2W -- General Manhole Rehabilitation Specifications

2W.1 Scope: This section covers all aspects of non-destructive sanitary sewer manhole rehabilitation, including type of repair, method of repair, materials, and required testing for each manhole scheduled for rehabilitation.

2W.2 Description: The Contractor shall be responsible for furnishing all labor, supervision, materials, and equipment required to complete all manhole rehabilitation work, testing, and surface restoration in accordance with this Specification.

2.W.2.1 This specification shall be interpreted to require that the Contractor shall provide all the items, articles, materials, operation or methods listed, mentioned or scheduled as specified, or both including all labor, materials, equipment and incidentals necessary and required for project completion.

2W.2.2 All sections of this Specification are mutually complimentary and the overall intent is that each Contractor shall provide for everything in his portion of the work required to make a complete and operable job in every respect unless specifically noted otherwise.

2W.2.3 It is the intent of this Specification to ensure that the work, as completed, shall meet all applicable codes, ordinances, rules and regulations of. every authority having jurisdiction in the area where the construction is located. Failure of the contractor to point out items that do not meet such requirements does not relieve any Contractor or his Subcontractors of the responsibility of meeting them.

2W.2.4 Reference to ASTM: Reference is made in this Specification to the following specifications published by the American Society for Testing and Materials:

a. ASTM A 240 Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate

b. ASTM A 479 Specification for Stainless and Heat-Resisting Steel Wire, Bars, and Shapes for Use in Boilers and Other Pressure Vessels

c. ASTM C 109 Test Method for Compressive Strength of Hydraulic Cement Mortars

d. ASTM C 150 Specification for Portland Cement

e. ASTM C 157 Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete

f. ASTM C 293 Test Method for Flexural Strength of Hydraulic Cement Mortars

g. ASTM C 495 Test Method for Compressive Strength of Lightweight Insulating Concrete

h. ASTM C 666 Test Method for Resistance of Concrete to Rapid Freezing and Thawing

i. ASTM C 882 Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete

j. ASTM C 1042 Test Method for Comparing Concrete on the Basis of the Bond Developed with Reinforcing Steel

k. ASTM F 593 Specification for Stainless Steel Bolts, Hex Cap Screws and Studs

l. ASTM C496 Test Method for Tensile Strength

m. ASTM C596 Test Method for Shrinkage at 90% relative humidity.

2W.3 Construction Site Storage

2W.3.1 All mortar-based supplies shall be stored and maintained by the Contractor in the same manner in which they are received from the manufacturer. Materials shall not be exposed to adverse conditions prior to the work. All materials shall be kept in a secured area and away from general public access. The Contractor shall review and maintain all

Material Safety Data Sheets (MSDS), product labeling, and technical literature at the project site.

2W.4 Construction Photographs

2W.4.1 The Contractor shall provide the Owner's Representative with preconstruction and postconstruction photographs of the manholes scheduled for rehabilitation. Photographs shall be of commercial quality, color prints and a minimum size of 3" x 5". Photographs shall be permanently mounted and labeled on commercial grade plate album sheets and bound with a hard-back photo album cover for each set. Each photograph shall identify the manhole number, approximate location, and data. Photo albums shall be labeled with the proper Project title. All photographs shall have sufficient detail of the interior of each manhole to reveal conditions of existing defects and rehabilitated features.

2W.5 Rehabilitation of Manhole Frame Seal

2W.5.1 Manhole frame sealing includes the sealing of the frame adjustment area with a corrosion resistant aromatic flexible urethane resin coating. The sealing system shall be Flex-Seal Utility Sealant as manufactured by Sealing Systems Inc. It shall be designed to prevent leakage of water into the manhole through this area. The sealing system shall remain flexible and allow vertical movement of the frame up to 0.5 inches. Technical information on this product: contact D. A. Van Dam & Associates at 888-818-0016.

2W.5.2 Materials

a. Primer- Flexible Aromatic Urethane Resin Liner Primer minimum requirements:

Hardness	ASTM D2240	85
Elongation	ASTM D412	400 percent
Tensile Strength	ASTM D412	3200 psi
Adhesive Strength	ASTM D903	400 lb/in
Tear Resistance	ASTM D1004	210 lb/in

b. Final Coat: Flexible Aromatic Urethane Resin
Liner Final Coat minimum requirements

Hardness	ASTM D2240	75
Elongation	ASTM D412	800 percent
Tensile Strength	ASTM D412	1150 psi
Adhesive Strength	ASTM D903	175 lb I/in
Tear Resistance	ASTM D1004	155 lb I/in

2W. 5. 3 Application

a. Contact surfaces shall be clean, smooth and circular, and free of excessive voids. Remove loose and protruding mortar and brick. Prepare surfaces of the ring adjustment area to include the lower 3 inches of the frame and the top 8 inches of the cone section according to manufacturer's instructions. A total of 12 vertical inches applied at 120 mil thickness. Greater depths may be covered at the engineer's direction depending on conditions of the manhole.

b. If the masonry surface is rough, irregular, or contains excessive voids and will not provide an effective seal, apply a bed of quick-setting, non-shrink mortar. Allow mortar to cure prior to installing the flexible manhole sealant system per manufacturer's recommendations. The minimum cure time will be 14 days before application of Flex Seal.

c. Correct active internal leaks prior to installing the flexible manhole sealant system per manufacturer's recommendations.

d. Prepare internal surface by sand blasting casting section to white metal with sand. After sandblasting, check the entire area to remove any loose sand, debris, laitances, dust, dirt, oil, grease or chemical combination. At engineer's discretion, sand is to be captured and not allowed to enter the manhole.

e. Use of a blower may be required to completely dry the surface as recommended by the manufacturer. Surface of manhole must be completely dry prior to primer application.

f. Mix and apply the adhesive primer to the clean and dry surface according to manufacturers recommendations. Cover the ring

adjustment area, the lower 3 inches of the casting frame and the top 8 inches of the cone section. Allow for proper drying of the adhesive primer, then apply sealant by brush, as evenly as possible over the entire area and allow to cure per manufacturer's recommendations. Minimum thickness of sealant is 120 mils.

2W.6 Rehabilitation of Manhole, Corbel & Wall

2W.6.1 Patching material shall be quick setting fiber reinforced calcium aluminate corrosion resistant cementitious material, mixed and applied according to manufacturer's recommendations and having the following minimum requirements:

Compressive Strength	ASTM C109	1400 psi, 6 hours
Bond	ASTM C321	145 psi, 28 days
Cement	Calcium Aluminate	
Applied Density	105 lbs +/- 5 lbs pcf	
Shrinkage	ASTM C596	0 percent at 90 percent relative humidity

Patching material shall be Strong-Seal® QSR.

2W.6.2 Infiltration control material shall be a rapid setting cementitious product specifically formulated for leak control to stop minor water infiltration and making repairs in concrete and brick structures, mixed and applied according to manufacturer's recommendations and having the following minimum requirements:

Compressive Strength	ASTM C109	400-600 psi, 1 hour 1800- 2400 psi, 24 hours
Expansion	ASTM C827	0.10 percent
Sulfate Resistance	ASTM C267	No weight loss after 15cycles, 200ppm

Freeze/Thaw	ASTM C666	100 cycles "Method A"
Pull Out Strength	ASTM C234	14,000 lbs
Placement time	Less than 1 minute	

Infiltration control material shall be Strong-Seal® or Strong-Plug.

2W.6.3 Grouting material shall be cementitious grout for stopping very active infiltration and filling voids when mixed and applied according to manufacturer's recommendations. The grout shall be volume stable with a minimum 28-day compressive strength of 250 psi. Grout shall be Strong-Seal® Grout 250 or Grout 1000.

2W.6.4 Cementitious based liner products shall be used to form a structural/structurally enhanced monolithic liner covering all interior substrate surfaces and shall have the following minimum requirements:

Cement	Calcium aluminate cement	
Compressive Strength	ASTM C109	9,000 psi at 28 days
Tensile Strength	ASTM C496	600 psi at 28 days
Flexural Strength	ASTM C293	1,400 psi at 28 days
Shrinkage	ASTM C596	0 percent at 28 days @ 90% relative hum
Bond	ASTM C882	2,000 psi at 28 days
Density when applied		134 pcf +/- 5 pcf
Freeze/Thaw	ASTM C666	100 cycles, No visible damage

Liner product shall be Strong-Seal® MS-2C cementitious-based factory blended liner product.

2W.6.5 All cementitious liner products shall be reinforced with alkaline resistant fiberglass rods not less and ½ inch or greater than 5/8 inch in length.

2W.6.6 Water used to mix products shall be clean and potable.

2W.6.7 Certification: The contractor must furnish certification to the Owner that the coating system materials proposed for the project meets or exceeds all of the minimum requirements as specified herein.

2W.6.8 Chemical Resistance: If the Owner determines that significant degradation of the manhole structure has occurred due to the presence of hydrogen sulfide, the Contractor shall apply Strong-Seal® High Performance Mix according to manufacturer's recommendations.

2W.6.9 Application

a. Use approved equipment designed and manufactured by the material supplier specifically for the application of cementitious liners in sanitary system manholes.

b. Deliver materials to the site in manufacturer's original, unopened containers and packaging, with labels clearly identifying the product name and manufacturer.

c. Store materials in accordance with manufacturer's instructions. Keep containers sealed until ready to use. Store materials in a cool dry environment and protect materials during handling and application to prevent damage.

d. Do not apply materials if ambient temperature is below 40 degrees F.

e. Do not apply materials to frozen surfaces or if freezing is expected within substrate within 24 hours after application.

f. Examine surfaces to receive manhole rehabilitation. Notify Engineer in writing if surfaces are not acceptable for rehabilitation.

g. Prepare surfaces according to manufacturer's instructions.

h. Place covers over invert to prevent extraneous material from entering sewer lines.

i. Clean manhole walls and bench by using a minimum of 3,500 psi water spray to remove contaminants, dirt, debris, and other foreign materials. Remove protruding roots.

j. Remove loose, unsound and protruding brick, mortar and concrete.

k. Before application of materials, inspect surfaces to be coated or sprayed. Correct defects or deficiencies identified before application of subsequent materials.

l. Voids: Repair and fill voids greater than 2 inches in depth with patching material. Apply patching material according to manufacturer's instructions.

m. Active Leaks: Stop active leaks with patching material or infiltration control materials applied according to manufacturer's instructions. Install weep holes as required to localize infiltration during application of patching material or infiltration control material. Plug weep holes after application with infiltration control material before applying liner material.

n. Severe Infiltration: Drill as required to pressure grout using an approved cementitious or chemical grout applied according to manufacturer's recommendations.

o. Invert Repairs: Remove loose and unsound materials and pressure wash walls, bench and invert after surface preparation is completed. Repair bench and invert using patching material. Repair inverts with visible damage and where infiltration is present. Apply patching material to invert by troweling at a minimum thickness of ½ inch at invert. Extend patching material onto bench of manhole sufficiently to tie into the liner material when applied.

p. Ensure surfaces have been properly prepared according to manufacturer's recommendations before applying liner material. Surface shall be damp and totally saturated with water, but free from noticeable free water droplets and running water.

q. Spray apply liner material using approved equipment designed and manufactured for applying cementitious liner material in sanitary manholes. Mix liner material with water according to manufacturer's recommendations. Discharge the prepared mix into hopper. Continue mixing as liner material is continuously sprayed.

r. Minimum thickness of liner material after application is ½ inch. Trowel the surface of the sprayed liner material to a smooth finish. Do not over trowel. Apply a brush finish to the troweled surface.

s. Remove wood covers and spray manhole bench with liner material to produce a gradual slope from the walls to the invert to form a monolith liner. Round the full circumference of the intersection of walls and bench to a uniform radius.

t. Cure materials according to manufacturer's recommendations. Minimize exposure of applied materials to sunlight and air movement. Do not expose finished materials to sunlight and air movement for longer than 15 minutes before covering or closing access. Cover the manhole if the time between application for additional coats of material is longer than 15 minutes.

u. Apply an approved concrete curing compound if the relative humidity is less than 70 percent within the manhole.

v. Allow a minimum of 4 hours of cure time, or as recommended by the manufacturer, prior to subjecting the manhole to flows.

w. Do not allow traffice over the manhole for a minimum of 24 hours after the final application of liner material.

2W.7 Field Quality Control

2W.7.1 Compressive Strength Test: Cast four 2 inch cubes each day or from each pallet of material. Label, package, and mail cubes to the manufacturer for testing. Manufacturer shall test cubes for compressive strength according to ASTM C109 and submit test results directly to the engineer.

2W.7.2 Vacuum Test: Allow a minimum of 14 days to pass after application of liner material prior to vacuum testing. Testing of manholes will be at engineer's discretion but no less than 10% of manholes will be vacuum tested.

2W.8 Rehabilitation of Manhole Bench & Trough

2W.8.1 Materials used for bench and trough repair shall conform to requirements of "Rehabilitation of Manhole Corbel and Wall" section of these Specifications.

2W.8.2 Cleaning: The existing bench and trough area shall be thoroughly cleaned. All loose mortar, brick, clay pipe, and concrete shall be removed by high-pressure water blasting. 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 of as directed by Owner.

2W.8.3 System Maintenance: Wastewater flow shall be maintained by methods which prevent contact with new bench and trough for a minimum of 72 hours after repair work is completed.

2W.8.4 Void Repair: Patching of large voids shall be accomplished by the method specified in this Specification. Prior to patching, one or more applications of an approved mortar shall be applied to stabilize the substrate.

2W.8.5 Reconstruction: The entire bench and trough area will be reshaped and reconstructed by the Contractor using a rapid strength repair mortar such as Strong-Seal® QSR. The bench and trough shall be finished in a manner as to have a smooth surface. If the Owner determines that the existing trough is unsuitable for continued use, the repair work shall include the entire trough area and all existing pipe shall be removed prior to applying the mortar. The bench and trough shall form a watertight seal with the manhole walls, base, and pipe seal.

2W.9 Vacuum Testing for Manholes – follow ASTM Specification for manhole vacuum testing and per engineer's direction.

2W.10 Rehabilitation Schedule set per engineer's plans and specifications.

2W.10.1 The Contractor shall rehabilitate manholes as indicated in the following schedule and/or as directed in the field by the Owner's Representative. All work shall be completed in accordance with the requirements of this specification.

2W.11 Mandatory Applicator/Contractor/Contractor Experience

2W.11.1 Contractor must furnish proof of successfully applying a minimum of 10,000 vertical feet of Strong-Seal® cementitious products on State of Michigan projects. Qualifications must be submitted in writing at mandatory pre-bid meeting. No contractor will be allowed to bid without this approved requirement. Contractor must also be certified to install Flex-Seal Utility Sealant per manufacturer's specification. No contractor will be allowed to apply Flex-Seal Material until engineer is furnished a certificate that shows personnel by name have been trained properly to apply the Flex-Seal material by the manufacturer's representative.

END OF SECTION