

DRAFT – Intended to be used as a draft. Manufacturer recommended design guidelines to assist with specification authoring for typical considerations and normal operating conditions in defined environments. It is recommended that these guidelines be reviewed and/or revised as needed by a licensed, Professional Engineer after a thorough condition assessment. Epoxytec is not a professional engineer; therefore, all guidelines herein must be tailored to the specific requirements required for the structure, its conditions and its operational environment. Often times, each specific situation may require to include, omit or revise sections.

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ET-SPEC-154

Epoxy-Modified cementitious lining w/ Mortartec Cladliner (sanitary sewer manholes)

Rehabilitation and Lining for Sanitary Sewer Manholes with Epoxy-Modified Cement Lining

PART 1 - GENERAL

1.1 DESCRIPTION

A. SCOPE:

Applicator shall provide all labor, materials, equipment, incidentals, and quality requirements for concrete for surface preparation, repair or resurfacing, and epoxy-cement lining work to the entire interior surfaces of the structures as shown on drawings and specified herein.

This Section's intent is to provide minimum requirements of an installation of an epoxy-cement lining system; for the lining of newly installed, existing, and/or defective specified concrete/masonry structures and surfaces exposed to municipal sanitary sewage. This is to be accomplished by an applied application of performance hybrid epoxy mortar engineered and formulated to undergo curing via Portland cement and epoxide combined, with hardened reinforcement graded silica aggregate, synthetic fibers and silica fume to achieve early development of properties for lining sanitary sewer infrastructure (Epoxy-Modified Cement).

This Section's intent is for concrete and/or other masonry structures which are exposed to or in contact with municipal sanitary sewage; constituting municipal sanitary sewage from collection systems (sanitary sewer and/or stormwater), where sewage contact and exposure to hydrogen sulfide are present (up to 100 ppm). Not intended for non-sewage applications or industrial waste.

Types of Epoxy-Modified Cement lining for concrete Work required include but are not necessarily limited to the following:

1. Hydraulic water plug
2. Chemical grout
3. Cementitious repair mortar
4. Epoxy-Modified cement lining
5. Manhole chimney joint sealant
6. Miscellaneous materials

B. Coordination:

1. Coordinate surface preparation of substrates to avoid later difficulty or delay in performing the Work of this Section.

2. Review installation procedures under other Sections and coordinate the installation of items that must be installed prior to application of the Epoxy-Modified Cement lining.
3. The Contractor shall coordinate with Engineer regarding the availability of work areas, completion times, safety, access, and other factors which can impact plant operations.

C. Related Sections:

1. Section 01300, Submittals
2. Section 03300, Cast-in-Place Concrete
3. Section 03400, Precast Concrete
4. Section 03640, Chemical Grouting
5. Section 03706, Concrete Repair

1.2 REFERENCES

- A. This Section contains references to the governing standards and documents listed below. They are a part of this Section as specified and modified; the current version shall apply unless otherwise noted. In case of conflict between the requirements of this section and those of the listed documents, the more stringent of the requirements shall prevail.

American Concrete Institute, (ACI)

1. ACI 301 – Specifications for Structural Concrete

ASTM International, (ASTM)

2. ASTM C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
3. ASTM C 267 - Standard Test Methods for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacing and Polymer Concretes
4. ASTM C 293 - Standard Test Method for Flexural Strength of Concrete
5. ASTM C 496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
6. ASTM C 596 - Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement
7. ASTM C 666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
8. ASTM F 414 – Standard Practice for Sealing Sewer Manholes Using Chemical Grouting
9. ASTM D 4258 - Standard Practice for Surface Cleaning Concrete for Coating

10. ASTM D 4414 – Standard Practice for Measurement of Wet Film Thickness by Notch Gages
11. ASTM C 1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

International Concrete Repair Institute, (ICRI)

12. Guideline No. 310.1R – Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion
13. Guideline No. 310.2 – Selecting and Specifying Concrete Surface Preparation for Sealer, Linings, and Polymer Overlays

NACE International, (NACE)

14. NACE No. 6/SSPC-SP13 – Surface Preparation of Concrete

Occupational Safety and health Administration, (OSHA)

15. Safety and health Standards (29 CFR 1910/1926)

SSPC: The Society for Protective Coatings, (SSPC)

16. SSPC-SP13/NACE No. 6 – Surface Preparation of Concrete
17. SSPC-Guide 12 – Guide for Illumination of Industrial Painting Projects

- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of receipt of Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents, the last version of the document before it was discontinued.

1.3 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300 entitled “Submittals”, the Contractor shall submit all required information as specified herein.
- B. Shop Drawings: Submit for approval prior to commencing any Work:
 1. Manufacturer’s project reference lists with lining systems specified herein, stating project location, Owner contact information, Engineer contact information, Installer contact information, containing a minimum of 10 projects of similar capacity with a minimum of 5 years of satisfactory service.
 2. Product Data Sheets: Copies of current technical data for each component specified and applied as outlined in this Section.
 3. Safety Data Sheets: Copies of current SDS for any materials brought on-site including all clean-up solvents, repair or resurfacing mortars and lining materials.
 4. Performance Testing Reports: Copies of test data for the entire physical, chemical, and permeation properties listed herein and as outlined within this Section.
 5. Installation Instructions: Manufacturer’s written installation instructions for the materials specified in this Section.

C. Product Substitution: The specified corrosion protection system is the minimum standard of quality for this project. Equivalent materials of other manufacturers may be substituted only by approval of Engineer. Requests for material substitutions shall be in accordance with requirements of the project specification.

1. All Contractors must provide pricing based on the compliant system of Epoxytec Company in the Base Bid. Other approved lining manufacturer system, if provided, will be shown in the Bid Schedule as Additive Bid Item as an ADD or DEDUCT to overall Base Bid.
2. Manufacturers of "or equal" products shall provide direct property comparison with the materials specified in addition to complying with all other requirements of these Specifications. "Or equal" products shall employ the same generic materials and system components as the Epoxy-Modified Cement lining specified and shall provide same intent by description and equivalent performance as the specified Epoxy-Modified Cement lining to protect against H₂S corrosion.
3. "Or equal" products' manufacturer must provide documentation supporting product's success and history in severe wastewater environments for at least ten (10) years; must also provide samples of cured material covering at least one (1) square foot of surface, at the specified thickness; and must provide written repair instruction and a list of materials should a repair be needed in the future.
4. Bidders desiring to use linings other than those specified shall submit proposed system with their proposal at the time of bid, together with the information required herein, and indicate the sum which will be deducted from the base bid should alternate materials be accepted.

D. Jobsite Reports: Submit at the completion of Work

1. Daily Reports: Include surface preparation, substrate conditions, ambient conditions application procedures, lining materials applied, material quantities, material batch number(s), description of work completed and location thereof.
2. Quality Control Reports: Include all quality control testing and physical specimens.
3. Contractor shall maintain a copy of records until the expiration of the specified warranty period.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications:

1. Installation equipment shall be acceptable to the Epoxy-Modified Cement manufacturer. If spraying Epoxy-Modified Cement, Applicator must utilize equipment specifically made for wet spray of cementitious materials.
2. Applicator shall establish quality control procedures and practices to monitor phases of surface preparation, storage, mixing, application, and inspection throughout the duration of the project. Contractor to provide a fulltime, on-site

person whose dedicated responsibilities will include quality control of the Epoxy-Modified Cement lining.

3. Applicator's quality control procedures and practices must include the following items:
 - a. Training of personnel in the proper surface preparation requirements.
 - b. Training of personnel in the proper storing, mixing, and application and quality control testing of the Epoxy-Modified Cement linings.
 - c. If spraying, training of personnel with the spray equipment to ensure proper film build, quality, and ratio control.

B. Mock-Ups:

1. Prior to the installation of the Epoxy-Modified Cement lining and auxiliary system components, but after Engineer's approval of the Samples and Shop Drawings, install 150 square foot (14 square meters) stepped-back mock-ups of the systems showing surface preparation and each system component in an area selected by Engineer to show representative installation of the Work.
2. Engineer shall approve the mock-up before the start of Work.
3. Retain and protect mock-ups during construction as one standard for judging completed corrosion protection lining Work. Do not alter mock-ups after approval by Engineer.
4. Contractor shall build as many mock-ups as required to achieve Engineer's acceptance of the corrosion protection lining.
5. The approved mock-up shall be considered the acceptable minimum standard of quality.
6. Any corrosion protection lining Work that proceeds without approved mock-ups will not be accepted by the Engineer and removed at no cost to the Owner.

C. Pre-Installation Conference:

1. Before erecting mock-ups Contractor, Installer and technical representative of the corrosion protection lining manufacturer shall meet on-site with Engineer to discuss approved products and workmanship to ensure proper application of the corrosion protection lining components and substrate preparation requirements.
2. Review foreseeable methods and procedures related to the Epoxy-Modified Cement lining of coating Work including but not necessarily limited to the following:
 - a. Review Project requirements and the Contract Documents.
 - b. Review required submittals, both completed and yet to be completed.
 - c. Review status of substrate Work, including approval of surface preparations and similar considerations.
 - d. Review requirements of on-Site quality control testing and requirements for preparing Site Quality Control Report as specified herein.
 - e. Review availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.

- f. Review required inspection and testing.
 - g. Review environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.
 - h. Review regulations concerning code compliance, environmental protection, health, safety, fire and similar considerations.
 - i. Review procedures required for the protection of the Epoxy-Modified Cement lining during the remainder of the construction period.
- 3. Record the discussions of the Pre-Installation Conference and the decisions and agreements or disagreements reached and furnish a copy of the minutes to each party attending. Record any revision or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.
 - 4. Reconvene the conference at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.
- D. Performance Criteria: Epoxy-Modified Cement lining shall be capable of withstanding under constant exposure to raw wastewater and hydrogen sulfide (H₂S) exposure up to one-hundred parts per million (100 ppm); cured material at specified thickness must withstand negative side forces from inflow and infiltration. Products must have sufficient field history and accelerated laboratory testing to substantiate product viability for these exposures.
- E. Source Quality Control: Provide each component of Epoxy-Modified Cement lining produced by a single manufacturer, including recommended repair mortar, repair overlay (resurfacer), joint sealant, lining (coating) materials.
- F. Reference Standards: Comply with applicable provisions and recommendations of all standards listed in Section 1.2 except as otherwise shown or specified.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials:
- 1. Deliver material in manufacturer's original, unopened and undamaged packages.
 - 2. Clearly identify manufacturer's, brand name, contents, color, batch number, and any personal safety hazards associated with the use of or exposure to the materials on each package.
 - 3. Packages showing indications of damage that may affect condition of contents are not acceptable.
- B. Storage of Materials:
- 1. Materials shall be stored in accordance with manufacturer's recommendations in enclosed structures and shall be protected from weather and adverse temperature conditions. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding storage life as defined by the manufacturer shall be removed promptly from the site. Store all materials only in area or areas designated by the Engineer solely for this purpose.

2. Store in original packaging under protective cover and protect from damage.
 3. Stack containers in accordance with manufacturer's recommendations.
- C. Handling of Materials: Handle materials in such a manner as to prevent damage to products or finishes.

1.6 JOB CONDITIONS

A. Environmental Requirements:

1. Proceed with Work only when temperature and moisture conditions of substrates, air temperature, relative humidity, dew point and other conditions comply with the Epoxy-Modified Cement lining manufacturer's written recommendations and when no damaging environmental conditions are forecasted for the time when the material will be vulnerable to such environmental damage. Record all such conditions and include in final Site Quality Control Report.
 2. Maintain substrate temperature and ambient temperature before, during and after installation above 45°F (8°C) in accordance with Epoxy-Modified Cement lining material manufacturer's instructions.
 3. Provide adequate ventilation during instillation and full curing periods of the Epoxy-Modified Cement lining.
- B. Dust and Contaminants: Protect work and adjacent areas from excessive dust and airborne contaminants during Epoxy-Modified Cement lining application and curing. Schedule Work to avoid excessive dust and airborne contaminants.

1.7 WARRANTY

- A. Epoxy-Modified Cement lining Manufacturer shall warranty its products as free from material defects for a minimum period of five (5) years. Provide associated Warranty Certificate.
- B. Contractor shall warranty the installed Epoxy-Modified Cement lining system as free from workmanship defects for a minimum period of five (5) years.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Products and Manufacturer:

1. Materials specified are those that have been evaluated for the specific service. Products of Epoxytec LLC (a Tnemec company, www.tnemec.com, +1-800-863-6321) www.epoxytec.com are specified as a standard of quality and basis of design. The specified basis of design is intended to provide the longest service life possible, lowest life cycle cost, and most sustainable solution. All Contractors must provide pricing based on the compliant system of Epoxytec in the Base Bid.

2. Or Engineer Approved Equal. Materials specified herein shall not preclude consideration of equivalent or superior materials. Alternate materials shall include the following:
 - a. Shown in the Bid Schedule as Additive Bid Item as an ADD or DEDUCT to overall Base Bid.
 - b. Completion of Appendix A of this Section. The burden of proof of performance equality is the responsibility of the Party requesting a substitution in materials. Standardized industry test methods in Appendix A shall be used in part for comparison.
 - c. Materials must have a proven track record of successful installation. Provide Manufacturer's project reference lists with lining systems specified herein stating project location, Owner contact information, Engineer contact information, Installer contact information, containing a minimum of 10 projects of similar capacity with a minimum of 5 years of satisfactory service.
 - d. The owner will decide which Bid Item to accept.
- B. Contractor shall provide all accessory components, as specified or recommended by the manufacturer for optimal application of the Epoxy-Modified Cement lining system's adhesion to substrate and long-term service performance.
- C. Hydraulic Water Plug:
 1. Active leak control materials are to be utilized for I&I abatement, to stop leaks, running water, infiltration, and other water stop needs. Material must be a quick setting, hydraulic cement compound designed for minor patching, and as a leak stopper and water plug which stops running water and/or seepage through concrete. Materials must be designed to set rapidly, in dry powder form, with no prior mixing of water needed (if necessary), to apply directly to active leaks under hydrostatic pressure in manholes or related structures, in accordance with the manufacturer's recommendations.
- D. Chemical Grout:
 1. Depending on the specific application Urethane Based Grout shall be furnished. The type of grout to be used shall be in accordance with the manufacturer's recommendation for the specific application area of the project. Chemical grout sealant solution containing principal chemical sealant constituent, initiator (trigger) and catalyst specifically recommended for the purpose of sealing leaks in manholes. Chemical sealant constituent, initiator (trigger) and catalyst shall be compatible when mixed. Solution shall have ability to tolerate dilution and react in moving water. After final reaction, it shall be a stiff, impermeable, yet flexible gel. The grout proportions shall be such that dilute aqueous solutions, when properly catalyzed will form stiff gels. Materials provided shall gel in a predetermined time period when exposed to normal groundwater pH ranges, and be capable of formula adjustments to compensate for changing conditions. Final reaction shall produce a continuous, irreversible, impermeable stiff Gel and shall not be rigid or brittle. The cured material must be impervious to water

penetration and withstand submergence in water, without degradation and must not be biodegradable.

E. Cementitious Repair Mortar:

1. Rapid-setting, cementitious repair mortar when concrete is deteriorated greater than a depth of 1/2-inch (12.7 mm) and when recommended by the Manufacturer to rehabilitate and restore concrete and provide level substrate for application of the protective lining. Cementitious repair mortar shall be a rapid-setting, non-shrinking resurfacing material capable of spray-transfer. Material shall have similar CLTE properties as concrete.

F. Epoxy-Modified Cement Lining:

1. Epoxy-Modified Cement shall be a formulated blend of Portland cement, high density graded silica aggregate, and synthetic fibers cured with epoxy polymerization which is designed to enhance acid resistance and provide lining protection from corrosion derived from mild-to-moderate hydrogen sulfide (H₂S) conditions (up to 100 ppm) found in sanitary sewer and domestic wastewater environments.
2. Epoxy-Modified Cement shall be capable of achieving up to one inch (1") sag resistance, vertical and overhead.
3. Epoxy-Modified Cement must have a long open recoat window without the need for abrasive or mechanical preparation for simple repair requirements.
4. Epoxy-Modified Cement must be self-priming, able to be applied direct-to-concrete (DTC), requiring no primer.
5. Epoxy-Modified Cement must be able to bond to saturated-surface-dry (SSD) concrete, with moisture and relative humidity tolerances up to 85%.

G. Manhole Chimney Joint Sealant:

1. Manhole chimney joint sealant is an applied polymer elastomer designed to prevent leakage of water into the manhole through the frame joint area and the area above the manhole cone including all extensions to the chimney area. Extensions shall include but are not limited to lifting rings, brick and/or block material that may have been used to achieve grade. The polymer chimney seal material shall be corrosion resistant to H₂S. The sealing system shall line the interior of the adjustment area from the cone/top of the manhole and onto the inside of the casting.

PART 3 - EXECUTION

3.1 GENERAL

- A. All work shall be in strict accordance with the specifications and recommendations including mixing, handling, storage, and application of all products as required and in accordance with manufacturer's published technical instructions, safety data sheets, including manufacturer's published PDS, design guidelines, and/or other written specifications.
- B. Contractor shall provide, erect, and maintain all required hoists, scaffolding, staging and planking, and perform all access related hoisting work required to complete the Work of this Section as specified.
- C. Contractor shall cover or otherwise protect finish work or other surfaces not being coated within the scope of this Section. Contractor shall erect and maintain protective tarps, enclosures and/or masking to contain debris, including dust or other airborne particles from surface preparation or application activities. This may include the use of dust or debris collection apparatus as required at no additional cost to Owner.

3.2 EXAMINATION

- A. Contractor shall examine the areas and conditions under which the Epoxy-Modified Cement lining Work is to be performed in accordance with SSPC-SP13/NACE No. 6, and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work.
- B. Commencement of the Work of this Section shall indicate that the substrate and other conditions of installation are acceptable to the Contractor and his Applicator and will produce a finished product meeting the requirements of the Specifications. All defects resulting from accepted conditions shall be corrected by Contractor at his own expense.
- C. Stopping Active Leaks: After surface cleaning, any visible leaks or other water ingress shall be reported to the Engineer. Any water infiltration through minor leaks must be stopped using specified hydraulic cement water stop; should flows be aggressive, a chemical grout method shall be used in accordance with Section 03640. Surface and grouting material may require additional surface preparation prior to application of Epoxy-Modified Cement lining.
- D. Prior to and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the structure being coated.

3.3 PREPARATION

- A. Concrete surfaces to receive Epoxy-Modified Cement lining shall be cast with a Smooth Form Finish in accordance with ACI 301. Surfaces shall not be rubbed, sacked, troweled or otherwise finished in any manner that will obscure or cover the parent concrete surface with materials other than materials as specified in this Section.

- B. Allow cast-in-place concrete to cure for a minimum of 28 days at 75°F (24°C) and with adequate air movement before installing the applied lining system.
- C. All surface washing, abrasive blasting, waterjetting, grinding, patching, filling and preparation shall be completed by the Applicator in accordance with the Epoxy-Modified Cement lining Manufacturer's recommendations.
- D. Substrate: Concrete surfaces to be coated shall be free of curing compounds and form release agents, laitance and foreign particles that may inhibit bonding. Prior to start of Epoxy-Modified Cement application, pre-clean as required, and inspect the substrate in accordance with SSPC-SP13/NACE No. 6, Severe Service. Surface preparation procedures shall be in accordance with NACE No. 6/SSPC-SP13 and ICRI Guideline No. 310.2. Surface preparation shall expose aggregate and obtain a uniform surface texture resembling the minimum recommended concrete surface ICRI-CSP profile.
- E. Level or grind concrete substrates to produce a uniform and smooth surface, including removal of all sharp edges, ridges, form fins, and other concrete protrusions.
- F. Surface preparation of the substrate must be achieved immediately prior to utilizing any repair material and/or lining material that will require bond to the substrate, re-inspection and/or subsequent surface preparation may need to be repeated should conditions change after initial preparation.
- G. Surface preparation will be required on existing and new concrete.
- H. The objective of surface preparation is to produce a surface that is suitable for application and adhesion of the specified repair materials and lining material. Surfaces therefore are to be free of contaminants and loosely adhering or unsound concrete, and should provide a dry, sound, uniform substrate suitable for the application of repair and lining material.
- I. Structures to receive Epoxy-Modified Cement lining system must be capable of withstanding imposed loads. All oil, grease, waste and chemical contaminants must be removed from the surface of the concrete prior to preparation in accordance with NACE No. 6/SSPC-SP13. Concrete surfaces must be sound and capable of supporting the Epoxy-Modified Cement lining system as determined by the engineer. Surface preparation requirement is to expose a sound, uniform surface texture confirming to the minimum recommended ICRI-CSP amplitude. The appropriate cementitious repair mortar shall be applied to the entire, prepared surface to level surface suitable for lining application.

3.4 APPLICATION

- A. Epoxy-Modified Cement lining system shall be installed when ambient air and surface temperature is above 45°F. Condition the material between 70-80°F (21-27°C) for 24 hours prior to use. Application when temperatures outside of this range will require written instruction from the Manufacturer and approval of the Engineer.
- B. Application in direct sunlight is not advised, as this may result in adverse curing of the materials due to loss of retained water saturation required for curing. Concrete surfaces that have been in direct sunlight should be shaded for at least 24 hours prior to

application. Consult the Manufacturer for application schedule guidelines specific to temperature and environmental conditions.

- C. Hydraulic Water Plug: Epoxytec Mortartec Hydrxx-1 or Hydrxx-3 hydraulic cement water plug shall be used for low pressure active leak stopping.
 - 1. Cure – Press firmly pre-mixed paste or dry material into place, maintaining pressure until the material begins to harden and the leak is stopped. Continue until all active leaks cease.

- D. Chemical Grout: Sanitary sewer grade chemical grouts shall be urethane-based, and formulated specifically for use in grouting pre-cast barrel joints, brick and CMU structures, and/or pipe penetrations and pinholes to stop aggressive flowing leaks.
 - 1. Cure – Mixing and handling of all the chemical grout materials shall be in accordance with chemical grout manufacturer’s recommendations. Application of materials shall be by injection method according to chemical grout manufacturer recommendation and industry defined standard ASTM F 2414, using appropriate pressure to ensure no damage to the structure.
 - 2. Re-Blast - All excess chemical grout must be removed from the surface by mechanical means.

- E. Cementitious Repair Mortar: Epoxytec Mortartec Silicate or Tnemec Series 217 MortarCrete cementitious repair mortar shall be used for structural repairs or surface repairs exceeding a depth 1/2 inch (12.7 mm) in accordance with Manufacturer’s written instructions as outlined in the product data sheet and application guide.
 - 1. Thickness – Minimum ½ inch as required to re-establish original plane.
 - 2. Cure – Ensure that the mortar while curing will remain moist, covered from direct sunlight, and if needed, covered by damp coverings to avoid mortar dry-out and to optimize curing.
 - 3. Re-blast – Clean and profile the surface to remove the laitance layer and to uniformly profile the surface to produce a minimum ICRI CSP 6 surface profile amplitude.

- F. Epoxy-Modified Cement Lining: Epoxytec Mortartec Cladliner shall be the topcoat epoxy-cement applied corrosion protection liner. Epoxy-Modified Cement shall be applied and in accordance with Manufacturer’s written instructions as outlined in the product data sheet and application guide.
 - 1. Thickness – Epoxy-Modified Cement lining shall be applied to a minimum thickness of one-quarter inch (1/4”).

- G. Manhole Chimney Joint Sealant: Applied polymer elastomer sealant, Epoxytec Uroseal 45V shall be applied and in accordance with Manufacturer’s written instructions as

outlined in the product data sheet and application guide. Applied polymer elastomer material is applied after the Epoxy-Modified Cement lining material is installed and cured.

1. Thickness – Manhole chimney joint sealant shall be applied to a minimum thickness of 250 mils (1/4" inch) dry film thickness.
2. Re-blast – Lightly abrade and clean the surface of the Epoxy-Modified Cement liner when applying manhole chimney joint sealant beyond the recoat window of the Epoxy-Modified Cement.

3.5 FIELD QUALITY CONTROL, INSPECTION AND TESTING

- A. Contractor to perform the quality control procedures listed below in conjunction with the requirements of this Section.
- B. Inspect all materials upon receipt to ensure that all are supplied by the approved Manufacturer.
- C. Surface pH Testing: The pH of substrate will be measured using pH indicating paper or pH meter. Acceptable pH values shall be a minimum 9.0 as measured using color indicating pH paper with readable color calibrations and a scale at whole numbers or pH meter.
- D. Surface Profile: Inspect and record substrate profile (anchor pattern) at least once every 5 vertical feet or every 100 square feet (9.3 square meters). If applying Epoxy-Modified Cement direct-to-concrete (DTC), surfaces shall be profiled equal to the CSP 5 amplitude as recommended by the coating manufacturer in accordance with ICRI Guideline 310.2 and SSPC-SP13/NACE No. 6; for Cementitious Repair Mortar work, surfaces shall be profiled equal to the CSP 6.
- E. Provide verification of correct mixing of lining materials in accordance with the Manufacturer's instructions.
- F. Verify curing of the lining materials in accordance with the Manufacturer's instructions.
- G. Dry-Film Thickness:
 1. Wet-Film Thickness shall be taken every two vertical feet (2 vf) or every 25 square feet (2.3 square meters) in accordance with ASTM D 4414 and recorded.
 2. The Dry-Film Thickness can be determined using a surface area calculation for material consumption.
- H. Contractor is responsible for keeping the Engineer informed of all progress so that Engineer may provide additional quality control at his discretion.
- I. Inspection by the Engineer or others does not absolve the Contractor from his responsibilities for quality control inspection and testing as specified herein or as required by the Manufacturer's instructions.

3.6 ACCEPTANCE CRITERIA

- A. All surfaces shall be prepared, applied, and tested in accordance with the specification and referenced standards herein.
- B. Where specified if the entire manhole including invert and pipe penetrations is rehabilitated monolithically then a Vacuum Test may be performed according ASTM F 1244. If vacuum test fails then the contractor shall spray entire manhole with a soap solution and retest to determine where air is entering the manhole. Inspector shall determine if failure was due to improper rehabilitation or poor pipe condition or improperly seated plugs. If inspector determines that the failure is due to improper rehabilitation then the Contractor shall repair manhole according to manufacturer recommendations and retest until a successful vacuum test is achieved. If inspector determines that the failure was due to poor condition of the pipes, or annular space between the pipe and its liner, or the inability to seat the plugs properly and that there are no visible defects in the applied product then it will be determined that the manhole has passed.

3.7 ADJUSTMENTS AND CLEANING

- A. At the completion of the Work, Contractor shall remove all materials and debris associated with the Work of this Section.
- B. Clean all surfaces not designated to receive Epoxy-Modified Cement lining. Restore all other work in a manner acceptable to Engineer.
- C. All finished Epoxy-Modified Cement shall be protected from damage until Final Acceptance of the Work. Epoxy-Modified Cement damaged in any manner shall be repaired or replaced at the discretion of Engineer, at no additional cost to Owner.

Appendix A

END OF SECTION#