**SECTION 5.5**

**TECHNICAL SPECIFICATION FOR**

**MANHOLE PROTECTIVE LINING**

**PART 1: GENERAL**

* 1. **Scope of Work**

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

**1.2 Acceptable Manufacturers**

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

**PART 2: QUALITY ASSURANCE**

* 1. **Reference Standards**

Unless otherwise stated, the latest editions of the following documents are applicable

for this specification:

ACI 506.2-77 Specifications for Materials, Proportioning, and Application of Shotcrete by the American Concrete Institute (ACI)

ASCE Manual 52 Manuals and Reports on Engineering Practice, Manhole Inspection and Rehabilitation

ASTM D638 Tensile Properties of Plastics

ASTM D790 Flexural Properties of Unreinforced and Reinforced Plastics

ASTM D695 Compressive Properties of Rigid Plastics

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

ASTM D7234 Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers

ASTM D4787 Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates

ASTM D2584 Volatile Matter Content

ASTM D543 Resistance of Plastics to Chemical Reagents

ASTM D4258 Standard Practice for Surface Cleaning Concrete

ASTM D4259 Standard Practice for Abrading Concrete

ASTM C109 Compressive Strength Hydraulic Cement Mortars

ASTM C579 Compressive Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars

ICRI Guideline No. 03732 Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays by International Concrete Repair Institute (ICRI)

NACE RPO 188-99 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates by National Association of Corrosion Engineers (NACE)

SSPC-SP 1 Solvent Cleaning by standards of the Society of Protective Coatings (SSPC)

SSPC-SP 5 White Metal Blast Cleaning by SSPC

SSPC-SP 10 Near White Metal Blast Cleaning by SSPC

SSPC-SP 12 Surface Preparation and Cleaning of Metals by Water Jetting prior to Recoating by SSPC

SSPC SP-13/NACE No. 6 Surface Preparation of Concrete by SSPC

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

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

SSPWC 500-2 Manhole and Structure Rehabilitation by SSPWC

* 1. **Qualification Requirements**

2.2.1 Installer

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

2.2.2 Product

* For a product to be commercially acceptable, the product must have a minimum 500,000 square feet and five (5) year history of successful wastewater collection system installation in the United States.
* The products must be verified by third party test results supporting the long-term performance and structural strength of the product and such data shall be satisfactory to the Owner.
  1. **Warranty**
     + Contractor shall provide five (5) years of warranty (including labor) from the manufacturer against any defects in materials and workmanship.
     + Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

**2.4 Submittal**

Following submittals shall be provided by the contractor:

2.4.1 Product

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

Description                               Method

- Tensile Strength                            ASTM D 638

- Tensile Ultimate Elongation         ASTM D 638

- Compressive Strength                   ASTM D 695

- Flexural Strength                          ASTM D 790

- Hardness, Shore D                        ASTM D 2240

- Taber Abrasion, CS-17 Wheel      ASTM D 4060

- Adhesion, Concrete                      ASTM D 7243

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

2.4.2 Installer

* Verification of certified applicator’s status

**PART 3: PRODUCTS**

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

for compatibility with the specified coating product. It shall also be handled, mixed, installed and cured in accordance with manufacturer’s guidelines.

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

**PART 4: EXECUTION**

**4.1 General**

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

**4.2 Examination**

* Prior to commencing surface preparation, Contractor shall inspect all surfaces specified to receive the coating and notify Owner, in writing, of any noticeable disparity in the site, structure or surfaces which may interfere with the work, use of materials or procedures as specified herein.
* New Portland cement (not quick setting, high strength) concrete manhole or structures shall have endured a minimum of 28 days since manufacture prior to commencing coating installation.

**4.3 Surface Preparation**

* Surface preparation is required for new and selected existing manholes prior to receive any repair and coating materials.
* Excessive debris, sediment, root intrusion or other foreign materials which may impact the effectiveness of the surface preparation process shall be removed prior to the commencement thereof.
* Offset structural components, lids, covers, frames, etc. shall be repaired, replaced, or reset prior to the commencement of surface preparation.
* Oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants which may affect the performance and adhesion of the coating to the substrate shall be removed using a water based biodegradable emulsifying/ saponin product(s) as necessary.
* Choice of surface preparation method(s) should be based upon the condition of the concrete or masonry surface, potential contaminants present, access to perform work, and the required cleanliness and profile of the prepared surface to receive the repair and/or coating product(s).
* Surface preparation method, or combination of methods, that may be used include high-pressure water blasting (3500 psig at the nozzle), water jetting, dry abrasive blasting along with other additional method(s) in accordance with following industry accepted standards:

- SSPC SP-13/NACE No. 6: Surface Preparation of Concrete,

- ASTM D-4258: Standard Practice for Surface Cleaning Concrete for Coating and ASTM-D-4259: Standard Practice for Abrading Concrete,

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

- NACE/SSPC Standards for the surface preparation of steel.

* Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound, clean, and neutralized surface suitable for the specified coating product(s). Resulting concrete surface profile (CSP) shall be at least a CSP-4 in accordance with ICRI Technical Guideline No. 03732 as referenced in section 2.1. Typically, CSP ranges from CSP 1 (nearly flat) through CSP 9 (very rough) as indicated through ICRI Guideline No. 03732.

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

**4.5 Application of Coating Product**

* Application procedures shall conform to the recommendations of the coating product(s) manufacturer, including environmental controls, product handling, mixing, application equipment, and methods.
* Spray equipment shall be specifically designed to accurately ratio and apply the coating product(s) and shall be in proper working order.
* Prepared surfaces shall be coated via spray application of the coating product(s) described herein unless otherwise recommended by the coating product manufacturer.
* **For all new and selected existing concrete manholes, the coating product(s) shall be applied to a minimum dry film thickness (DFT) of 125 mils with minimum surface profile of CSP-4 in accordance with ICRI Technical Guideline No. 03732.** 
  1. **Testing and Inspection**
* Coating system thickness shall be inspected to ensure compliance with the specifications herein.
  + During application a wet film thickness gauge, meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used. Measurements shall be taken, documented, and attested to by Contractor for submission to Owner.
  + After the coating product(s) have cured in accordance with manufacturer recommendations, coating system thickness may be measured according to SSPC-PA 9 - Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages.
    - * After the coating product(s) have cured in accordance with manufacturer recommendations, all surfaces shall be inspected for holidays as per NACE RPO 188-99 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates or ASTM D4787 Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates. All detected holidays shall be

marked and repaired according to the coating product(s) manufacturer’s recommendations.

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

**PART 5: METHOD OF MEASUREMENT AND PAYMENT**

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

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

**\*\*END OF SECTION\*\***