



ADDENDUM NUMBER TWO (2)

DATE: June 4, 2013

RE: BID NO. 2013-84

OWNER: CITY OF EDINBURG

TO: ALL PROPOSERS, HOLDERS OF SPECIFICATIONS, AND ALL INTERESTED PARTIES TO THE CITY OF EDINBURG

BID OPEN: 3:00 P.M. (Central Time), Monday, June 10, 2013 (*Revised by Addendum #1*)

The following clarifications, corrections and directives shall become part of the Proposal, Contract Documents and Specifications for **BID No. 2013-84 – Manhole Rehabilitation Project**.

BID PROPOSAL FORM

1. Replace Bid Proposal Form, Pages C1-C5 with Revised Bid Proposal Form, Pages C1-C5 (SEE ATTACHMENTS).

CLARRIFICATION: The items description is include "Raven 405 epoxy coating (Or Approved Equal)". That includes a cementitious liner based on condition of brick or concrete manholes.

MEASUREMENT AND BASIS OF PAYMENT:

1. Replace MEASUREMENT AND BASIS OF PAYMENT, Pages D1-D3 with Revised Basis of Payment, Page D1 (SEE ATTACHMENTS).

TECHNICAL SPECIFICATIONS SECTION:

1. Remove; Sanitary Sewer Specification – Section 02570.
2. Remove; Erosion and Sediment Control During Construction – Section 01568
3. Remove; Trench Excavation, Backfill and Compaction – Section 02221
4. Remove; Excavation – Section 02230
5. Remove; Water Transmission and/or Pressure Sewer Lines – Section 02556
6. Remove; Sanitary Sewers – Section 02570
7. Remove; Sanitary and Storm Sewers – Section 02571



8. Remove; Manholes – Section 02574
9. Remove; Paving Repair and Resurfacing – Section 02575
10. Remove; Trench Protection System – Section 19000
11. Remove; Trench Shoring, Minimum Requirements – Section 19000-1
12. Add; Manhole Protective Lining – Section 5.5 (SEE ATTACHMENT)
13. Add; Installing a Protective Cementitious Cement Liner System in Sanitary Sewer Manholes F 2551-09 (SEE ATTACHMENT)

CLARRIFICATION: The project consists of a cementitious liner if required with an epoxy coating finish. There are no proposed installations of pipe and/or manholes that include manhole lids to be replace in accordance.

CONSTRUCTION PLANS:

1. Remove and Replace Cover Sheet and Detail Sheet from construction plans.

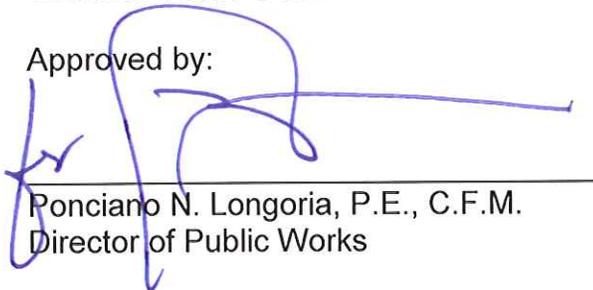
CLARRIFICATION:

Standard Detail Sheet – Disregard Note # 7 (no lids will be replaced in this project)

Please make the necessary corrections to the Plans and Proposal, as appropriate.

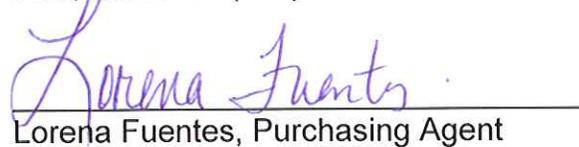
PLEASE ACKNOWLEDGE RECEIPT OF THIS ADDENDUM IN THE SPACE PROVIDED IN THE BID PROPOSAL FORM.

Approved by:



Ponciano N. Longoria, P.E., C.F.M.
Director of Public Works

Please direct your questions regarding the preparation of the bid to Mr. Ponciano Longoria, P.E., C.F.M. at (956) 388-8211.



Lorena Fuentes, Purchasing Agent

ADDENDUM #2
REVISED BID PROPOSAL FORM
MANHOLE REHABILITATION PROJECT
BID NO. 2013-84
EDINBURG, TEXAS

MR. PONCIANO N. LONGORIA, P.E., C.F.M.
DIRECTOR OF PUBLIC WORKS
CITY OF EDINBURG
415 W. UNIVERSITY DR.
EDINBURG, TEXAS 78539

The undersigned, as bidder(s), declares that the only person or parties interested in this proposal as principals are those named herein, that this proposal is made without collusion with any other person, firm or corporation; that he has carefully examined the Form of Contract, Notice to Bidders, General Conditions, Special Provisions, Measurement and Basis of Payment, specifications and the plans thereon referred to, and has carefully examined the locations, and conditions and classes of materials of the proposed work; and agrees that he will provide all the necessary labor, machinery, tools, and apparatus, and other items incidental to construction, and will do all the work and furnish all the materials called for in the contract and specifications in the manner prescribed therein and according to the requirements of the Engineer/Architect as therein set forth.

It is understood that the following quantities of work to be done at unit prices are approximate only and are intended principally to serve as a guide in evaluating bids.

It is further agreed that the quantities of work to be done at unit price and materials to be furnished, may be increased or diminished as may be considered necessary, in the opinion of the Engineer, to complete the work fully as planned and contemplated, and that all quantities of the work, whether increased or decreased, are to be performed at the unit prices set forth below except as provided for in the specifications.

It is further agreed that lump sum prices may be increased to cover additional work ordered by the Engineer, but not shown on the plans or required by the specifications, in accordance with the provisions of the General Conditions. Similarly, they may be decreased to cover deletion of work so ordered.

The 5% bid security accompanying this proposal shall be returned to the bidder, unless in case of the acceptance of the proposal the bidder shall fail to execute a contract and file a performance bond and payment bond within the ten (15) days after its acceptance, in which case the bid security shall become the property of the OWNER, and shall be considered as payment for damages due to delay and other inconveniences suffered by the Owner on account of such failure of the bidder. It is understood that the Owner reserves the right to reject any or all bids.

ORIGINAL BID PROPOSAL FORM MUST BE SUBMITTED ALONG WITH THE BID AND CONTRACT DOCUMENTS BOOKLET

BIDDERS BOND in the amount of \$ _____, (5%) of the greatest amount bid in compliance with the INSTRUCTION TO BIDDERS.

The above Cashiers Check or Bidder's Bond is to become the property of the City of Edinburg, Texas, in the event the construction contract (when offered by the Owner) and bonds are not executed within the time set forth.

IMPORTANT NOTE:
For information regarding the method UNIT ITEMS are to be MEASURED AND PAID, please refer to the "MEASUREMENT AND BASIS OF PAYMENT" Section attached and made part of this Proposal.

ESTIMATED QUANTITIES:

Item No.	Estimated Quantity	Unit	Item Description	Width & Depth	Bid Amount
1.	1	EA	Brick - Manhole #1 Raven 405 Epoxy (Or Approved Equal)	5' - 18.5'	\$ _____
2.	1	EA	Precast Concrete - Manhole #2 Raven 405 Epoxy (Or Approved Equal)	5' - 18.0'	\$ _____
3.	1	EA	Precast Concrete - Manhole #3 Raven 405 Epoxy (Or Approved Equal)	5' - 13.8'	\$ _____
4.	1	EA	Precast Concrete - Manhole #4 Raven 405 Epoxy (Or Approved Equal)	5' - 12.4'	\$ _____
5.	1	EA	Precast Concrete - Manhole #5 Raven 405 Epoxy (Or Approved Equal)	5' - 12.1'	\$ _____
6.	1	EA	Precast Concrete - Manhole #6 Raven 405 Epoxy (Or Approved Equal)	5' - 11.3'	\$ _____
7.	1	EA	Precast Concrete - Manhole #7 Raven 405 Epoxy (Or Approved Equal)	5' - 7.3'	\$ _____
8.	1	EA	Precast Concrete - Manhole #8 Raven 405 Epoxy (Or Approved Equal)	5' - 10.0'	\$ _____
9.	1	EA	Precast Concrete - Manhole # 9 Raven 405 Epoxy (Or Approved Equal)	5' - 11.0'	\$ _____
10.	1	EA	Precast Concrete - Manhole # 10 Raven 405 Epoxy (Or Approved Equal)	4' - 16.0'	\$ _____
11.	1	EA	Precast Concrete - Manhole # 11 Raven 405 Epoxy (Or Approved Equal)	5' - 11.5'	\$ _____

12.	1	EA	Precast Concrete - Manhole # 12 Raven 405 Epoxy (Or Approved Equal)	5' – 8.8'	\$ _____
13.	1	EA	Precast Concrete - Manhole # 13 Raven 405 Epoxy (Or Approved Equal)	5' – 11.0'	\$ _____
14.	1	EA	Precast Concrete - Manhole # 14 Raven 405 Epoxy (Or Approved Equal)	5' – 14.0'	\$ _____
15.	1	EA	Precast Concrete - Manhole # 15 Raven 405 Epoxy (Or Approved Equal)	5' – 14.0'	\$ _____
16.	1	EA	Precast Concrete - Manhole # 16 Raven 405 Epoxy (Or Approved Equal)	5' – 10.3'	\$ _____
17.	1	EA	Precast Concrete - Manhole # 17 Raven 405 Epoxy (Or Approved Equal)	5' – 9.2'	\$ _____
18.	1	EA	Precast Concrete - Manhole # 18 Raven 405 Epoxy (Or Approved Equal)	5' – 12.8'	\$ _____
19.	1	EA	Precast Concrete - Manhole # 19 Raven 405 Epoxy (Or Approved Equal)	5' – 10.4'	\$ _____
20.	1	EA	Precast Concrete - Manhole # 20 Raven 405 Epoxy (Or Approved Equal)	5' – 8.3'	\$ _____
21.	1	EA	Precast Concrete - Manhole # 21 Raven 405 Epoxy (Or Approved Equal)	5' – 12.0'	\$ _____
22.	1	EA	Precast Concrete - Manhole # 22 Raven 405 Epoxy (Or Approved Equal)	5' – 10.5'	\$ _____
23.	1	EA	Brick - Manhole # 23 Raven 405 Epoxy (Or Approved Equal)	4' – 7.2'	\$ _____
24.	1	EA	Brick - Manhole # 24 Raven 405 Epoxy (Or Approved Equal)	4' – 7.2'	\$ _____
25.	1	EA	Brick - Manhole # 25 Raven 405 Epoxy (Or Approved Equal)	4' – 6.0'	\$ _____
26.	1	EA	Brick - Manhole # 26 Raven 405 Epoxy (Or Approved Equal)	4' – 7.2'	\$ _____
27.	1	EA	Brick - Manhole # 27 Raven 405 Epoxy (Or Approved Equal)	4' – 15.0'	\$ _____
28.	1	EA	Precast Concrete - Manhole # 28 Raven 405 Epoxy (Or Approved Equal)	4' – 16.5'	\$ _____

29.	1	EA	Precast Concrete - Manhole # 29 - Raven 405 Epoxy (Or Approved Equal)	4' - 16.5'	\$ _____
30.	1	EA	Precast Concrete - Manhole # 30 Raven 405 Epoxy (Or Approved Equal)	4' - 10.0'	\$ _____
31.	1	EA	Precast Concrete - Manhole # 31 Raven 405 Epoxy (Or Approved Equal)	4' - 10.0'	\$ _____
32.	1	EA	Brick - Manhole # 32 Raven 405 Epoxy (Or Approved Equal)	4' - 9.0'	\$ _____
33.	1	EA	Brick - Manhole # 33 Raven 405 Epoxy (Or Approved Equal)	4' - 8.0'	\$ _____
34.	1	EA	Brick - Manhole # 34 Raven 405 Epoxy (Or Approved Equal)	4' - 7.0'	\$ _____

TOTAL: IMPROVEMENTS
(Items 1-34)

\$ _____

The Number of Calendar days to complete contract 90.

The undersigned agrees, unless hereinafter stated otherwise to furnish all materials as shown and specified in the Plans and Specifications.

Bidder hereby agrees to commence work under this contract within 10 days after "NOTICE TO PROCEED" is issued, and to complete all the work in the Contract within 90 **Calendar Days**.

The undersigned bidder acknowledges the receipt of the following addenda:

ADDENDUM NO.	DATE	BY
ADDENDUM No. 1		
ADDENDUM No. 2		
ADDENDUM No. 3		
ADDENDUM No. 4		
ADDENDUM No. 5		

Respectfully Submitted:

DATE: _____

BY: _____
(Signature)

(Type or Print Name)

(Title)

(Company)

(Address)

(City, State, Zip)

(Phone Number)

(Fax Number)

(Seal – If Bidder is a Corporation)

MEASUREMENT AND BASIS OF PAYMENT

1.00 GENERAL

IT IS THE INTENT OF THIS CONTRACT TO COVER ALL THE WORK TO BE PERFORMED SUBSIDIARY TO ALL THE ITEMS INCLUDED IN THE BID AND SUCH PRICES SHALL BE BALANCED INDIVIDUALLY AND SHALL INCLUDE FURNISHING ALL MATERIALS, SUPERINTENDENCY, SUPERVISION, CONSTRUCTION SURVEYING AND LAYOUT, LABOR, INSURANCE, BONDS, BENEFITS, MACHINERY, FUEL, VEHICLES, SAFETY EQUIPMENT, ADMINISTRATIVE COSTS, QUALITY CONTROL, GUARANTEES AND WARRANTIES, OVERHEAD, AND ALL INCIDENTALS FOR COMPLETING THE ASSIGNED WORK IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS COMPLETE IN PLACE. ***IN CASE THE FOLLOWING MEASUREMENT AND BASIS OF PAYMENT DESCRIPTIONS CONFLICT WITH THE CORRESPONDING DESCRIPTIONS CONTAINED WITHIN THE TECHNICAL SPECIFICATIONS FOR THIS PROJECT, THE FOLLOWING DESCRIPTIONS SHALL GOVERN.***

<p>THE FOLLOWING APPLICABLE ITEMS SHALL BE CONSIDERED AS PAY ITEMS. ALL OTHER WORK NOT SPECIFICALLY LISTED OR INDICATED BELOW SHALL BE SUBSIDIARY TO THE OVERALL COST OF THE PROJECT. ALL EXCAVATION IS <u>UNCLASSIFIED</u>.</p>

1. **PRECAST OR BRICK MANHOLE REHABILITATION** : When called for in the proposal, shall be measured and paid per EACH (EA), and shall include the all necessary materials using cementitious liner system and a epoxy coating finish of Raven 405 Epoxy (Or Approved Equal) with submittal for application process, labor, safety procedures entering manhole, that shall include traffic control, barricades, flagmen and construction signs as required in the Traffic Control Plan including all necessary regular inspection and maintenance of barricades and signage all in accordance with the plans and in conformance the Texas Department of Transportation Permit Instructions as applicable and TRAFFIC CONTROL PLAN (as prepared by a Registered Professional Engineer and approved by the City of Edinburg, which cost is subsidiary to this Item), including all necessary traffic control for temporary road closures as approved by the City of Edinburg for the maintenance of manholes, all in accordance with the UNIFORM TRAFFIC CODE, all complete in place.

The intent of this contract to install an application of cementitious material on manholes with minimal to severe infiltration, minimal to severe exposed aggregates or exposed reinforcing steel and minimal to severe gases and infiltration with a finish of 100% solids epoxy monolithic coating (Raven 405 Epoxy or Approved Equal) to walls, benches and inverts of the manholes. This process covers work, materials, equipment and tools including special developed application equipment as required for the installation of a field applied unique monolithic interior surfacing system. Product application requirements and procedures described include surface preparation by a cementitious liner system, mixing application, material handling and storage, qualification of the applicator and application quality control. The use of specialized equipment combined with rigorous surface preparation requirements shall be used to apply the product without the use of solvents.

SECTION 5.5

TECHNICAL SPECIFICATION FOR MANHOLE PROTECTIVE LINING

PART 1: GENERAL

1.1 Scope of Work

Furnish all the necessary materials, labor, equipment, tools, and associated appurtenances to install a protective lining on the interior walls and bench of all new and selected existing wastewater manholes.

1.2 Acceptable Manufacturers

Raven 405 as manufactured by Raven Lining Systems or approved equal shall be used.

PART 2: QUALITY ASSURANCE

2.1 Reference Standards

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

ACI 506.2-77	Specifications for Materials, Proportioning, and Application of Shotcrete by the American Concrete Institute (ACI)
ASCE Manual 52	Manuals and Reports on Engineering Practice, Manhole Inspection and Rehabilitation
ASTM D638	Tensile Properties of Plastics
ASTM D790	Flexural Properties of Unreinforced and Reinforced Plastics
ASTM D695	Compressive Properties of Rigid Plastics
ASTM D4541	Pull-off Strength of Coatings Using a Portable Adhesion Tester

ASTM D7234	Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
ASTM D4787	Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
ASTM D2584	Volatile Matter Content
ASTM D543	Resistance of Plastics to Chemical Reagents
ASTM D4258	Standard Practice for Surface Cleaning Concrete
ASTM D4259	Standard Practice for Abrading Concrete
ASTM C109	Compressive Strength Hydraulic Cement Mortars
ASTM C579	Compressive Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars
ICRI Guideline No. 03732	Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays by International Concrete Repair Institute (ICRI)
NACE RPO 188-99	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates by National Association of Corrosion Engineers (NACE)
SSPC-SP 1	Solvent Cleaning by standards of the Society of Protective Coatings (SSPC)
SSPC-SP 5	White Metal Blast Cleaning by SSPC
SSPC-SP 10	Near White Metal Blast Cleaning by SSPC
SSPC-SP 12	Surface Preparation and Cleaning of Metals by Water Jetting prior to Recoating by SSPC
SSPC SP-13/NACE No. 6	Surface Preparation of Concrete by SSPC

SSPC-PA 9 Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages by SSPC

SSPWC 210-2.3.3 & 211-2 Chemical Resistance Test (Pickle Jar Test) Standard Specifications for Public Works Construction (SSPWC) (Greenbook)

SSPWC 500-2 Manhole and Structure Rehabilitation by SSPWC

2.2 Qualification Requirements

2.2.1 Installer

- For an installing Contractor to be considered commercially acceptable, the Contractor must satisfy all insurance, financial and bonding requirements of the Owner.
- The Contractor must have a certification from the manufacturer as a licensed and fully trained installer of the product.
- The Contractor must have a minimum 50,000 square feet of successful wastewater system installation and three (3) years of rehabilitation experience.

2.2.2 Product

- For a product to be commercially acceptable, the product must have a minimum 500,000 square feet and five (5) year history of successful wastewater collection system installation in the United States.
- The products must be verified by third party test results supporting the long-term performance and structural strength of the product and such data shall be satisfactory to the Owner.

2.3 Warranty

- Contractor shall provide five (5) years of warranty (including labor) from the manufacturer against any defects in materials and workmanship.
- Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

2.3 Submittal

Following submittals shall be provided by the contractor:

2.3.1 Product

- Technical data sheet showing the physical and chemical properties
- Material Safety Data Sheet (MSDS)
- Physical properties of third party test results within five (5) years of submittal including the following:

Description	Method
- Tensile Strength	ASTM D 638
- Tensile Ultimate Elongation	ASTM D 638
- Compressive Strength	ASTM D 695
- Flexural Strength	ASTM D 790
- Hardness, Shore D	ASTM D 2240
- Taber Abrasion, CS-17 Wheel	ASTM D 4060
- Adhesion, Concrete	ASTM D 7243

- Surface preparation and application method
- Copies of field test data

2.3.2 Installer

- Verification of certified applicator's status

PART 3 PRODUCTS

3.1 Repair/Resurfacing Product

- Repair/ resurfacing product(s) shall be used for all existing and new manholes to fill voids or bugholes, smooth transitions between components, replace lost mortar in masonry structures, smooth rough surfaces, and rebuild severely deteriorated substrates and/or to remediate infiltration prior to the installation of the coating product(s).
- All repair/ resurfacing product(s) must be supplied by the coating product manufacturer or shall be approved by the coating product manufacturer in writing for compatibility with the specified coating product. It shall also be

handled, mixed, installed and cured in accordance with manufacturer's guidelines.

3.2 Coating Product

- Coating product shall be applied to all interior surfaces to provide a permanent impermeable, high strength; monolithic lining for concrete structures that is sulfuric acid corrosion, abrasion and impact resistant.
- 100% solids, solvent-free, ultra-high build epoxy or similar coating to be applied to all interior surfaces of exposed concrete as per manufacturer's guidelines.
- The material must be suitable for overhead, vertical and horizontal surfaces, and capable of being applied at a specified thickness of minimum 200 mils in a single application.
- Coating must be designed for temperatures up to 200 degrees F.
- Coating product physical properties shall be substantiated through submittal of accredited third party testing results and shall be representative of the actual field applied product and cure mechanism(s) to be employed in the field.

PART 4 EXECUTION

4.1 General

- Appropriate actions shall be taken by Contractor to comply with local, state, and federal regulatory and other applicable agencies with regard to environment, health, and safety during work.
- Limits of Application - The interior walls and ceiling of structures, exposed part of manhole frame and manhole benches.
- The repair and coating materials must be applied by factory trained and/or fully qualified technicians only. Contractor shall have a manufacturer's representative must present at the start of the installation procedure.
- Remove all steps, protrusions or other such obstructions prior to beginning the lining process as directed by the Owner.

4.2 Examination

- Prior to commencing surface preparation, Contractor shall inspect all surfaces specified to receive the coating and notify Owner, in writing, of any noticeable disparity in the site, structure or surfaces which may interfere with the work, use of materials or procedures as specified herein.

- New portland cement (not quick setting, high strength) concrete manhole or structures shall have endured a minimum of 28 days since manufacture prior to commencing coating installation.

4.3 Surface Preparation

- Surface preparation is required for new and selected existing manholes prior to receive any repair and coating materials.
- Excessive debris, sediment, root intrusion or other foreign materials which may impact the effectiveness of the surface preparation process shall be removed prior to the commencement thereof.
- Offset structural components, lids, covers, frames, etc. shall be repaired, replaced, or reset prior to the commencement of surface preparation.
- Oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants which may affect the performance and adhesion of the coating to the substrate shall be removed using a water based biodegradable emulsifying/ saponin product(s) as necessary.
- Choice of surface preparation method(s) should be based upon the condition of the concrete or masonry surface, potential contaminants present, access to perform work, and the required cleanliness and profile of the prepared surface to receive the repair and/or coating product(s).
- Surface preparation method, or combination of methods, that may be used include high-pressure water blasting (3500 psig at the nozzle), water jetting, dry abrasive blasting along with other additional method(s) in accordance with following industry accepted standards:
 - SSPC SP-13/NACE No. 6: Surface Preparation of Concrete,
 - ASTM D-4258: Standard Practice for Surface Cleaning Concrete for Coating and ASTM-D-4259: Standard Practice for Abrading Concrete,
 - ICRI Technical Guideline No. 03732: Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
 - NACE/SSPC Standards for the surface preparation of steel.
- Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound, clean, and neutralized surface suitable for the specified coating product(s). Resulting concrete surface profile (CSP) shall be at least a CSP-4 in accordance with ICRI Technical Guideline No. 03732 as referenced in section 2.1. Typically, CSP ranges from CSP 1 (nearly flat) through CSP 9 (very rough) as indicated through ICRI Guideline No. 03732.

4.4 Application of Repair/ Resurfacing Product

- Repair/ resurfacing products as per section 3.1 shall be used to fill voids, bugholes, and other surface defects which may affect the performance or adhesion of the coating product(s).

4.5 Application of Coating Product

- Application procedures shall conform to the recommendations of the coating product(s) manufacturer, including environmental controls, product handling, mixing, application equipment, and methods.
- Spray equipment shall be specifically designed to accurately ratio and apply the coating product(s) and shall be in proper working order.
- Prepared surfaces shall be coated via spray application of the coating product(s) described herein unless otherwise recommended by the coating product manufacturer.
- For all new and selected existing concrete manholes, the coating product(s) shall be applied to a minimum dry film thickness (DFT) of 125 mils with minimum surface profile of CSP-4 in accordance with ICRI Technical Guideline No. 03732.

4.6 Testing and Inspection

- Coating system thickness shall be inspected to ensure compliance with the specifications herein.
 - 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. Measurements shall be taken, documented, and attested to by Contractor for submission to Owner.
 - After the coating product(s) have cured in accordance with manufacturer recommendations, coating system thickness may be measured according to SSPC-PA 9 - Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages.
- After the coating product(s) have cured in accordance with manufacturer recommendations, all surfaces shall be inspected for holidays as per NACE RPO 188-99 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates or ASTM D4787 Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates. All detected holidays shall be marked and repaired according to the coating product(s) manufacturer's recommendations.

- Test voltage shall be a minimum of 100 volts per mil of coating system thickness.
 - Detection of a known or induced holiday in the coating product shall be confirmed to ensure proper operation of the test unit.
 - All areas repaired shall be retested following cure of the repair material(s).
 - In instances where high voltage holiday detection is not feasible a close visual inspection shall be conducted and all possible holidays shall be marked and repaired as described above.
 - Documentation of areas tested, equipment employed, results, and repairs made shall be submitted to the Owner/Engineer by Contractor.
-
- Adhesion of the coating system to the substrate shall be confirmed in a minimum of 10% of the manholes coated. After the coating product(s) have cured in accordance with manufacturer recommendations, testing shall be conducted in accordance with ASTM D7234 Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers. Owner's representative shall select the manholes or areas to be tested.
 - Visual inspection shall be made by the Project Engineer and/or Inspector. Any deficiencies in the finished coating affecting the performance of the coating system or the operational functionality of the structure shall be marked and repaired according to the recommendations of the coating product(s) manufacturer.

PART 5 METHOD OF MEASUREMENT AND PAYMENT

Payment for Protective Lining for new manhole shall be incidental and inclusive in the applicable unit price bid item.

Payment for Protective Lining System for existing manhole as specified in the plans will be in accordance with the payment schedule in the Bid Proposal.

****END OF SECTION****



Standard Practice for Installing a Protective Cementitious Liner System in Sanitary Sewer Manholes¹

This standard is issued under the fixed designation F 2551; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

A sanitary sewer manhole may be repaired or rehabilitated by applying a prepackaged cementitious liner to the interior surface after it has been properly prepared and cleaned. Sanitary sewer manholes can be damaged by dynamic loading, abrasion, erosion, and corrosion.

1. Scope

1.1 This specification describes all the work required to structurally reinforce, seal, and protect sanitary sewer manholes. Applications include applying a prepackaged cementitious liner that can function as a full depth restoration or a partial depth repair. A uniform high-strength, fiber-reinforced cementitious mortar should be manually sprayed and hand troweled or centrifugally cast in a uniform, prescribed thickness to all cleaned, interior surfaces from the bottom of the frame to the bench. The cementitious liner may be applied to manholes constructed of brick, concrete, block, and various other materials.

1.2 A manufacturer's approved applicator shall furnish the complete application of the protective, prepackaged cementitious liner material. All of the cleaning, preparation, and application procedures shall be in accordance with the manufacturer's recommendations.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Manholes are permit required confined spaces in accordance with OSHA definition and should be treated as such, requiring confined space entry permits, appropriate monitoring equipment, and the associated personal protective equipment.*

¹ This practice is under the jurisdiction of ASTM Committee F36 on Technology and Underground Utilities and is the direct responsibility of Subcommittee F36.20 on Inspection and Renewal of Water and Wastewater Infrastructure.

Current edition approved May 1, 2009. Published June 2009.

2. Referenced Documents

2.1 ASTM Standards:²

- C 39/C 39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C 109/C 109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
- C 309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- C 494/C 494M Specification for Chemical Admixtures for Concrete
- C 969 Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
- C 1140 Practice for Preparing and Testing Specimens from Shotcrete Test Panels
- C 1244 Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
- C 1315 Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
- F 2414 Practice for Sealing Sewer Manholes Using Chemical Grouting

2.2 ACI Standards:³

- ACI 301-05 Specifications for Structural Concrete
- ACI 305R-99 Hot Weather Concreting
- ACI 306R-88 Cold Weather Concreting
- ACI 308R Practice for Curing Concrete
- ACI 506R Guide to Shotcrete

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, <http://www.concrete.org>.

2.3 ICRI Technical Guidelines:⁴

Guideline No. 03732 Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

Guideline No. 03737 Guide for the Preparation of Concrete Surfaces for Repair Using Hydro-demolition Methods

3. Ordering Information

3.1 *Submittals*—Orders for all prepackaged materials listed under this practice shall include the following:

3.1.1 Product data, including manufacturer and brand name;

3.1.2 Technical data stipulating physical characteristics of applied liner material; and

3.1.3 Manufacturer's Safety Data Sheets.

3.2 *Delivery, Storage, and Handling*:

3.2.1 The prepackaged cementitious materials should be stored according to the manufacturer's recommendations. No modification should be made to the manufacturer's recommendations for handling and delivery of these products.

4. Materials and Manufacture

4.1 All prepackaged materials shall be designed, manufactured, and intended for sewer manhole rehabilitation and the specific application in which they are used. Each material shall be designed for application over damp surfaces without degradation of the final product or the bond between the product and the manhole surface.

4.2 *Materials for Substrate Repairs*—All voids and irregularities of the substrate should be filled or repaired with structurally sound materials before applying the cementitious liner material.

4.2.1 *Cementitious Repair Materials*—Hand mix and apply for filling voids and reforming benches and resurfacing the brick, concrete walls, and bench surfaces of the sewer manhole. Mix the cement repair material and apply according to the manufacturer's instructions. The cementitious liner material can be used as the repair material.

4.3 *Infiltration Water Control Materials*—Specifically formulated for stopping water leaks and minor infiltration.

4.3.1 *Cementitious Water Control Materials*—Used to stop flowing water leaks in concrete and masonry structures. This material may be applied in dry form directly to the leak area or mixed with potable water to a soft putty consistency for larger active leaks. This material is held in place until it sets and the leak stops. Mix and use according to the manufacturer's instructions.

4.3.2 No modification should be made to the products recommendations for handling, mixing, placing, and finishing without the manufacturers prior written approval.

4.4 *Chemical Grout Material*—To stop water leaks and infiltration with chemical grout, refer to Practice F 2414.

4.5 *Lining Material*—Prepackaged cementitious lining materials are specifically designed to repair or rehabilitate sewer manhole.

4.6 *Other Materials*—No other material shall be used with or added to the prepackaged cementitious liner materials without prior written approval from the manufacturer.

5. Surface Preparation, Cleaning, and Repair

5.1 The applicator is responsible to ensure that the manhole is properly cleaned and prepared.

5.2 Place wooden or plastic covers or other protective devices over the sewer manhole invert while cleaning the manhole wall and bench sections before applying the prepackaged cementitious liner. Wire mesh and fabric filters allowing water to pass are also acceptable.

5.3 Remove all foreign materials from the manhole wall and bench sections. Remove all loose and protruding bricks, mortar, and concrete. Remove metal, plastic, or brick stairs, if required, before applying the new liner. Fill any large voids with fast setting cementitious repair material.

5.4 *Surface Cleaning Procedures*:

5.4.1 *High Pressure Cleaning*—Properly cleaning the surface of the structure is critical to the success of this rehabilitation method. Use a high-pressure washer delivering a minimum of 3500 psi (2413 MPa). A minimum of two and a half gallons per minute (9.46 litres per minute) should be delivered through the spray tip. The spray tip should be kept between 6 and 12 in. (15.24 and 30.48 cm) from the surface and be held at an angle between 45° and 90° to the surface being cleaned. The spray tip should be directed across the surface at a speed of no more than one foot per second (0.3 metres per second). If the surface is especially dirty or greasy, cleaning agents may be added to the pressure washer water or the water may be heated. When hot water is required, it should be heated to 210°F (99°C). Care should be taken to clean the frame sealing surface where the lid fits into the frame, removing any debris or other materials that negatively impact the lids ability to seal against the frame. Cleaning should begin with the frame surface and progress down to and include the bench. A rotating spray nozzle may be used for cleaning, if it meets pressure and flow requirements. Care should be taken to avoid further structural damage to the existing surface.

5.4.2 In some situations, when removing existing coatings or linings, pneumatic hammers, hydro-demolition, or sand blasting may be required. Refer to Guideline No. 03732 or Guideline No. 03737.

5.4.3 Some substrates may require more surface preparation including acid washing. If acid washing is performed, the acid cleaned surface should be neutralized.

5.4.4 Remove any loose material after all preparations and cleaning has been completed. Do not allow soil, sand, debris, or runoff to enter the sewer system. Properly dispose of any deleterious materials removed from the manhole according to local, state, and federal guidelines.

5.5 *Surface Repair*:

5.5.1 *Repair the Invert and Bench Sections*—Repair any invert and bench section that exhibits visible damage, degradation, or water infiltration. Remove obstructions and loose materials from benches prior to shaping inverts. Form smooth, u-shaped channels across the floor of the manhole. Use a high-strength, fast-setting cementitious repair material. Control or divert the flow to allow sufficient setting time for the

⁴ Available from the International Concrete Repair Institute, Inc. (ICRI), 3166 S. River Road, Ste 132, Des Plaines, IL 60018, <http://www.icri.org>.

material used. Make finished benches and inverts smooth without defects. Allow no accumulation of debris.

6. Mixing of Prepackaged Cementitious Repair Materials

6.1 The applicator shall bear complete responsibility for mixing of the materials, applying, and finishing of the sewer manhole repair system.

6.1.1 The prepackaged cementitious liner material should be mixed with water in accordance with the manufacturer's recommendations. Tempering of the material above the manufacturers published limits should not be allowed.

6.1.2 Use clean and potable water for mixing.

6.1.3 No modifications or changes should be made to the product without prior written approval of the manufacturer.

6.1.4 During hot weather, the cementitious liner material should be mixed at temperatures below 90°F (32.2°C) in order to avoid rapid loss of workability, to decrease water evaporation, and to prevent premature set time. Retarding admixtures Type A, B, or D that meet Specification C 494/C 494M may be used to allow work in hotter weather. However, applicators should obtain manufacturers permission or use products recommended by manufacturer. Apply admixtures in accordance with ACI 305R-99 recommendations for hot weather conditions.

6.1.5 If work is to be performed near 40°F (4.4°C), preheat the water and keep prepackaged material warm. The mix should be kept near 70°F (21.1°C). Apply in accordance with ACI 306R-88 recommendations for cold weather concreting. Some liner materials are capable of setting in cold weather; consult with manufacturer for suitability.

7. Execution—Application of the Cement Liner

7.1 *Spray Application—Manual Surface Sealing:*

7.1.1 Dampen the manhole wall surface. Surface must be damp without noticeable free water droplets or running water (surface, saturated, dry). Spray or apply the cementitious liner material to a uniform thickness as specified. Use a hand trowel to hand work and compact the manhole cementitious liner material into all the voids and crevices but do not over trowel. Allow the cementitious liner material to set as recommended by the manufacturer.

7.1.2 Spray the cementitious liner material to a nominal thickness of ½ in. (1.25 cm) in one or more passes. The thickness of the cementitious lining material applied to the surface depends on a wide array of variables. These variables include overall condition of the manhole, depth, construction materials, location, dynamic traffic load, source and state of corrosion, diameter, hydrostatic pressure, soil type, and any other factors that might impact the design of the cementitious liner. The design engineer should determine appropriate liner thickness and liner material properties and may be prepared to include the addition of protective coatings or other methods used to limit or eliminate corrosion factors. Use a wet gauge to measure applied cementitious liner material thickness at three sections of the manhole: the cone/corbel section, middle of barrel, and the barrel near the invert. The liner shall be even and uniform with a troweled, brushed, or natural finish.

7.1.3 Not all manufacturers recommend the use of a protective coating over the cementitious liner material. If the liner is

to receive a top coating, then an anchor tooth finish is recommended and shall be free of curing or similar compounds. For dry gunite applications, finish in accordance with ACI 506R, using the recommended trowel.

7.1.4 Apply the prepackaged cementitious liner material from the top of the manhole down to the bench. Overlay the bench with a gradual slope from the wall to the edge of the channel. The wall and bench intersection should have a rounded and uniform radius. The thickness of the bench shall be no less than ½ in. (1.25 cm) at the edge of the channel and shall increase in the direction of the wall so as to provide the required slope.

7.2 *Spray Application—Centrifugal Process:*

7.2.1 Position the high-speed, bi-directional, rotating applicator within the center of the manhole at the lowest point desired for the new wall and commence pumping the mixed prepackaged cementitious liner material. Man-entry may be required to assure the lining has been effectively applied, as on the underside of any brickwork or around laterals. As the cementitious liner material begins to be centrifugally cast evenly around the interior, retrieve the applicator head at the prescribed speed for applying the thickness that has been selected. Controlled multiple passes in both clockwise and counterclockwise directions are made until the desired thickness is attained.

7.2.2 If the procedure is interrupted for any reason, simply arrest the retrieval of the applicator head until flows are recommenced. Verify the desired thickness with a wet gage. The liners shall be even and uniform with a brushed or natural finish. If the liner is to receive a top coating refer to 7.1.3. Benches and channels are finished by hand as in 7.1.4.

8. Curing of Freshly Applied Cementitious Liner Material

8.1 Protect the freshly applied cementitious liner from extreme weather conditions. According to ACI 301-05, ACI 305R-99, ACI 306R-88, and ACI 308R, curing compounds should be used to minimize the loss of moisture to ensure the continuation of the cement hydration process. Curing compounds are used to obtain adequate and specified strength gain of the applied material. Liquid membrane curing compounds that are specified in Specifications C 309 or C 1315 should be used for these purposes.

8.2 During hot, dry weather conditions, protect the finished cementitious liner material at early ages to prevent rapid water loss. Use an accepted liquid membrane curing compound in accordance with Specifications C 309 or C 1315 on the finished cementitious liners to limit water loss. Apply curing compounds according to manufacturer's specification. Protect liner materials in accordance with ACI 305R-99.

8.3 During cold weather application provide protection of the cementitious liner at early ages to prevent damage from freezing. Do not apply prepackaged liner, when ambient temperature falls below 40°F (4.4°C) or freezing temperatures are expected within 24 h, or both. Protect liner materials in accordance with ACI 306R-88. Some liner materials are capable of setting in cold weather; consult with manufacturer for suitability.

8.4 The sewer manhole rehabilitation system is acceptable for day, nighttime, or continuous 24-h work schedules in the proper environment.

9. Sampling

9.1 Use cylinders as in accordance with Test Method C 39/C 39M, cubes as in accordance with Test Method C 109/C 109M, or shotcrete panels as in accordance with Practice C 1140, or as specified by the manufacturer or engineer document for testing compressive strength. Make cylinders, cubes, or panels from each day's work and label each with the date, location, project, and product batch numbers. The product batch numbers are located on each cement material bag or on the pallet. Send the cylinder, cube, or panel to a third-party laboratory or the manufacturer for verification. Test the cementitious liner material for compliance with specified strengths at 28 days or in accordance with the engineer's instructions. Retain one sample for further instructions should the others fail to meet the 28-day requirement. Field samples should not be moved for a minimum of the first 24 h and should be maintained according to ASTM specifications.

9.2 The engineer should approve the inspection and quality control protocol before project startup.

10. Manhole Verification and Testing

10.1 At the owner's option, one or more of the following procedures may be employed to verify the quality of the applied liner.

10.1.1 Vacuum testing in accordance with Test Method C 1244.

10.1.2 The water ex-filtration method in accordance with Practice C 969.

10.1.3 A visual inspection which may be recorded in still or video digital format.

10.1.4 Other methods as specified by the project engineer.

11. Quality Assurance

11.1 The engineer should verify that the repaired manhole meets specifications.

11.2 If the repaired manhole does not comply with the prescribed standards, the applicator should make corrections and repeat the test procedures until design specifications are met.

12. Keywords

12.1 cement liner; cementitious liner; corrosion protection; manhole rehabilitation; manhole renewal; sanitary sewer manhole; sewer manhole; stopping water infiltration; structural enhancement; structural rehabilitation

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MANHOLE MORTAR

Product Data Sheet_{ver.6.11}

Spray Applied Structural Repair Liner

Product Description

Ultra high strength blended **STRUCTURAL** Mortar with Microsilica and Polypropylene fibers. Designed to repair and/or reinforce sewer structures such as Manholes, Lift Stations, Waste Water Treatment Plants and/or any aged concrete or masonry structures. Product can be **SHOTCRETE**, hand applied, or pumped into place. Product is a well proportioned blend of quality materials such as **MICROSILICA**, and other **HIGH STRENGTH ADMIXTURES** to enhance workability, **BONDING**, strength, and resistance to harsh **h2s** gas/chemical attacks. Product comes in a prepackaged 50lbs bag and 3000 lbs bulk bags. Product conforms to industry standards **ACI 201.2R-01** Guide to Durable Concrete and **ASTM F 2551-09** Standard Practice for Installing a Protective Cementitious Liner System in Sanitary Sewer Manholes.

Physical Properties Data

Results can vary

Compressive Strength ASTM-C109

1 day 3300 psi

7 days 6400 psi

28 days >9500 psi

Compressive Strength ASTM-C39

28 day Load 101980 lbf.

Flexural Strength ASTM-C78

1 day 590 psi

7 days 1160 psi

28 days 1440 psi

Bonding ASTM C882

Substrate Failure

Sulfate Resistance ASTM-C1012

<0.05% at 180days

<0.1% at 365 days

Slump ASTM-C143 3 inches

Maximum of 5.00 inches per application

Water content/bag ~ 2/3-1 gal 50 lbs

Unit weight 149 pcf (2387 kg/m3)

Absorption 7.3%

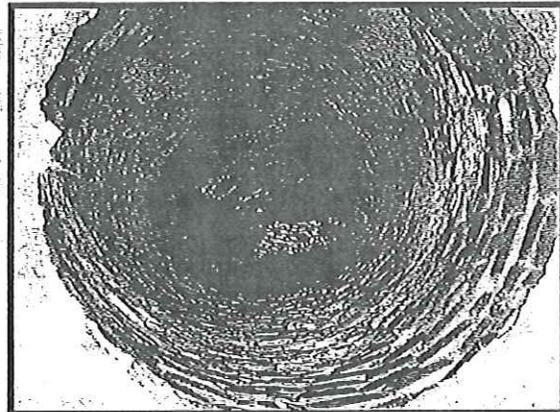
Rebound 2-3%

Rapid chloride permeability tests,

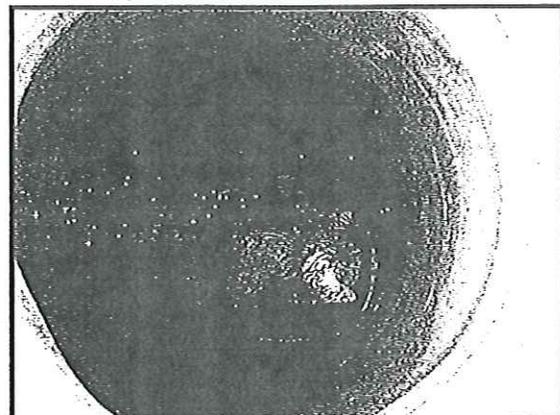
ASTM-C1202

Coulombs < 500 very low

STRUCTURE BEFORE MANHOLE MORTAR



STRUCTURE AFTER MANHOLE MORTAR



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MANHOLE MORTAR

Spray Applied Structural Repair Liner

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Technical Data

APPLICABLE STANDARDS

ASTM International

- ASTM C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete (AASHTO T24)
- ASTM C78 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
- ASTM C109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
- ASTM C882 Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
- ASTM C1012 Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution
- ASTM C1202 Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
- ASTM C1399 Test Method for Obtaining Average Residual Strength of Fiber-Reinforced Concrete
- ASTM C1480 Standard Specification for Packaged, Pre-Blended, Dry, Combined Materials for Use in Wet or Dry Shotcrete Application

PHYSICAL/CHEMICAL PROPERTIES

The performance of dry process shotcrete cannot be duplicated in the laboratory. In spite of that fact, laboratory data are important for quality control purposes and for making comparisons between formulations. Manhole Mortar products have been extensively tested both in the laboratory and in the field. The greatly enhanced performance in the field shows the benefits of low water/cement ratio and high compaction. The field test data are offered only as an example of what can be achieved with qualified operators using proper techniques. The quality of wet process shotcreting is very dependent on the skills of the operator. Table 1 shows typical laboratory data for shotcretes with and without fibers. Additionally, Manhole Mortar complies with Grades SR (Sulfate-Resistant) and LP (Low Permeability). Manhole Mortar with Steel Fibers complies with Grade FR (Fiber-Reinforced), Class II. Southern Trenchless Solutions LLC also offers custom

designs to meet other types and grades of ASTM C1480, as well as job specific specifications.

Consult a local Southern Trenchless Solutions LLC. Representative for details.

5. Installation EQUIPMENT

Manhole Mortar MSP is normally applied using wet process shotcrete machinery. Wet process shotcrete is a very efficient method for making repairs to horizontal, vertical and overhead surfaces.

The process allows for the placement of the repair material at a very low water/cement ratio with a high degree of compaction. The result is a repair that is superior to other methods of placement of repair material.

Manhole Mortar can also be applied using wet process shotcrete machinery. The performance will be enhanced by the appropriate choice of admixtures. Consult a local Southern Trenchless Solutions LLC. representative for details.

PREPARATORY WORK

Southern Trenchless Solutions LLC. recommends that job mock-ups be prepared by the contractor and tested prior to beginning a project.

METHODS

Southern Trenchless Solutions LLC. recommends that the applicator be ACI certified and that American Concrete Institute (ACI) Committee 506 or ASTM F 2551-09 Standard Practice for Installing a Protective Cementitious Liner System in Sanitary Sewer Manholes procedures be followed for surface preparation, equipment, nozzleman certification and shotcrete placement and curing procedures. Refer to the following

- ACI 506R-90 Guide to Shotcrete
- ACI 506.2-95 Specifications for Shotcrete
- ACI 506.1R-98 Committee Report on Fiber Reinforced Shotcrete
- ACI CP-60 Craftsman Workbook for ACI Certification of Shotcrete Nozzleman

APPLICATION

Application Over Concrete Surfaces
Remove all spalled, severely cracked, deteriorated, loose and unsound concrete from existing concrete surface by chipping, water blasting or other mechanical methods. Adequate prewetting of the concrete substrates should be done prior to shotcreting.

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MANHOLE REHAB SPECIFICATION

Product Application Procedure

Micro Silica Cementitious Spray Applied Structural Repair Liner for Manhole Rehab

Overview of Application of Manhole Mortar

Surface of preparation is the first step in a successful application of **Manhole Mortar** product. Surface shall be hydro blasted to clean, remove loose debris, and to etch the surface back to solid substrate up to ¼" anything beyond ¼" is not surface prep but hydro demolition a different scope of work. Once that is completed the next step is to moisten the surface of the substrate with water just enough to be damp or **SSD Saturated Surface Dry**. Then the structure is ready to have **Manhole Mortar** applied to it. Once all gases have reached a safe level naturally or by supplied fresh air the Nozzlemen shall conform to OSHA confined space regulations and lowered into place to be able to start spray applying the product to the substrate surface at its proscribed thickness not to exceed 4 inches in a single application. Once surface area has been completely sprayed by the Nozzlemen it will then be steel trowel out having a sealed smooth surface. If a top coating of Epoxy is to be applied to this surface it will receive a brushed tooled finish to allow the epoxy to anchor onto it (see epoxy manufactures recommendation, ASTM, or SSPC standards). Once all these steps have been executed properly the mortar will have already begun to cure and will increase in strength within 24 hours, 7days, and peak at 28 days. In order to be considered an approved equal product must meet or exceed physical properties shown on the Manhole Mortar Data sheet. The information subsequent to this paragraph goes into further technical details of the entire process which conform to ASTM guidelines for using a cementitious liner system to rehab manholes.

Surface Preparation:

5.4 Surface Cleaning Procedures:

5.4.1 High Pressure Cleaning—Properly cleaning the surface of the structure is critical to the success of this rehabilitation method. Use a high-pressure washer delivering a minimum of 3500 psi (2413 MPa). A minimum of two and a half gallons per minute (9.46 litres per minute) should be delivered through the spray tip. The spray tip should be kept between 6 and 12 in. (15.24 and 30.48 cm) from the surface and be held at an angle between 45° and 90° to the surface being cleaned. The spray tip should be directed across the surface at a speed of no more than one foot per second

(0.3 metres per second). If the surface is especially dirty or greasy, cleaning agents may be added to the pressure washer water or the water may be heated. When hot water is required, it should be heated to 210°F (99°C). Care should be taken to clean the frame sealing surface where the lid fits into the frame, removing any debris or other materials that negatively impact the lids ability to seal against the frame. Cleaning should begin with the frame surface and progress down to and include the bench. A rotating spray nozzle may be used for cleaning, if it meets pressure and flow requirements. Care should be taken to avoid further structural damage to the existing surface. Prepare surfaces to be repaired by water blasting, abrasive blast, hand or power tool to remove unsound concrete, contaminants, dirt, and/or debris. Contact your Southern Trenchless Representative for information on removal techniques that are best for your application.

Mixing of Prepackaged Cementitious Repair Materials

6.1 The applicator shall bear complete responsibility for mixing of the materials, applying, and finishing of the sewer manhole repair system.

6.1.1 The prepackaged cementitious liner material should be mixed with water in accordance with the manufacturer's recommendations. Tempering of the material above the manufacturers published limits should not be allowed.

6.1.2 Use clean and potable water for mixing.

6.1.3 No modifications or changes should be made to the product without prior written approval of the manufacturer.

6.1.4 During hot weather, the cementitious liner material should be mixed at temperatures below 90°F (32.2°C) in order to avoid rapid loss of workability, to decrease water evaporation, and to prevent premature set time. Retarding admixtures Type A, B, or D that meet Specification C 494/C 494M may be used to allow work in hotter weather. However, applicators should obtain manufacturers permission or use products recommended by Southern Trenchless Representative. Apply admixtures in accordance with ACI 305R-99 recommendations for hot weather conditions.

6.1.5 If work is to be performed near 40°F (4.4°C), preheat the water and keep prepackaged material warm. The mix should be kept near 70°F (21.1°C). Apply in accordance with ACI 306R-88 recommendations for cold weather concreting. Some liner materials are

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MANHOLE REHAB SPECIFICATION

Product Application Procedure

Micro Silica Cementitious Spray Applied Structural Repair Liner for Manhole Rehab

capable of setting in cold weather; consult Southern Trenchless Representative for suitability.

Application of the Cement Liner

7.1 Spray Application—Manual Surface Sealing:

7.1.1 Dampen the manhole wall surface. Surface must be damp without noticeable free water droplets or running water (surface, saturated, dry). Spray or apply the cementitious liner material to a uniform thickness as specified. Use a hand trowel to hand work and compact the manhole cementitious liner material into all the voids and crevices but do not over trowel. Allow the cementitious liner material to set as recommended by the manufacturer.

7.1.2 Spray the cementitious liner material to a nominal thickness of $\frac{1}{2}$ in. (1.25 cm) in one or more passes. The thickness of the cementitious lining material applied to the surface depends on a wide array of variables. These variables include overall condition of the manhole; depth, construction materials, location, dynamic traffic load, source and state of corrosion, diameter, hydrostatic pressure, soil type, and any other factors that might impact the design of the cementitious liner. The design engineer should determine appropriate liner thickness and liner material properties and may be prepared to include the addition of protective coatings or other methods used to limit or eliminate corrosion factors. Use a wet gauge to measure applied cementitious liner material thickness at three sections of the manhole: the cone/corbel section, middle of barrel, and the barrel near the invert. The liner shall be even and uniform with a troweled, brushed, or natural finish.

7.1.3 Not all manufacturers recommend the use of a protective coating over the cementitious liner material. If the liner is to receive a top coating, then an anchor tooth finish is recommended and shall be free of curing or similar compounds. For dry gunite applications, finish in accordance with ACI 506R, using the recommended trowel.

7.1.4 Apply the prepackaged cementitious liner material from the top of the manhole down to the bench. Overlay the bench with a gradual slope from the wall to the edge of the channel. The wall and bench intersection should have a rounded and uniform radius. The thickness of the bench shall be no less than $\frac{1}{2}$ in. (1.25 cm) at the edge of the channel and shall increase in the direction of the wall so as to provide the

required slope.

7.2 Spray Application—Centrifugal Process:

7.2.1 Position the high-speed, bi-directional, rotating applicator within the center of the manhole at the lowest point desired for the new wall and commence pumping the mixed prepackaged cementitious liner material. Man-entry may be required to assure the lining has been effectively applied, as on the underside of any brickwork or around laterals. As the cementitious liner material begins to be centrifugally cast evenly around the interior, retrieve the applicator head at the prescribed speed for applying the thickness that has been selected. Controlled multiple passes in both clockwise and counterclockwise directions are made until the desired thickness is attained.

7.2.2 If the procedure is interrupted for any reason, simply arrest the retrieval of the applicator head until flows are recommenced. Verify the desired thickness with a wet gage. The liners shall be even and uniform with a brushed or natural finish. If the liner is to receive a top coating refer to 7.1.3.

Benches and channels are finished by hand as in 7.1.4.

Quality Assurance

Since the nozzleman is a key element to quality in the shotcrete process the applicator performing this work must hold an **ACI Nozzleman Certification** and be an employee at the applicator firm. The name and certification ID must be submitted at the time of bid. Applicator shall also present **OSHA confined space** credentials at the time of the bid. Credentials, qualifications, and all applicable certifications must also be submitted at the time of the bid in order to qualify the applicator as capable to perform this scope of work. The stated quality assurance requirements described above are obtainable to anyone and help protect the owner from faulty craftsmanship from unqualified firms who do not meet these requirements.

Reference

ACI: American Concrete Institute
ASA: American Shotcrete Association
NASSCO: National Association of Sewer Service Companies
SSPC: The Society for Protective Coatings
NACE: National Association of Corrosion Engineers

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