SECTION XXXXXX – TECHNICAL SPECIFICATIONS FOR INSTALLATION OF PROTECTIVE AND RESTORATION COATINGS FOR MANHOLES, WETWELLS, AND OTHER SANITARY SEWER STRUCTURES

1.00 PART 1 -- GENERAL

1.01 SCOPE

A. It is the intent of this contract to install a high quality protective or restoration coating system to the interior surfaces of all manholes, wet wells, or other structures. This specification covers work, materials, equipment, and tools including specially developed application equipment as required for installation of a field applied interior surfacing system. The use of specialized equipment combined with rigorous surface preparation requirements shall be used to apply the products without the use of solvents. Product application requirements and procedures described herein include surface preparation, mixing application, material handling and storage, qualification of the applicator, and application quality control.

1.02 PRE-QUALIFICATION OF PRODUCTS AND INSTALLERS

A. The Owner will only approve experienced installers utilizing proven Commercially Acceptable sewer rehabilitation products. In order to be considered Commercially Acceptable, the Product and Installer must demonstrate compliance with the following requirements.

B. Bid proposals must be labeled clearly on the outside of the bid envelope, defining the product(s) and installer being proposed. Only bids using pre-approved products and installers will be opened and read. Bids submitted on products or from installers that have not been pre-approved will be returned unopened.

C. The following PRODUCTS and INSTALLERS are classified Commercially Acceptable and are pre-approved for use on this project:

1. Geopolymer System
   a. GeoKrete® by Quadex, LLC (Vortex Companies); Suncoast Infrastructure, Inc.
   b. GeoSpray® by Geo Tree Solutions; Pre-Approved Installer
2. Epoxy System
   a. Structure Guard® by Quadex, LLC (Vortex Companies); Suncoast Infrastructure, Inc.
   b. ARC S1HB by A. W. Chesterton Company; Pre-Approved Installer
3. Composite System
   a. QM-1s Restore® by Quadex LLC (Vortex Companies), Structure Guard® by Quadex, LLC (Vortex Companies); Suncoast Infrastructure, Inc.
   b. MS-2®A by the Strong Company, Inc., Strong-Seal® Epoxy by The Strong Company, Inc.; Pre-Approved Installer
4. CIPM System

a. Triplex® Liner System by McNeil Technologies; Suncoast Infrastructure, Inc.
b. Poly-Triplex Liner by Envirocort Technologies; Pre-Approved Installer

D. Documentation for other products and installers seeking pre-approved status must be submitted to the Engineer no less than two (2) weeks prior to bid date to ensure adequate consideration.

E. Pre-approval of products and installers shall be classified as Commercially Acceptable. To be considered Commercially Acceptable, the product and the installer must demonstrate full compliance with the requirements outlined below. Only products and installers deemed Commercially Acceptable will be allowed to bid as specified.

F. All additional products and installers that are pre-approved by the Engineer shall be identified in an addendum issued prior to the bid date.

1. For a PRODUCT to be considered Commercially Acceptable, the PRODUCT must document verifiable references that show the successful installation and use of the PRODUCT in a wastewater collection system at the following minimum quantities:
   a. Geopolymer System – 500,000 SF
   b. Epoxy System – 750,000 SF
   c. Composite System – Underlayment - , Epoxy Topcoat – 750,000 SF
   d. CIPM System – 250,000 SF

2. For an INSTALLER to be considered as Commercially Acceptable, the INSTALLER must satisfy all insurance, financial, and bonding requirements of the Owner, must be trained and certified by the manufacturer, and must have successfully the products in a wastewater collection system at eh following minimum quantities:
   a. Geopolymer System – Five (5) years' experience
   b. Epoxy System – 250,000 SF
   c. Composite System – Five (5) years' experience
   d. CIPM System – 50,000 SF

3. If a proposed INSTALLER does not meet the years of experience or the installation history requirements, the proposed INSTALLER, at the Engineer's request, may make arrangements for the manufacturer to provide a representative to periodically inspect the installation to confirm the product is installed in accordance with the manufacturer's requirements.

G. The condition of the structures to receive the protective coating will be classified in accordance with the following criteria:

Condition	Description
New	New structures or structures that have not been exposed to sanitary sewer. No evidence of infiltration.
A	Minimal damage. Minimal evidence of exposure to sanitary sewer gases. No evidence of infiltration.
B	Moderate damage such as some missing mortar between bricks in brick manholes, some exposed aggregates in concrete structures. Moderate evidence of exposure to sanitary sewer gases. Evidence of minimal to moderate infiltration.
C	Severe damage such as significant missing bricks in brick manholes, severe exposed aggregates or exposed reinforcing steel in concrete structures. Severe evidence of exposure to sewer gases. Evidence of moderate to heavy infiltration.

H. The minimum coating system type shall be as described in the following table:

Structure Condition	Structure Material	Non-Structural Structural	System Type
New	Precast	Non-Structural	1
New	Brick	Non-Structural	2
A	Precast	Non-Structural	2
A	Brick	Non-Structural	3
B	Precast	Structural	4
B	Brick	Structural	5
C	Precast	Structural	6
C	Brick	Structural	7

1.03 DESCRIPTION OF SYSTEMS

A. The following systems have been designated as the minimum acceptable requirements for the conditions listed in the above table. (NOTE: For depths greater than shown in these CIPM systems, contact manufacturer)

1. System 1
   a. Geopolymer System
      i. Minimum ½" of approved Geopolymer Coating
   b. Epoxy System
      i. Minimum 80 mils DFT of approved epoxy coating
   c. Composite System
      i. Minimum ½" of approved Portland cement underlayment with 80 mils of approved epoxy coating
   d. CIPM System
      i. Minimum 56 oz. per SY thickness of approved CIPM Liner (max. depth 29')
2. System 2
   a. Geopolymer System
      i. Minimum ½" of approved Geopolymer Coating
   b. Epoxy System
      i. Minimum 125 mils DFT of approved epoxy coating
   c. Composite System
      i. Minimum ½" of approved Portland cement underlayment with 80 mils of approved epoxy coating
   d. CIPM System
      i. Minimum 56 oz. per SY thickness of approved CIPM Liner (max. depth 29')
3. System 3
   a. Geopolymer System
      i. Minimum ½" of approved Geopolymer coating
   b. Epoxy System
      i. Minimum 180 mils DFT of approved epoxy coating
   c. Composite System
      i. Minimum ½" of approved Portland cement underlayment with 80 mils of approved epoxy coating
   d. CIPM System
      i. Minimum 56 oz. per SY thickness of approved CIPM Liner (max. depth 29')
4. System 4
   a. Geopolymer System
      i. Minimum ¾" of approved Geopolymer coating
   b. Epoxy System
      i. Minimum 180 mils DFT of approved epoxy coating
   c. Composite System
      i. Minimum ¾" of approved Portland cement underlayment with 100 mils of approved epoxy coating
   d. CIPM System

i. Minimum 56 oz. per SY thickness of approved CIPM Liner (max. depth 29')

5. System 5
   a. Geopolymer System
      i. Minimum 3/4" of approved Geopolymer coating
   b. Epoxy System
      i. Minimum 200 mils DFT of approved epoxy coating
   c. Composite System
      i. Minimum ¾" of approved Portland cement underlayment with 100 mils of approved epoxy coating
   d. CIPM System
      i. Minimum 56 oz per SY thickness of approved CIPM Liner (max. depth 29')
6. System 6
   a. Geopolymer System
      i. Minimum ¾" of approved Geopolymer coating
   b. Epoxy System
      i. Minimum 250 mils DFT of approved epoxy coating
   c. Composite System
      i. Minimum ¾" of approved Portland cement underlayment with minimum 100 mils of approved epoxy coating
   d. CIPM System
      i. Minimum 68 oz per SY thickness of approved CIPM liner (max. depth 38')
7. System 7
   a. Geopolymer System
      i. Minimum 1" of approved Geopolymer coating
   b. Epoxy System
      i. Minimum 350 mils DFT of approved epoxy coating
   c. Composite System
      i. Minimum 1" of approved Portland cement underlayment with minimum 100 mils of approved epoxy coating
   d. CIPM System
      i. Minimum 68 oz. per SY thickness of approved CIPM liner (max. depth 38')

1.04 REFERENCES AND STANDARDS

A. All references and standards listed shall be the latest revisions

B. References
   1. American Society for Testing and Materials (ASTM)
   2. International standard Organisation (ISO)
   3. National Association of Corrosion Engineers (NACE)
   4. SSPC
   5. International Concrete Repair Institute (ICRI)

6. American Concrete Institute

C. ASTM Standards
   1. ASTM D638: Tensile Properties of Plastics
   2. ASTM D790: Flexural Properties of Un-reinforced and Reinforced Plastics
   3. ASTM D695: Compressive Strength of Rigid Plastics
   4. ASTM D4541: Pull-off Strength of Coatings Using a Portable Adhesion Tester
   5. ASTM D2584: Volatile Matter Content
   6. ASTM D2240: Durometer Hardness, Type D
   7. ASTM D1653: Water Vapor Transmission of Organic Coating Films
   8. ASTM D543: Resistance of Plastics to Chemical Reagents
   9. ASTM C297: Flatwise Tensile Strength of Sandwich Constructions.
   10. ASTM E-1907: Calcium Chloride Test for Moisture Vapor Transmission.
   11. ASTM D-4263: Test Method for Indicating Moisture in concrete by Plastic Sheet Method.
   12. ASTM E-337: Test Method for Measuring Humidity with a Psychomotor.
   13. ASTM D-6132: Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gauge.
   14. ASTM D-4138: Test Method for Measurement of Dry film Thickness of Protective Coating Systems by Destructive Means.
   15. ASTM D-4787: Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.
   16. ASTM C39/C39M: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   17. ASTM C666/C666M: Standard Test for Resistance of Concrete to Rapid Freezing and Thawing.

D. SSPC Standards
   1. SSPC Publication No. 91-08: Surface Preparation Specifications
   2. SSPC TU-13: Surface Preparation of Concrete
   3. SSPC TU-2: Design, Installation and Maintenance of Coating Systems for Concrete

E. NACE Standards
   1. NACE Standard SP 0188: discontinuity (Holiday) Testing for Protective Coatings
   2. NACE Standard SP 0892: Linings Over Concrete for Immersion Service
   3. NACE No. 6: Surface Preparation of Concrete
   4. NACE 6/SSPC 13: A Joint Standard for Surface Preparation of Concrete

F. Other Standards

1. ICRI Technical Guidelines 03730: Surface Preparation Guidelines for the Repair of Deteriorated Concrete Resulting from Reinforced Steel Corrosion
2. ICRI Technical Guidelines 03731: Guide for Selecting Application Methods for the Repair of Concrete Surfaces
3. ICRI Technical Guidelines 03732: Guide for Selecting and Specifying Surface Preparation for Sealers, Coatings and Membranes

1.05 SUBMITTALS

A. All submittals shall be submitted in accordance with the applicable portions of these specifications.

B. The Contractor shall submit the following information to the Engineer for approval prior to beginning the installation of the protective coating.

1. Manufactures data sheets for the coating materials
2. Third party test results verifying the physical properties of the coating materials meet or exceed the requirements of these specifications.
3. Applicator's procedures for preparing the surface of the structure and installing the coating system.
4. Documentation that the Applicator of the coating has been trained and certified by the Manufacturer.

2.00 PART 2 -- PRODUCTS

2.01 Other manufactures or products seeking pre-approval must submit the following documentation to the Engineer a minimum of two weeks prior to bid date. This time frame allows the Engineer ample time to determine if the proposed product is an acceptable alternative.

A. Manufactures data sheets for the coating materials
B. Applicator's procedures for preparing the surface of the structure and installing the coating system.
C. Documentation that the Applicator of the coating has been trained and certified by the Manufacturer.
D. Documentation that the proposed Product meets the specified minimum physical characteristics including results of testing performed by a bonded, third party testing company.
E. An affidavit attesting to the successful use of the Product as a protective coating for concrete or masonry structures for a minimum continuous period of five (5) years in wastewater conditions recognized as corrosive or otherwise detrimental to concrete and masonry.
F. A verifiable list of references that document the successful installation and use of the Product that meets the requirements listed above.

2.02 All additional Products that are pre-approved by the Engineer shall be identified in an addendum issued prior to the bid date.

2.03 PORTLAND CEMENT UNDERLAYMENT PRODUCTS

A. All products to be used on this project must be pre-approved by the Engineer prior to the bid date. The following products have been pre-approved for use on this project.
   1. QM-1s Restore® by Quadex (Vortex Companies)
   2. MS-2®A by the Strong Company, Inc.
   3. Pre-Approved Equal(s)

B. Portland Cement Underlayment
   1. A Portland cement based, single component, high strength, fiber reinforced, shrinkage compensated cement mortar enhanced with a monocrystalline quartz aggregate.
   2. Typical Physical Properties
      a. Compressive Strength, PSI >9000
      b. Freeze-Thaw No visible damage after 300 cycles
      c. Shrinkage 0% @ 28 days

2.04 GEOPOLYMER LINING PRODUCTS

A. All products to be used on this project must be pre-approved by the Engineer prior to the bid date. The following products have been pre-approved for use on this project.
   1. GeoKrete® by Vortex Companies
   2. GeoSpray® by Geo Tree Solutions
   3. Pre-Approved Equal(s)

B. Geopolymer Lining
   1. A geopolymer formulated to provide corrosion resistant protection in a high hydrogen sulfide environment, restore structural integrity and eliminate the infiltration of groundwater in deteriorated structures.
   2. Typical Physical Properties
      a. Compressive Strength, PSI >8000
      b. Freeze-Thaw No visible damage after 300 cycles
      c. Shrinkage <0.02%

2.05 100% SOLIDS EPOXY PRODUCTS

A. All products to be used on this project must be pre-approved by the Engineer prior to the bid date. The following products have been pre-approved for use on this project.
   1. Structure Guard® by Quadex, LLC (Vortex Companies)
   2. ARC S1HB by A. W. Chesterton Company
   3. Pre-Approved Equal(s)

B. Epoxy Coating
   1. The coating system shall be a spray-applied 100% solids epoxy monolithic surfacing system for use in coating new or existing manholes, wetwells, lift stations, treatment plants, and other structures.

C. Typical Physical Properties.

1. Minimum Compressive Strength 13,000 psi
2. Minimum Tensile Strength 8,500 psi
3. Minimum Flexural Strength 12,000 psi
4. Minimum corrosion resistance suitable for environments pH of 0.5 or higher.

2.06 CURED IN PLACE MANHOLE (CIPM) LINER PRODUCTS

A. All products to be used on this project must be pre-approved by the Engineer prior to the bid date. The following products have been pre-approved for use on this project.
   1. Poly-Triplex Liner by Envirocort Technologies
   2. Triplex® Liner System by McNeil Technologies
   3. Pre-Approved Equal(s)

B. Cured-in-Place Lining System
   1. The lining system shall be a cured-in-place liner method for use in new or existing manholes, wetwells, liftstations, treatment plants, and other structures.

C. Materials
   1. Liner shall be of the type that allows rehabilitation of a concentric, eccentric, or flat top round structure without removing the access hatch frame, top section or corbel.

   2. As a minimum the liner is composed of two outer layers of fiberglass with an impermeable membrane as the middle layer. Various weights of fiberglass are used to accommodate structural needs.

   3. The layers of the liner will be impregnated with a modified epoxy resin. For additional liner thickness, additional layers of resin and fiberglass can be incorporated.

2.07 All additional Products that are pre-approved by the Engineer shall be identified in an addendum issued prior to the bid date.

3.00 PART 3 -- EXECUTION

3.01 INSTALLER QUALIFICATIONS

A. Other installers may request pre-approval for the individual products by submitting documentation verifying the requirements below.

B. Installers seeking pre-approval must submit the following documentation to the Engineer a minimum of two weeks prior to bid date. This time frame allows the Engineer ample time to determine if the proposed installer is an acceptable alternative.
   1. Certification by the Manufacturer of the Product(s) that the Installer has been trained and is approved to install the Product(s).

2. A verifiable list of references that document the successful installation and use of the Product that meets the requirements listed above.

3.02 All additional Installers that are pre-approved by the Engineer shall be identified in an addendum issued prior to the bid date.

3.03 QUALITY ASSURANCE

A. Installer shall be trained and certified by the manufacturer of the individual products and use surface preparation and product installation procedures and methods as directed by the manufacturer.
B. Installer shall initiate and enforce quality control procedures consistent with applicable ASTM standards.
C. Installer shall use an adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts. These workmen shall be completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
D. Installer shall use approved specialty equipment adequate in size, capacity and number sufficient to accomplish the work of this Section in a timely manner.

3.04 SAFETY

A. Installer shall perform his work in a manner to protect the health and safety of all workmen and the public.
B. All work shall be in accordance with standard industry safety practices.
C. All work, including entry into confined spaces shall be performed in strict compliance with current OSHA regulations.

3.05 PRE-COAT INSPECTION

A. The Installer's vehicles and equipment must be able to access the structures to be coated under their own power.
B. Active flows shall be dammed, plugged or diverted as required to ensure that the liquid flow is maintained below the surfaces to be coated.
C. Installation of the protective coating shall not commence on any surfaces containing freshly poured concrete until the concrete substrate has properly cured, and in no case less than 28 days.

3.06 INSTALLATION OF GEOPOLYMER SYSTEM OR UNDERLAYMENT FOR COMPOSITE SYSTEM

A. SURFACE PREPARATON – GEOPOLYMER SYSTEM OR UNDERLAYMENT FOR COMPOSITE SYSTEM

1. Applicator shall inspect all surfaces specified to receive the monolithic surfacing system prior to surface preparation. Applicator shall promptly notify Owner of any noticeable disparity in the surfaces that

may interfere with the proper preparation or application of the monolithic surfacing system.

2. All concrete that is not sound or has been damaged by chemical exposure shall be restored to a sound concrete surface. All contaminants including all oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.
3. Surfaces to receive lining shall be cleaned to produce a sound concrete or masonry surface with adequate profile and porosity to provide a strong bond between the lining system and the substrate. Surface preparation methods shall be based upon the conditions of the substrate and the requirements of the lining system to be applied, but as a minimum, shall be in accordance with the procedures listed below.

4. Clean all surfaces with high pressure water to remove all loose or contaminated debris. Other equipment and methods may be required to remove all unsound material.
5. Active water infiltration shall be stopped by using a cementitious water plug that is compatible and suitable for top coating with the specified monolithic surfacing system.
6. If pre-installation inspection reveals severe infiltration (defined as visible and consistent movement of water) though the wall of the structure, a collapse in an area of the wall, a bench that needs to be rebuilt/repaired, the contractor will advise the Owner's representative. Such extra work will be approved in writing between the Owner and the contractor prior to the commencement of the work and shall be considered as a separate pay item.

B. APPLICATION – GEOPOLYMER SYSTEM OR COMPOSITE SYSTEM

1. For each bag of product, use the amount of water required per manufacturer's recommendations following mixing procedures noted on product bag using only enough water to produce a mix consistency to allow application of liner material up to one (1) inch thick in a single application without material "sagging" on vertical surface and using the approved equipment for mixing and application.
2. Prepared mix shall be discharged into a hopper and another batch prepared to occur in such a manner as to allow spraying continuously without interruption until each application is complete.
3. The substrate shall be clean and free of all foreign material and shall be damp without noticeable free water droplets or running water prior to the application of liner material. Liner material shall be applied up to 1 inch thick in one or more passes starting from the bottom of the frame; however, minimum total thickness shall not be less than 1/2 inch. The surface shall then be firmly troweled to a smooth finish

being careful not to over trowel. A wet brush finish shall be applied to the trowel-finished surface.

4. Manufacturer's recommendations shall be followed whenever more than 24 hours have elapsed between applications.
5. The covers shall be removed at this time and the bench sprayed with liner material as mixed per specifications (4.3) and spray applied in such a manner that a gradual slope is produced from the walls to the invert with the thickness at the invert to be no less than 1/2 inch. The wall/bench intersection shall be rounded to a uniform radius the full circumference of the intersection.
6. Caution shall be taken to minimize exposure of applied liner material to sunlight and air movement. If time between applications of additional passes is to be longer than 15 minutes, the structure shall be covered. The structure shall not be exposed to sunlight or air movement for longer than 15 minutes before covering or closing access. In extremely hot and arid climates, the structure shall be shaded during application. The liner material shall be kept damp for the first 72 hours if humidity levels are below 70%. A curing compound conforming to ASTM C309 may be used in lieu of keeping the liner material damp if a polymeric topcoat will not be applied. Follow manufacturer's recommendations while applying curing compound.
7. No application shall be made if ambient temperature is below 40 degrees Fahrenheit. No application shall be made to frozen substrates or if the substrate is expected to freeze within 24 hours after application.
8. Precautions shall be taken to keep the mix temperature at time of application below 90 degrees Fahrenheit. Water temperature shall not exceed 80 degrees Fahrenheit. Chill with ice if necessary.
9. Four 2 inch cube specimens shall be cast each day or from every pallet of liner material used, whichever occurs first. Specimens shall be properly packaged, labeled, and returned to manufacturer for testing in accordance with the owner's or manufacturer's directions for compression strength per ASTM C109.

3.07 100% SOLIDS EPOXY SYSTEM OR TOPCOAT FOR COMPOSITE SYSTEM

A. SURFACE PREPARATION – 100% SOLIDS EPOXY SYSTEM OR TOPCOAT FOR COMPOSITE SYSTEM

1. Applicator shall inspect all surfaces specified to receive the monolithic surfacing system prior to surface preparation. Applicator shall promptly notify Owner of any noticeable disparity in the surfaces that may interfere with the proper preparation or application of the monolithic surfacing system.

2. All concrete that is not sound or has been damaged by chemical exposure shall be restored to a sound concrete surface. All contaminants including all oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.
3. Surfaces to receive protective coating shall be cleaned to produce a sound concrete or masonry surface with adequate profile and porosity to provide a strong bond between the monolithic surfacing system and the substrate. Surface preparation methods shall be based upon the conditions of the substrate and the requirements of the monolithic surfacing system to be applied, but as a minimum, shall be in accordance with the procedures listed below.

    a. Clean all surfaces with high pressure water to remove all loose or contaminated debris. Other equipment and methods may be required to remove all unsound material.
    b. When all loose, contaminated, and unsound debris has been removed, the surface shall be etched with a solution of 20% muriatic acid to clean and open the pores of the substrate.
    c. The surface shall be washed again and the wash water shall contain a dilute solution of chlorine to diminish microbiological bacteria growth and to kill any bacteria residing on the surface.
    d. The surface shall be tested with litmus paper at various points throughout the structure to ensure that the pH is within acceptable limits (not to exceed 8.5). If the surface does not meet the pH requirements, the above steps shall be repeated until the surface pH is within acceptable limits. All tests results will be retained for review by the Engineer.
    e. Active water infiltration shall be stopped by using a cementitious water plug that is compatible and suitable for top coating with the specified monolithic surfacing system.
    f. If pre-installation inspection reveals infiltration (defined as visible and consistent movement of water) though the wall of the structure, a collapse in an area of the wall, a bench that needs to be rebuilt/repaired, a necessity for sandblasting (if necessary after surface preparation as described in specification) or anything that will require more than typical preparation of the structure, the contractor will advise the Owner's representative. Such extra work will be approved in writing between the Owner and the contractor prior to the commencement of the work and shall be considered as a separate pay item.

B. APPLICATION – 100% SOLIDS EPOXY SYSTEM OR TOPCOAT FOR COMPOSITE SYSTEM

1. The interior surfacing system shall be applied to the chimney, and walls of all manholes and to the specified surfaces of all other structures.
2. The interior surfacing system shall be continuously bonded to all brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the manhole according to ASTM C882 testing and therefore shall be designed for hydrostatic loading.
3. The cured surfacing shall be monolithic with proper sealing connections to all un-surfaced areas and shall be placed and cured in conformance with the recommendations of the monolithic surfacing system manufacturer.
4. When cured, the system shall form a continuous, tight-fitting, hard, impermeable surfacing that is suitable for sewer system service and chemically resistant to any chemicals, bacteria or vapors normally found in domestic sewage.
5. The system shall effectively seal the interior surfaces of the manhole and prevent any penetration or leakage of groundwater infiltration.
6. The system shall be compatible with the thermal conditions of the existing sewer manhole surfaces.
7. Heated, plural component, specially designed equipment for use in the spray or spin-cast application of the specified system approved for use by the monolithic surfacing system manufacturer.
8. Application procedures shall conform to the recommendations of the interior surfacing system manufacturer, including material handling, mixing, and environmental controls during application, safety, and equipment.
9. The equipment shall be specially designated to accurately ratio and apply the specified materials and shall be regularly maintained and in proper working order.
10. The specified materials must be applied by an approved installer of the monolithic surfacing system.
11. The walls of the structure shall be lined with the monolithic surfacing system to provide a thickness as previously specified based on the condition of the existing structure. The cured surfacing shall be monolithic with proper sealing connections to all un-surfaced areas and shall be placed and cured in accordance with the recommendations of the monolithic surfacing system manufacturer.
12. Specially designed spray and/or spin-cast application equipment shall be used to apply each coat of the system.

3.08 CURED IN PLACE MANHOLE (CIPM) SYSTEM

A. SURFACE PREPARATION – CIPM LINER

1. Voids and irregularities in the structure interior walls and benches shall be patched with cementitious patching/plugging compounds as manufactured by Tamms, Inc., or approved equal.
2. Channel reconstruction cement shall be speed-crete as manufactured by Tamms, Inc., formed Portland cement concrete of 4,000-psi compression strength, or approved equal.
3. Unlined flow channel. Install a bridge or flow through tube and cut the liner bottom near the flow line in the channel to expose the flow channel and give access to the pipes. Plug the pipes entering the structure through the wall and trim the pipe opening to restore flow.
4. Lined flow channel. Plug the pipes entering the structure and line the flow channel to the edge of the pipe. Trim all pipe openings and restore the flow.
5. Wet well bottoms. Wet well bottoms, as a minimum shall be lined to one foot below the lowest level. A wooden false floor shall be placed at the liner termination level to support the inflation bladder. Alternatively, the bottom may be lined and the bottom section removed to avoid building a false floor.
6. All surfaces of the structure shall be cleaned with a high-pressure water-jet sprayer with an operating pressure of at least 3,500 psi. Pressure wash the structure to remove all dirt, grease, sand, and surface contaminants on the wall and floor leaving a clean damp surface.
7. Badly deteriorated and pitted pre-cast structures and brick round structures, with missing bricks and grout, shall be repaired to form a smooth compatible surface for the liner.
8. The interior wall surfaces shall be air-dried. The relative humidity of the wall surfaces shall be less than 100% of the ambient environment. The structure may not show damp surfaces prior to the application of the lining.
9. The stopping of active hydrostatic infiltration shall be accomplished by using Tamms cementitious products Speed Crete and Powder X, as manufactured by Tamms Industrial, Division of LaPorte Construction Chemicals, Mentor, Ohio, Hydro-gel by prime resins, or approved equal.
10. Water infiltration can also be stopped using expansion type grouts such as Seal Guard™, Sikafix H-H, 3M, or Avanti.

B. INSTALLATION – CIPM LINER

1. Installation shall be by a certified installer that is qualified by the liner manufacturer. The Installer shall include the furnishing of all materials, equipment, tools, and labor as required for the rehabilitation of the structures selected, including the installation of the interior liner.
2. The installation of the approved liner system shall be in strict accordance with the manufacturer's instructions. This shall include

the preparation, installation, inflation, curing, and finishing operations required for the completion of the round structure rehabilitation process.

3. The structural liner shall be manufactured to the shape of the structure. The fibrous portion of the liner shall be saturated with a modified epoxy resin, then pressurized, and cured in-place.
4. The liner shall be installed and cured in place via controlled curing by heat and pressurization in the structure to complete the curing process.
5. The lining of the structure shall cover the shape and contour of the existing structure. The liner shall be installed and substantially bond to the interior structure substrate. The liner shall be free of open joints or openings other than pipe inlets, outlets and the access hatch opening.

3.09 QUALITY ASSURANCE

A. Installer shall initiate and enforce quality control procedures consistent with applicable ASTM standards.
B. Installer shall use an adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts. These workmen shall be completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
C. Installer shall use approved specialty equipment adequate in size, capacity and number sufficient to accomplish the work of this Section in a timely manner.

3.10 TESTING AND INSPECTION

A. Thickness of coatings should be measured using non-destructive methods as recommended by the system manufacturer to ensure a uniform thickness during application.
B. The Engineer and Installer shall make a final visual inspection. Any deficiencies in the finished system shall be marked and repaired according to the procedures set forth herein by Applicator.

4.00 PART 4 -- MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Measurement for new and rehabilitated structures shall be per square foot and shall be measured as the total area that receives the protective coating.

4.02 PAYMENT

A. Payment will be made under the following pay items:

1. Coating of Structure (New) - per SF
2. Rehabilitation of Structure (Type A) - per SF
3. Rehabilitation of Structure (Type B) - per SF
4. Rehabilitation of Structure (Type C) - per SF