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.

revised: November 1, 2022
ET-SPEC-114
Ultra-high build, structural epoxy lining system w/ CPP Product Line (sanitary sewer manholes)

Rehabilitation and Lining for Sanitary Sewer Manholes with Ultra-high Build Structural Epoxy

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PART 1 - GENERAL

1.1 DESCRIPTION

A. SCOPE:

A manufacturer certified Applicator shall provide all labor, materials, equipment, incidentals, and quality requirements for concrete for surface preparation, repair or resurfacing, and ultra-high build, Structural Epoxy 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 ultra-high build, high strength, structural epoxy system; and the lining of newly installed, existing, and/or defective specified concrete/masonry structures and surfaces exposed to municipal sanitary sewage by an applied and bonded application of high performance, 100% solids, ultra-high build, structural grade, applied fiber-reinforced-polymer (FRP) epoxy coating/lining system (Structural Epoxy).

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. Not intended for non-sewage applications or industrial waste.

Structural Epoxy minimum film thickness specified herein is designed and intended for applied and bonded coating/lining, delivering barrier protection with high mechanical strength with a reinforced film to bridge and seal against low pressure forces of effective lateral earth pressure, moisture vapor transmission (MVT), hydrostatic head pressure, and inflow and infiltration (I&I) once cured; while protecting from effluent and H_2S. Design thickness herein also accounts for long term performance; as unintentionally there may be circumstances that may prevent bonding in certain areas that an engineered Structural Epoxy is designed to bridge (with limitations), whereas non-structural coatings may not. Not intended: excessive or high-pressure forces and loading, or other force considerations for full structural reinstatement without a qualified assessment with calculated, verified and adjusted structural thickness calculations performed and certified by a registered Professional Engineer (film or system thicknesses may change depending on types of forces, force values and other variables, engineering assessments and calculations).

Types of Structural Epoxy 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 cementitious resurfacer
5. Structural epoxy lining
6. Manhole chimney joint sealant
7. 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 Structural Epoxy 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 868 – Standard Test Method for Chemical Resistance of Protective Linings
3. ASTM C 1583/1583M – Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)

4. ASTM D 4060 – Standard Test Method for Abrasion Resistance of Organic Linings by the Taber Abraser

5. ASTM D 4285 – Standard Test Method for Indicating Water or Oil in Compressed Air

6. ASTM D 4414 – Standard Practice for Measurement of Wet Film Thickness by Notch Gages

7. ASTM D 7682 – Standard Test Method for Replication and Measurement of Concrete Surface Profiles Using Replica Putty

8. ASTM F 2414 – Standard Practice for Sealing Sewer Manholes Using Chemical Grouting

9. 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)

10. Guideline No. 310.1R – Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion

11. Guideline No. 310.2 – Selecting and Specifying Concrete Surface Preparation for Sealer, Linings, and Polymer Overlays

NACE International, (NACE)

12. NACE SP0188 – Standard Practice for Discontinuity (Holiday) Testing of Protective Linings

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

Occupational Safety and health Administration, (OSHA)

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

SSPC: The Society for Protective Coatings, (SSPC)

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

16. 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 coating 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. Qualification Data: Approved Installer Certification from manufacturer.

5. Performance Testing Reports: Copies of test data for the entire physical, chemical, and permeation properties listed herein and as outlined within this Section.

6. 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 coating 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 Structural Epoxy lining specified and shall provide same intent by description and equivalent performance as the specified Structural Epoxy lining to protect against H_2S corrosion and seal from I&I.

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. Contractor shall be a certified Applicator by the Structural Epoxy manufacturer prior to bid date. Submit proof of Applicator certification by manufacturer to Engineer.

2. Installation equipment shall be acceptable to the Structural Epoxy manufacturer. If spraying Structural Epoxy, Applicator must utilize equipment approved by Structural Epoxy manufacturer.

3. 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 Structural Epoxy linings and completed manufacturing certification training.

4. 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 Structural Epoxy linings.
   c. If spraying, training of personnel with the spray equipment to ensure proper film build, film quality, and ratio control.

B. Mock-Ups:

1. Prior to the installation of the Structural Epoxy 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 Structural Epoxy 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 Structural Epoxy 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: Structural Epoxy lining shall be capable of withstanding under constant exposure to raw wastewater, permeation from hydrogen sulfide and other sewer gases, and attack from organic acids generated by microbial sources with no adverse effects; cured film at specified thickness must withstand negative side film 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 Structural Epoxy 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 Structural Epoxy 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) and rising in accordance with Structural Epoxy lining material manufacturer's instructions.

3. Provide adequate ventilation during instillation and full curing periods of the Structural Epoxy lining.

4. Structural Epoxy lining shall not be applied when ambient air temperature is within 5°F (3°C) of the dew point.

5. Structural Epoxy lining shall not be applied when relative humidity is outside of material manufacturer's recommendations. Do not prepare surfaces or apply materials in rain, snow, fog, mist, or otherwise inclement weather as per material manufacturer's instructions.

B. Dust and Contaminants: Protect work and adjacent areas from excessive dust and airborne contaminates during Structural Epoxy lining application and curing. Schedule Work to avoid excessive dust and airborne contaminants.

1.7 WARRANTY

A. Structural Epoxy lining Manufacturer shall warranty its products as free from material defects for a minimum period of three (3) years. Provide associated Warranty Certificate.

B. Contractor shall warranty the installed Structural Epoxy lining system as free from workmanship defects for a minimum period of three (3) 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 coating 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 Structural Epoxy 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 Cementitious Resurfacer:

1. Epoxy cementitious resurfacer shall be an epoxy-modified, aggregate reinforced material with for surfacing, patching and filling voids and bugholes in concrete. The material shall be suitable for the application down to 1/16 inch (1.6 mm) thickness and be capable of spray-transfer.

2. Epoxy cementitious resurfacer shall exhibiting high bond strength and high mechanical strengths. Initial set time occurs early (4 hours @ 77F) to allow for Structural Epoxy coating. The Epoxy cementitious resurfacer shall not require for

any further preparation or conditioning within 36 hours (at 77F) to accept epoxy top coats.

G. Structural Epoxy Lining:

1. Structural Epoxy shall be available in both trowel-version and spray-version to assist with various application needs or applications in limited access areas or perform any touch-ups.

2. Structural Epoxy shall be 100% solids, highly thixotropic microfiber-reinforced, applied epoxy polycyclic polymer protective barrier material specifically designed to protect concrete and masonry surfaces in severe wastewater environments, including H_2S attack, while sealing inflow and infiltration (I&I).

3. Structural Epoxy is to provide protection from H_2S corrosion and seal from I&I with applied and bonded high build Structural Epoxy; Structural Epoxy film thickness specified herein is designed and intended for applied and bonded coating, delivering barrier protection lining with high mechanical strength and a reinforced film to bridge and seal against moisture vapor transmission (MVT), hydrostatic head pressure, fine root intrusion, and seal inflow and infiltration (I&I).

4. Structural Epoxy lining must be a verified technology of US Environmental Protection Agency's, Environmental Technology Verification Program for Infrastructure Rehabilitation Technologies (EPA ETV).

5. Structural Epoxy lining shall be capable of achieving up to 375 mil. (3/8 inch) sag resistance, vertical and overhead.

6. Structural Epoxy lining must have a long open recoat window without the need for abrasive or mechanical preparation for simple repair requirements.

7. Structural Epoxy lining must be self-priming, able to be applied direct-to-concrete (DTC), requiring no primer.

8. Structural Epoxy lining must be able to bond to saturated-surface-dry (SSD) concrete, with moisture and relative humidity tolerances up 85% and capable to fully cure underwater.

H. 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 H_2S. 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 Structural Epoxy coating 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 Structural Epoxy 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. Where varying surface temperatures do exist, coating installation should be scheduled when the temperatures are falling versus rising.

3.3 PREPARATION

A. Concrete surfaces to receive Structural Epoxy coating 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 corrosion protection lining system.

C. All surface washing, abrasive blasting, waterjetting, grinding, patching, filling and preparation shall be completed by the Applicator in accordance with the Structural Epoxy 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 Structural Epoxy coating systems 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 coating/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 coating/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 coating/lining material.

I. Structures to receive Structural Epoxy 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 Structural Epoxy 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 or epoxy cementitious resurfacer material shall be applied to the entire, prepared surface to level surface suitable for coating.

J. Metal Application: Remove all visible contaminants per SSPC-SP1. Prepare the surfaces in accordance with SSPC/NACE surface preparation standards per the Manufacturer's instructions.

3.4 APPLICATION

A. Structural Epoxy lining systems shall be installed when ambient air and surface temperature is above 45°F. The substrate temperature shall be at least 5°F (3°C) above the dew point. 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 and/or with rising surface temperatures is not advised, as this may result in blistering of the materials due to expansion of entrapped air or moisture in the concrete (induced outgassing). In such cases, it will be necessary to postpone the application until later in the day when the temperature of the substrate is falling or take precautionary steps as recommended by the Manufacturer. 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 conditions and possible sealer application recommendations to reduce outgassing.

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 Cementitious Resurfacer: Epoxytec Mortartec Ceramico epoxy cementitious resurfacer shall be used for filling voids, bugholes, static cracks and joints, and for general concrete patching, and to provide a uniform, void free surface for Epoxy Lining application.

1. Thickness – Epoxy lining shall be applied to a minimum thickness of 1/16 inch (1.6 mm) to the entire surface.

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.

G. Structural Epoxy Lining: Epoxytec CPP Sprayliner MH or Epoxytec CPP Trowel-Liner epoxy lining. Structural Epoxy coating shall be applied and in accordance with Manufacturer's written instructions as outlined in the product data sheet and application guide.

1. Thickness – Epoxy lining shall be applied to a minimum thickness of 125 mils (1/8" inch) dry film thickness.

H. 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 Structural Epoxy 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 Structural Epoxy liner when applying manhole chimney joint sealant beyond the recoat window of the Structural Epoxy.

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 Structural Epoxy direct-to-concrete (DTC), surfaces shall be profiled equal to the CSP 4 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 coating materials in accordance with the Manufacturer's instructions.

F. Inspect and record that the "pot life" of coating materials is not exceeded during installation.

G. Verify curing of the coating materials in accordance with the Manufacturer's instructions.

H. 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.

I. High-Voltage Holiday (Spark) Testing: Upon full cure, the installed lining system shall be checked by high voltage spark detection in accordance with NACE SP0188 and the Manufacturer's printed application guide to verify a pinhole-free surface. Areas which do not pass the spark detection test shall be corrected at no cost to the Owner.

J. Contractor is responsible for keeping the Engineer informed of all progress so that Engineer may provide additional quality control at his discretion.

K. 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 Structural Epoxy coating. Restore all other work in a manner acceptable to Engineer.

C. All finished Structural Epoxy coating shall be protected from damage until Final Acceptance of the Work. Structural Epoxy coating 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#