SECTION 33 01 36:
TECHNICAL SPECIFICATIONS FOR THE REHABILITATION OF SANITARY SEWER MANHOLES USING A SPRAY APPLIED PROTECTIVE COATING

FOREWORD

This specification covers work, materials and equipment required for protecting and/or rehabilitating concrete manholes by spray-application of a 100% solids coating to eliminate infiltration, provide corrosion protection, repair voids and enhance structural integrity. Procedures for surface preparation, cleaning, application and testing are described herein. The product may be a stand-alone epoxy or a top coat to a cementitious product.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements for surface preparation, repairs and application of the spray applied protective coating to specified surfaces.

1.2 RELATED SECTIONS

A. Concrete Repair.

B. Environmental, Health and Safety.

1.3 REFERENCES

A. ASTM D638 - Tensile Properties of Plastics.

B. ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastics.

C. ASTM D695 - Compressive Properties of Rigid Plastics.

D. ASTM D4541 - Pull-off Strength of Coatings Using a Portable Adhesion Tester.

E. ASTM D2584 - Volatile Matter Content.

F. ASTM D2240 - Durometer Hardness, Type D.

G. ASTM D543 - Resistance of Plastics to Chemical Reagents.

H. ASTM C109 - Compressive Strength Hydraulic Cement Mortars.

I. ASTM C348 - Flexural Strength Hydraulic Cement Mortars.

J. ASTM C396 - Compressive Strength of Cement Mortars.

K. ASTM - The published standards of the American Society for Testing and Materials, West Conshohocken, PA.

1.4 SUBMITTALS

A. The following items shall be submitted:

1. Technical data sheet on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.

2. Material Safety Data Sheets (MSDS) for each product used.

3. Project specific guidelines and recommendations.

4. Qualification of Applicator:

a. Manufacturer certification that Applicator has been trained and approved in the handling, mixing and application of the products to be used.

b. Proof of any necessary federal, state or local permits or licenses necessary for the project.

5. Design details for any additional ancillary systems and equipment to be used in site and surface preparation, application and testing.

6. Depths of each structure coated along with the thickness of material applied and the pounds and/or volume of material applied.

7. A copy of a blank permit for Permit Required Confined Space Entry.

8. A before and after photograph (digital format) of the interior of each manhole.

1.5 QUALITY ASSURANCE

A. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM standards and the protective coating manufacturer's recommendations.

B. The manufacturer shall provide written certification that Applicator has been trained and certified by the manufacturer to handle and apply their products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Materials are to be kept dry, protected from weather and stored under cover.

B. Protective coating materials and components are to be stored and mixed, and handled according to the manufacturer's recommendations and according to their material safety data sheets.

1.7 SITE CONDITIONS

A. Applicator shall conform to all local, state and federal regulations including those set forth by OSHA and the EPA and any other applicable authorities. Owner or Engineer's on-site representation in no way relieves Contractor of Contractor's Safety Obligations.

B. To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, red lanterns and guards as required shall be placed and maintained during the progress of the construction work and until it is safe for traffic to use the highway. All material piles, equipment and pipe which may serve as obstructions to traffic shall be enclosed by fences or barricades and shall be protected by proper lights when the visibility is poor. The rules and regulations of the local authorities respecting safety provisions shall be observed.

C. The Contractor shall carry on the work in a manner which will cause the least interruption to traffic, and may close to through travel not more than two (2) consecutive blocks, including the cross street intersected.

D. Specifically the Contractor shall provide all necessary traffic control in accordance with the TDOT Manual of Uniform Traffic Control Devices (MUTCD) and provide all work site restraints, and safety equipment necessary to meet OSHA requirements and to safely perform the work.

E. The City of Cookeville has designated all sanitary sewer manholes to be permit-required confined spaces. The contractor shall be responsible to follow a Company developed confined space entry program including using properly trained employees.

F. Contractor shall be responsible for all flow diversion, and bypass pumping as needed. The discharge of untreated sewage is not permitted.

1.8 WARRANTY

A. Applicator shall warrant all work against defects in materials and workmanship for a period of five (5) years (written warranty on company letterhead required), unless otherwise noted, from the date of final acceptance of the project. Applicator shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship which may develop during said warranty period, and any damage to other work caused by such defects or the repairing of same, at his own expense and without cost to the Owner.

PART 2 - PRODUCTS

2.1 PROTECTIVE COATING MATERIAL

A. Raven Lining Systems' AquataPoxy SRS epoxy coating system - a 100% solids, solventless two-component epoxy resin system, or Sprayroq, Inc.’s Spraywall,

100% solids, polyurethane spray applied system, Spectrashield, 3 layer modified Polymer/polymeric lining, Warren Environmental Epoxy Spray System, and Madewell's Mainstay Composite Liner (Topcoat System with ML-72 and DS-5) are acceptable systems to be bid. Others may be approved by the engineer.

2.2 LEAK STOP PRODUCTS

A. All flowing leaks through visible cracks shall be sealed by placing Oakum saturated with 3M Scotch Seal Chemical Grout 5600 (or approved equal) into the crack or opening. Smaller openings with flowing water shall be sealed with 3M Scotch Seal Chemical Grout 5610, Avanti 202, or approved equal, injected into the leak site. In order to inject the grout through the concrete, it may be necessary at times to drill a hole into the concrete and use a grout needle. Manhole sealing shall be performed using the methods shown in the 3M Scotch Seal Chemical Grout Application Guide which is hereby made a part of these Specifications by reference - a copy of these will be provided by the Engineer if requested. Other methods as approved by the Engineer may be used for each of the approved methods outlined above. If other methods are to be used a written submittal detailing what steps will be taken to seal this leak will be required prior to work beginning.

B. A cementitious product may be used to seal other cracks (seeps) into the manhole as determined by the Contractor.

C. All leaks must be stopped for a period of at least 20 minutes prior to the applications of the protective coating material. All leak stop products must be compatible with the protective coating material.

PART 3 - EXECUTION

3.1 ACCEPTABLE APPLICATORS

A. Repair mortar applicators should be trained to properly apply the cementitious mortar according to manufacturer's recommendations if used to repair manhole prior to applying the protective coating.

B. Protective coating must be applied by a Certified Applicator of the protective-coating manufacturer and according to manufacturer specifications.

3.2 EXAMINATION

A. The contractor shall examine the location of the manholes and determine the best access to each. The Owner has a twenty-foot wide easement along sewer lines installed off of the right-of-way and will assist with other access routes if requested by the Contractor. **As part of his bid the contractor shall designate any of the manholes shown on the drawings that he has determined as inaccessible for him to rehabilitate. If any are designated, he should specify his limiting factor so that the Owner may look at options to overcome that limiting factor. In the Owner's evaluation of the bids we will**

look at this and discuss it with the bidders to try to find a method to reach the manhole(s) and depending on the number of manholes that the bidder deems inaccessible his bid may be rejected.

B. Appropriate actions shall be taken to comply with local, state and federal regulatory and other applicable agencies with regard to environment, health and safety.

C. Any active flows shall be dammed, plugged or diverted as required to ensure that the liquid flow is maintained below the surfaces to be coated. Flows should be totally plugged and/or diverted if coating the invert. All extraneous flows into the manhole at or above the area coated shall be plugged and/or diverted until the coating has set hard to the touch. Bypass pumping is not a separate pay item.

D. No leaks may be present prior to commencing with the installation of the protective coating and during its installation.

E. Installation of the protective coating shall not commence until the sealers have properly cured in accordance with their manufacturer's specifications.

3.3 SURFACE PREPARATION

A. Applicator shall inspect all surfaces specified to receive a protective coating prior to surface preparation.

B. All concrete or mortar that is not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface.

C. All contaminants including: oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.

D. Surface preparation method(s) should be based upon the conditions of the substrate, service environment and the requirements of the protective coating to be applied.

E. All surfaces shall be repaired as required by the protective coating system in the intended service condition.

F. Surfaces to receive protective coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a strong bond between the protective coating and the substrate. Generally, this can be achieved with high-pressure water cleaning using equipment capable of 3,000 psi at 4 gpm. Other methods such as high-pressure water jetting (refer to NACE Standard No. 5/SSPC-SP12), abrasive blasting, shotblasting, grinding, scarifying or acid etching may also be used. Detergent water cleaning and hot water blasting may be necessary to remove oils, grease or other hydrocarbon residues from the concrete. Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound clean neutralized surface that is not excessively damaged.

G. A mild chlorine solution may be used to neutralize the surface to diminish microbiological bacteria growth prior to final rinse and coating.

H. Infiltration shall be stopped by using a material which is compatible with the specified repair mortar and is suitable for topcoating with the specified protective coating.

I. Test prepared surfaces after cleaning but prior to application of the protective coating if a specific pH or moisture content of the concrete is required according to manufacturer's recommendations.

J. The area between the manhole and the manhole ring and any other area that might exhibit movement or cracking due to expansion and contraction, shall be grouted with a flexible or elastomeric grout or gel. Castings can be abrasive blasted and coated to prevent corrosion if desired.

K. All surfaces should be inspected by the Inspector during and after preparation and before the repair mortar is applied.

3.4 APPLICATION OF REPAIR MATERIALS

A. Areas where structural steel has been exposed or removed shall be repaired in accordance with the Project Engineer's recommendations. Anticipate either building up the concrete with a cementitious product or applying some extra thickness of the lining product.

B. Repair materials shall meet the specifications herein. The materials shall be trowel or spray applied utilizing proper equipment on to specified surfaces. The material thickness shall be specified by the Project Engineer according to Owner's requirements and manufacturer's recommendations.

C. If using approved cementitious repair materials, such shall be trowelled to provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive the protective coating. No bugholes or honeycomb surfaces should remain after the final trowel procedure of the repair mortar.

D. The repair materials shall be permitted to cure according to manufacturer recommendations. Curing compounds should not be used unless approved for compatibility with the specified protective coating.

E. After abrasive blast and leak repair is performed; all surfaces shall be inspected for remaining laitance prior to protective coating application. Any evidence of remaining contamination or laitance shall be removed by additional abrasive blast, shotblast or other approved method. If repair materials are used, refer to these specifications for surface preparation. Areas to be coated must also be prepared in accordance with these specifications after receiving a cementitious repair mortar and prior to application of the coating.

G. All surfaces should be inspected during and after preparation and before the protective coating is applied.

3.5 APPLICATION OF PROTECTIVE COATING

A. Application procedures shall conform to the recommendations of the protective coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment.

B. The spray equipment shall be specifically designed to accurately ratio and apply the specified protective coating materials and shall be regularly maintained and in proper working order.

C. The protective coating material must be spray applied by a Certified Applicator of the protective-coating manufacturer.

D. Spray application of any coat shall not exceed that which is recommended by the manufacturer. Written certification of the maximum thicknesses must be submitted by the coating manufacturer.

E. Airless spray application equipment approved by the coating manufacturer shall be used to apply each coat of the protective coating to avoid any potential contamination from compressed air oil which may encourage inter-coat delamination. Air assisted spray application equipment may be acceptable, especially for thinner coats (<10 mils), only if the air source is filtered to completely remove all oil and water.

F. If necessary, subsequent topcoating or additional coats of the protective coating should occur as soon as the basecoat becomes tack free, ideally within 12 hours but no later than 24 hours after the prior coat has been applied at 75 deg F unless additional prior coat surface preparation is performed. The protective coating manufacturer must be consulted for any additional-coat surface preparation guidelines if necessary.

G. If the invert is not damaged, leaking, or deteriorated, it does not have to be coated. If one or more of the mentioned defects are present, the invert is to be coated. To have a proper flow channel the invert may have to be chipped out to allow for the thickness of the coating. No leaks shall be present in the manhole including the invert area at any time during the warranty period.

H. (Optional) Fiberglass woven-roving fabric may be rolled into the resin or chopped glass spray applied with the resin for added tensile and flexural strength where desired. Sloped surfaces of the floor may be made non-skid by broadcasting aluminum oxide or silica sand into the surface prior to gelation.

3.6 REQUIRED THICKNESS OF PROTECTIVE COATING

A. The contractor shall provide design data for the thickness of the epoxy coating assuming that there are four feet (4') of ground water present. If no high strength material is used for the build coat / profiling the following thickness shall be the minimum allowed: (1) the thickness of the protective coating shall be at least 200 mils in the bottom 5 feet of the manhole (excluding the invert). The engineer may

allow different thickness in the invert to provide acceptable flow conditions; (2) the thickness of the protective coating on the portion of the manhole above the ground water shall be at least 150 mils thick. A chart is shown in Appendix A that gives the estimated depths that were used to estimate quantities. Most of this information was taken off of design and/or record drawings and are not the result of pulling the manholes and measuring the depths. It is therefore considered accurate for the purpose used, but it will not be used as the depths for the purpose of payment.

B. If using a top-coat system such as the Mainstay Composite Liner, a minimum of 1 ½" of the cementitious mortar (ML-72) shall be applied and then a minimum of ½ of the thickness specified in Paragraph A, above for the standalone epoxy shall be applied. All manufacturers' specifications regarding the application of the two products, including curing time and minimum thickness shall be followed.

3.7 TESTING AND INSPECTION

A. The Contractor shall provide the Owner with reasonable assurances that the desired thicknesses are applied. Weights or volume of materials applied shall be kept by the Contractor for each manhole and submitted to the owner. One method the contractor may use to verify thickness is to use a wet film thickness gage meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages.

B. Manhole Vacuum Testing: Designated Manholes shall be vacuum tested by the contractor in the presence of the Owner. The coating must have been in place for at least 24 hours prior to vacuum testing. All pipes entering the manhole should be plugged, taking care to securely place the plug from being drawn into the manhole. The test head shall be placed and the seal inflated in accordance with the manufacturer's recommendations. A vacuum pump of ten (10) inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to nine (9) inches. Following are minimum allowable test times for manhole acceptance at the specified vacuum drop:

MANHOLE DEPTH	**TIME TO DROP 1″ HG**
4 ft to 10 ft	**60 seconds**
10 ft. to 15 ft.	**75 seconds**
15 ft. to 25 ft.	**90 seconds**

If the manhole fails the initial test, repairs and adjustments necessary due to extenuating circumstances (i.e. pipe joint, liner, plug sealing) should be made. Re-testing shall proceed until a satisfactory test is obtained. The Owner will witness the testing and retesting of these initially designated manholes at no cost to the contractor

If in the opinion of the Engineer, an excessive number of the designated manholes fail the initial vacuum test, the Engineer may pick another representative sample for testing or require that all manholes be tested. If due to a high failure rate it is determined that all manholes need to be tested, it is

recommended that the contractor pre-test all manholes as the Owner will charge an inspection fee of $50.00 per hour for all retesting of failed manholes after the initial representative sampling.

C. A final visual inspection shall be made by the Inspector and Contractor's representative. Any deficiencies in the finished coating shall be marked and repaired according to the procedures set forth herein by Applicator.

3.8 GROUTING MANHOLES

A. As a separate preventative measure above what is required in rehabilitating the manholes and in Part 2 of these specifications, the Engineer may require drilling grout injection holes in the manhole in strategic locations to cease Inflow/Infiltration from coming through cracks and other defects in the wall and inject hydrophilic grout. Grout shall be injected through the drilled holes using the recommended probe and applying pressures that will effectively inject the grout but, not cause damage to the manhole structure or the surrounding area. Grout typically, shall be injected through the lowest holes first, working the grout higher until the manhole is externally sealed with grout. Additional holes may be required to verify that the grout has encompassed the entire outside of the manhole. All grouting work shall be in accordance with the recommendations of the grout manufacturer

3.9 MANHOLE INNER FRAME SEAL

A. Cretex LSS Internal Chimney Seal shall be used to seal the entire chimney of all sanitary manholes included in this project. The seal shall extend from the frame casting down to the top of the manhole cone. The manhole frame seal shall be designed to prevent leakage of water through the above described portions of the manhole throughout a 50 year design life. The seal shall also be designed so that it can be installed in manholes where the diameters of the frame and chimney differ by up to 20%. The frame seal shall be capable of repeated vertical movement of not less than 2 inches and/or repeated horizontal movement of not less than 1/2 inch after installation and throughout its design life. The Contractor shall field measure the manholes to determine the information required on the manufacturer's "Sizing and Ordering" procedure. This information is needed to obtain the proper size of bands and size and width of the rubber sleeve. The contractor shall have a manufacturer's recommended expansion tool and all other equipment/tools necessary to prepare the surfaces of the manhole and install the frame seals. Manhole frame seals shall be visually inspected after installation to insure that the seal is properly positioned, tight against the manhole and frame surfaces, that no voids or leakage points exist and that the bands are securely locked in place. Any seals failing this test shall be reworked as necessary and retested at no additional cost to the owner. Any seals not passing this visual inspection may, at the Contractor's option, be tested for leakage using a method approved by the Engineer.

PART 4 – BASIS OF PAYMENT

4.1 BASIS OF PAYMENT (See also “Payment” in the Supplementary General Conditions)

A. Payments for the work included in this section will be in accordance with the prices set forth in the proposal for the quantity of work performed and will be processed as detailed in the General Conditions. Progress payments will be made with a 5% retainage held until completion of the project.

B. Measurement of manhole depths will be from the lowest invert to the bottom of the casting. Measurements will be rounded to the nearest 0.25 feet.

C. Final Payment will not be made until a final inspection is made an all areas in the work zone are clean and any damaged yards are restored.