhole prior to sealing.

- J. Polyurethane Liner Installation and Curing: Lining material shall be applied to all prepared surfaces from 25mm (1 inch) below the low-flow water level to the base of the ring and cover unless otherwise specified. All termination points of the lining material to the existing subsurface shall be keyed into the subsurface by mechanically scoring a minimum 6mm x 6mm (1/4 inch x 1/4 inch) keyway. Prior to application of the polyurethane, the subsurface shall be primed with the epoxy primer to a thickness of 7.6µm (3 mils) minimum to 12.7µm (5 mils) maximum. Polyurethane shall be applied to a thickness of 3.2mm (125 mils) immediately prior to the epoxy primer becoming tack-free. Lining material shall be uniform in color, fully cured, free of holidays, surface imperfections, blisters and sags and adequately adhered to the subsurface.
- K. Epoxy Liner Installation and Curing: Lining material shall be applied to all prepared surfaces from 25mm (1 inch) below the low-flow water level to the base of the ring and cover unless otherwise specified. Termination points of the lining to the existing subsurface shall be keyed into the subsurface by mechanically scoring a minimum 6mm x 6mm (1/4 inch x 1/4 inch) keyway. Epoxy shall be applied to a thickness of 3.2 mm (125 mils). Lining material shall be uniform in color, fully cured, free of holidays, surface imperfections, blisters and sags and adequately adhered to the subsurface.

3.02 SANITARY SEWER MANHOLE INVERT AND BENCH REPAIR

- A. The existing bench and trough area shall be thoroughly cleaned. Remove loose and unsound materials such as mortar, brick, clay pipe and concrete. Care shall be taken to avoid damage to other parts of the manhole structure. Loose materials shall be prevented from entering into the sewer lines and shall be properly disposed by the Contractor.
- B. Repair manhole inverts and rebuild benches that have visible damage or infiltration present.
- C. Trowel mix uniformly onto damaged invert and bench at a minimum thickness of ½ inch, extending out onto base of manhole sufficiently.
- D. Finished invert and bench surfaces shall be smooth and free of ridges.

3.03 FIELD SAMPLE AND FINAL ACCEPTANCE

- A. The Contractor shall provide the Engineer for approval, with certified test results of the short term properties of the structural grout material from the actual installed grout liner at a minimum of 4 samples taken at random from different batch of material.
- B. Grout samples shall be submitted to a certified laboratory hired by the Engineer and tested to confirm that the liner pipe conforms to the minimum ASTM requirements stated in Section 1.01-B.2. Final payment for project shall be withheld pending receipt and approval of results of tests.
- C. Visually verify the absence of leaks. Manholes will also be inspected after completion and within the guarantee period. Leakage and other defects that were a result of the Contractor's work shall be eliminated and repaired by the Contractor as required by the Engineer, at the Contractor's expense.

3.04 TESTING AND REPAIR

- A. The testing costs are to be paid by the City and therefore, should not be included in the bid. However, if the work should fail to pass the tests, it is the Contractor's responsibility to correct the work and re-test at the Contractor's expense. The City shall not pay for these re-installations and re-tests.

- B. **Spark Test:** The cured lining system shall be spark tested for holidays with the high voltage holiday detector instrument specified by the coating manufacturer or as specified in the Special Provisions. The voltage shall be set at a minimum of 15,000 volts. For thicknesses greater than 3.81mm (150 mils), the voltage shall be set at 100 volts per 25.4 μ m (1 mil) of thickness of the applied lining material. Identified holidays shall be marked without contaminating the lining surface and repaired.

- C. **Mil Gauge Test:** During installation, a mil gauge shall be used to verify that the minimum thickness of the lining meets and/or exceeds the minimum thickness as specified herein.

- D. **Adhesion Testing:** Adhesion testing shall be performed on a minimum of 1 structure or 15 percent of all rehabilitated structures, whichever is greater. Adhesion testing shall be conducted after the liner system has cured in accordance with the manufacturer's specifications. Adhesion testing shall be in accordance with ASTM D4541.

- E. **Liner Repairs:** Holidays, uncured lining material, blisters, surface imperfections and damage to the liner resulting from the adhesion test shall be repaired to a point 25mm (1 inch) minimum beyond the limits of the damaged area. The repair shall be 3mm (125 mils) thick. Holidays shall be primed and recoated with the same lining system to a minimum additional thickness of 30 mils unless otherwise specified by the liner manufacturer or approved by the Engineer. Blisters, uncured lining and surface imperfections shall be completely removed and the areas recoated with appropriate lining material to 25 mm (1 inch) minimum beyond the repair areas at a minimum thickness of 100 mils. Additional spark testing shall be performed after repairs are completed.

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- E.** Where occur, seal crack openings greater than 1/8 inch on inside of existing manholes by chipping out a minimum depth and width of 3/4" to provide mechanical key for mortar.
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- J. Polyurethane Liner Installation and Curing: Lining material shall be applied to all prepared surfaces from 25mm (1 inch) below the low-flow water level to the base of the ring and cover unless otherwise specified. All termination points of the lining material to the existing subsurface shall be keyed into the subsurface by mechanically scoring a minimum 6mm x 6mm (1/4 inch x 1/4 inch) keyway. Prior to application of the polyurethane, the subsurface shall be primed with the epoxy primer to a thickness of 7.6µm (3 mils) minimum to 12.7µm (5 mils) maximum. Polyurethane shall be applied to a thickness of 3.2mm (125 mils) immediately prior to the epoxy primer becoming tack-free. Lining material shall be uniform in color, fully cured, free of holidays, surface imperfections, blisters and sags and adequately adhered to the subsurface.
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- B. Grout samples shall be submitted to a certified laboratory hired by the Engineer and tested to confirm that the liner pipe conforms to the minimum ASTM requirements stated in Section 1.01-B.2. Final payment for project shall be withheld pending receipt and approval of results of tests.
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