**SECTION 4.4**

**TECHNICAL SPECIFICATION FOR**

**WATER METER VAULT 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, floor and ceiling of all new and selected existing water meter vaults.

**1.2 Acceptable Manufacturers**

SprayWall as manufactured by SprayRoq, Raven AquataPoxy A-6 Series as manufactured by Raven Lining Systems or pre-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:

ANSI/NSF 61 Drinking Water Components

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

**2.2 Qualification Requirements**

2.2.1 Manufacturer

* Manufacturer shall be certified in compliance with ISO 9001/14001 Quality standards for formulation, manufacturing and technical support.

2.2.2 Product

* For a product to be commercially acceptable, the product must have a minimum 2,000,000 square feet and ten (10) year history of successful water/wastewater system installations 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.

2.2.3 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 1,000,000 square feet of successful water/wastewater system installations and five (5) years of rehabilitation experience.

**2.3 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:

* + 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
* Verification of minimum installation requirements set forth in section 2.2.2.
  + 1. Installer
* Verification of “certified applicator” status
* Verification of minimum installation requirements set forth in section 2.2.3.

**PART 3: PRODUCTS**

* 1. **Repair/Resurfacing Product**
     1. General:
* Repair/ resurfacing product(s) shall be used for all existing and new structures 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. Acceptable Types

3.1.2.1 Cementitious Repair Material (CRM)

* The Cementitious Repair Material (CRM) shall be a factory blended, rapid setting, high early strength, calcium aluminate corrosion resistant non-shrink grout that is specifically formulated for use in the underground environment.
* The CRM shall be capable of being trowelled or pneumatically spray applied.
* The CRM shall be mixed with water only and applied according to manufacturer recommendations.
* The CRM must be compatible with the Protective Coating Material (PCM) that is going to be used. The CRM manufacturer must certify compatibility.
* The physical properties of the CRM shall meet the following minimum requirements:

Compressive Strength (24 hours) 2,500 psi

Compressive Strength (28 days) 8,000 psi

Tensile Strength (28 days) 600 psi

Flexural Strength (28 days) 1,500 psi

3.1.2.2 Epoxy Mastic Repair Materials (EMRM)

* The Epoxy Mastic Repair Material (EMRM) shall be a two part, highly thixotropic
* Epoxy system formulated specifically for trowel or a heated plural system application. EMRM shall be formulated with special additives and modifiers to enhance the water resistance, chemical resistance, and bond strength to a variety of substrates as well as its own internal strength.
* The EMRM shall be compatible with the Protective Coating Material that is going to be used. EMRM manufacturer must certify compatibility.
* The physical properties of the EMRM shall meet the following minimum requirements:

Compressive Strength 11,000 psi

Tensile Strength 4,500 psi

Flexural Strength 4,500 psi

3.1.2.3 Chemical Grout Material

* The chemical grout shall be a semi ridged injection grout designed for sealing larger volume leaks in concrete cracks and fissures.
* The chemical grout shall be capable of filling voids, stabilize soils or gravel.
* The chemical grout shall be a two part system (grout and accelerator) that, when it makes contact with water, is designed to set-off and cut-off gushing water. Set times must be adjustable.
* The water used to activate the chemical grout must be in the range of pH3-10 for proper cross-linking of the materials and optimum foam quality.
* Once cured, the chemical grout shall become closed cell polyurethane foam that is resistant to most organic solvents, mild acids, alkali, petroleum and micro-organisms.
* The chemical grout physical properties when cured shall meet the following minimum requirements:

Density 8.75-9.17 lbs./gal

Tensile Strength 56 psi

Compressive Strength 895 psi

Bending Strength 213 psi

Bond Strength to Bending Bond Strength 28 psi

Mortar Joints Shearing Bond Strength 255 psi

Toxicity Non-Toxic

Absorption (6 month immersion) 15 %

3.1.2.4 Hydraulic Cement Material (HCM)

* The Hydraulic Cement Material (HCM) shall be specifically designed to stop minor water infiltration and develop high-early strengths.
* The HCM shall be capable of being hand mixed and applied in either a “wet” or “dry” state.
* The water used to mix the HCM should be clean and free of contaminants.
* The HCM should be formulated with calcium silicate, calcium aluminate cements, mineral fillers, and specially selected additives for set control.
* The HCM should be used according to the manufacturer recommendations.
* The physical properties of the HCM shall meet the following minimum requirements:

Compressive Strength (1 hour) 1000 psi

Compressive Strength (24 hours) 2500 psi

Pull out Strength 14,000 lbs.

Set Time <1.0 mins

* 1. **Protective Coating Material (PCM)**
     1. General:
* The Protective Coating Material **(**PCM) 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, polyurethane or similar PCM to be applied to all interior surfaces of exposed brick/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 125 mils in a single application.
* PCM must designed for temperatures up to 200 degrees F.
* PCM 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.
  + - * All protective coating material (PCM) shall be ANSI/NSF 61 approved.
    1. Acceptable Types:

3.2.2.1 Polyurethane PCM

* The PCM shall be a spray applied, ultra-high-build, self-priming polyurethane system.
* The PCM shall be 100% solids and VOC-free.
* The PCM shall have the ability to reinstate structural integrity, provide infiltration control, and supply chemical resistance to the structure.
* The PCM shall be a two component (A and B) resin system that uses a heated plural component spray system.
* The physical properties of the PCM shall meet the following minimum requirements:

|  |  |
| --- | --- |
| Property | Polyurethane |
| Flexural Modulus  Compressive Strength  Elongation  Hardness, Shore D  Tensile Strength  Adhesion to concrete | 735,000 psi  7,450 psi  18,000 psi  4% at break  85  Substrate Failure |

3.2.2.2 Epoxy PCM:

* The PCM shall be a spray applied, ultra high-build, self-priming epoxy resin system.
* The PCM shall be 100% solids and VOC-free.
* The PCM shall have the ability to reinstate structural integrity, provide infiltration control, and supply chemical resistance to the structure.
* The PCM shall be a two component (A and B) resin system that uses a heated plural component spray system.
* The physical properties of the PCM shall meet the following minimum requirements:

|  |  |
| --- | --- |
| Property | Epoxy |
| Flexural Strength  Compressive Strength  Tensile Ultimate Elongation  Hardness, Shore D  Tensile Strength  Adhesion to concrete | 9,400 psi  10,000 psi  1.3%  87  6,000 psi  Substrate Failure |

**PART 4: Condition Standards and Repair Methods**

The Engineer or Owner shall categorize each structure in the following manner:

**4.1 Condition 1: New or Like New**

* Condition Standard: A new, like new or existing structure that is considered structurally sound with no indications of settlement, cracking or other signs of fatigue. Infiltration or exfiltration through pre-cast joints, mortar joints, or around the pipe connections may exist and structure may be experiencing inflow, infiltration, mild erosion, aggregate exposure or deterioration.
* Repair Method: Pressure wash and clean structure per Surface Prep section, 5.3 in the specification. Stop any inflow/infiltration using appropriate products and methods (injection grout/hydraulic cement). Fill bug holes, joints, mortar joints, honeycombs and around pipe penetrations with a Cementitious Repair Material (CRM) as needed. Apply a minimum of 125 mils average thickness of approved Protective Coating Material (PCM).

**4.2 Condition 2: Fair**

* Condition Standard: An existing structure that is exhibiting early signs of structural fatigue evidenced by minor cracks, loss of mortar or brick, moderate to moderately severe erosion, aggregate exposure or deterioration due to age (less than ½ inch in depth), minor cross sectional distortion (less than 10 %); however, it is currently supporting the soil and live load.
* Repair Method: Pressure wash and clean structure per Surface Prep section, 5.3 in the specification. Stop any inflow/infiltration using appropriate products and methods (injection grout/hydraulic cement). Fill bug holes, joints, mortar joints, honeycombs and around pipe penetrations with a Cementitious Repair Material (CRM) as needed. Apply the specified Cementitious Repair Material (CMR) to the structure at a minimum thickness of one half inch (1/2”) in order to bring the vault back to an acceptable profile for application of the Protective Coating Material (PCM). CMR shall have at least a forty eight (48) hour initial curing time prior to the application of a minimum of 125 mils average thickness of approved Protective Coating Material (PCM).

**4.3 Condition 3: Poor**

* Condition Standard: An existing concrete or brick structure that is exhibiting moderate to severe deterioration due to age, erosion, aggregate exposure and/or ground movement. Conditions indicating this degree of deterioration may include very severe erosion (loss of original profile of one half inch or greater), cross sectional distortion beyond 10 percent, exposed reinforcing steel, loose or missing bricks, missing mortar.
* Repair Method: Pressure wash and clean structure per Surface Prep section, 5.3 in the specification. Fill voids with a Cementitious Repair Material (CRM) or Epoxy Mastic Repair Material as necessary. Stop any infiltration using appropriate products and methods (injection grout/hydraulic cement). Apply the specified Cementitious Repair Material (CRM) to the structure at a minimum thickness of one inch (1”) to bring structure back to an acceptable profile. Cementitious Repair Material (CRM) shall have at least a forty eight (48) hour initial cure time, prior to application of a minimum of 125 mils average thickness of approved Protective Coating Material (PCM).

|  |  |  |  |
| --- | --- | --- | --- |
| **Condition Type** | **Min.**  **Repair or Resurfacing Material** | **Min.**  **Protective Coating Material** | |
| **Cementitious, Epoxy Mastic, Chemical Grout or Hydraulic Cement Material** | **Polyurethane**  **Liner** | **Epoxy**  **Liner** |
| Type 1: New or Like New | As Needed | 125 mils | 125 mils |
| Type 2: Fair | ½ inch | 125 mils | 125 mils |
| Type 3: Poor | 1 inch | 125 mils | 125 mils |

**PART 5: EXECUTION**

**5.1 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 water meter vault frame/opening/hatch and floor.
* 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.
* The Contractor will coordinate with the Owner on appropriate traffic control measures and working times.
* Prior to man entry into any structure to be rehabilitated, proper ventilation and strict confined space OSHA regulations shall be followed. Failure to do so shall be grounds for removal from the project.

**5.2 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 conditions that are different than the original assessment and designated condition.
* 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.

**5.3 Surface Preparation**

* Proper surface preparation is required for new and selected existing water vaults 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 (5,000 psig at the nozzle) using a zero degree, rotating 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 prior to application of Protective Coating Material (PCM). Typically, CSP ranges from CSP 1 (nearly flat) through CSP 9 (very rough) as indicated through ICRI Guideline No. 03732.

**5.4 Water Infiltration Prevention and Repair**

The applicator shall determine the locations where infiltration is occurring and the process to use for stopping the active flow. For small leaks, a quick setting hydraulic cement product may be used. The process is as follows:

* + - * + The area should be free from all debris, loose brick, mortar, or concrete.
        + Small cracks should be enlarged by chipping with a hammer and chisel to facilitate filling the crack with slurry or dry material.
        + The product should be mixed in quantities such that placement can be made in less than one minute. Mixing may be done in a gloved hand, trowel, or any other means that is convenient.
        + The placement or working time is related to the amount of water used in making the mix. High water usage increases the set time, but in general, one minute should be considered maximum.
        + The product shall be placed in areas of active infiltration by hand or by trowel within the setting time and without further addition of water.
        + Repetitive applications of dry material will gradually establish a damming effect when held in place with maximum hand pressure until stiffening takes place.
        + Reduction of infiltration will be caused by a gradual build-up of hydrated product, which creates a barrier that is impermeable to infiltrating water. This may require multiple applications.
        + Once infiltration is stopped, the product should be brushed and cleaned to remove any loose material.

If the Applicator determines that the flow is too significant for hydraulic cement, a hydrophobic polyurethane injection chemical grout shall be used. The applicator shall follow manufacture recommendations.

* The applicator shall determine the location(s) of the infiltration.
* Injection ports shall be drilled through the wall near the leak and filled with a packer.
* Prior to mixing, both the grout and accelerator must be agitated separately before combining by vigorously shaking the containers. The applicator shall follow the manufacturer recommendation for mix ratios.
* Care should be taken during the mixing. Excess acceleration will cause vigorous expansion that may be prone to shrinkage.
* Before the grout is injected, it shall be tested for appropriate set-time with the actual leaking water from inside the structure.
* Once the product is mixed and ready for injection, an electric airless pump shall be used to pump product through the port and behind the structure.
* During injection the grout will follow the path of least resistance. Existing ground water flow is used to carry the grout to leaking locations.
* When the material has stopped penetrating it will continue to expand against the confines of the crack/joint and compress within itself, forming a very dense, closed cell material stopping the leak.
* For larger leaks or voids, the use of Oakum soaked in the mixed product may be used. The Oakum is forced into the crack/joint/leak using a pointed blunt object. Once exposed to the existing water, the grout will set-off and stop the leak.
* Once the leak is stopped, excess grout (foam) shall be trimmed away and removed from the structure.

* 1. **Application of Repair/ Resurfacing Product**
  + Prior to repair operations, the Engineer, Owner, and/or the Applicator shall review and confirm the designated condition of the structure and agree on the appropriate repair method.
  + Once all active infiltration, voids, and proper surface preparation have been addressed, the installation of the CRM can begin.
  + Place covers over the inverts or flow lines to prevent extraneous materials from entering the pipelines.
  + The applicator must use approved equipment for mixing and spraying the product. The machine shall consist of a progressive cavity pump and air system for low velocity spray application. Equipment should be completely self-contained with water storage and a metering system.
  + The product shall be mixed with water as per the manufacturer recommendations. Only enough water will be used to produce a mix consistency to allow the application of the CRM up to one inch thick in a single application without the material “sagging” or “slumping” on the vertical surface.
  + Factory blended bagged material shall be placed in the mixing chamber and water added. 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 intended thickness is achieved.
  + The surface shall be damp without noticeable free water droplets or running water, but totally saturated just prior to the application.
  + The CRM shall be applied up to one (3) inch thick in one pass; however, minimum total thickness shall not be less than 1 inch.
  + The surface will then be trowelled to a relatively smooth finish. Care should be taken to not “over trowel”.
  + Once the initial cure has taken place, the exposed surface area should be given a broom finish.
  + Because curing times will vary depending on thickness and ambient temperatures, a minimum curing time of 48 hours shall take place prior to Protective Coating installation.

**5.6 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.
  + The intended thickness of applied materials shall be determined by the designated condition and repair method of the structure as per §4.0.
  + The spray equipment shall be specifically designed to accurately ratio and apply the specified PCM and shall be regularly maintained and in proper working order.
  + The 100% solids, resin-based polyurethane or epoxy liner shall be manually sprayed on to all surfaces by a trained technician who is experienced in the application of the specific PCM and has been certified by the manufacturer.
  + Appropriate personal protection equipment shall be utilized. The spray technician shall be on supplied air at all times while in the structure.
  + The structure shall be completely dry prior to PCM application. The use of a heater with a high velocity air blower may be used. An approved HCM may also be used to dry suspect areas.
  + Prior to the PCM application, a test panel shall be sprayed to inspect the quality of the product. The technician shall check the test panel for appropriate color and mixing of the components. This will also insure that all equipment is functioning properly
  + All of the interior surfaces of the manhole/structure shall be coated including the invert, regardless of flow conditions. This will to provide monolithic coverage of the PCM on the entire structure.
  + The spray technician will begin spraying product at the bottom of the structure one side at a time.
  + Once the product has “tacked-off” the technician can move to the opposite side and repeat the process.
  + The trained spray technician may now spray the PCM to the required thickness.
  + The process is repeated from the bottom of the structure to the top. Although not harmful to the PCM, the use of a ventilating system or ripcord will help to minimize “dusting” or “over-spray”.
  + Achieving the specified thickness during application shall be determined using a formula based on the density of the product. The fully trained technician will calculate the appropriate amount of material needed to cover the intended area. A counter on the pumping system shall be used to determine the amount of product actually used.
  + Once the PCM is applied, any and all flow may be reinstated to the structure.

**5.7 Testing and Inspection**

5.7.1 Visual

The Engineer, Owner, or Owners Representative shall make a final visual inspection. Any deficiencies in the finish coating shall be marked and repaired according to the manufacturer recommendations.

5.7.2 Thickness Testing

PCM--Thickness testing of the PCM shall be done during the application by the use of a wet film thickness gauge. During application of epoxy coatings, Contractor shall regularly perform and record thickness readings with a wet film thickness gage, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, to ensure a monolithic coating and uniform thickness during application. A minimum of two readings every four (4 vf) vertical feet, two (2) readings on the Bench (one on each side of the invert) area and one (1) reading in the chimney area shall be recorded. Contractor will submit all documentation on thickness readings to Inspector on a daily basis when coating application occurs.

Due to the rapid cure of the approved polyurethane PCM, the use of a wet film thickness gage is not practical. Therefore, thickness testing for the polyurethane PCM will be done by cutting coupons at random locations on a minimum of (10%) one out of every ten of the total structures coated with the PCM in each basin and or subdivision, as directed by the inspector. Using test samples from the adhesion testing (dollies) is acceptable. All repairs shall be made by Contractor in strict accordance with manufacturer's recommendations using the manufacturer’s approved patching material to repair the structure where test coupons were taken.

5.7.3 Adhesion Testing

PCM - Adhesion Testing will be required on a minimum of (10%) one out of every ten of the total structures coated with the PCM in each basin and or subdivision will be subjected to random adhesion (bond) testing per this section. Measurement of bond strength of the epoxy coating to the substrate may be examined in accordance with ASTM D7234. Any areas detected to have inadequate bond strength shall be evaluated by the Owner.

If a test manhole fails, then owner shall randomly select two additional structures of the remaining nine and they will be subjected to adhesion (bond) testing. If one of the two structures fails, then all of the remaining 7 structures of the original ten in that basin and or subdivision will be tested. Upon completion of testing, owner will make repair recommendations.

The adhesion (bond) testing shall be conducted by using 3 test dolly’s per structure with a DeFelsko PosiTest Pull-Off Adhesion Tester – “AT”. One test dolly shall be affixed within 2 ft. of the bench area/bottom of structure, one test dolly shall be affixed in the middle of the structures wall area and the final test dolly shall be affixed within two foot of the top of the chimney area/top of the structure. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Applicator in strict accordance with manufacturer's recommendations using the manufacturer’s approved patching material to repair the structure where test samples were taken.

5.7.4 Bond Strength

PCM bond strength shall be measured in accordance with ASTM D4541, adhesion tester type IV and combined bond strength between the three test dolly’s from each structure tested, shall need to average greater than 200 psi. The test should also show 100% concrete failure. Test dolly should have coating with concrete struck to it.

5.7.5 Holiday Detection Testing

Contractor shall perform holiday detection testing on all surfaces coated with the PCM in the presence of Inspector, with test equipment appropriate for the PCM.

After the PCM has set hard to the touch, surfaces shall first be dried, an induced holiday shall then be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of PCM film thickness (i.e., 12,500 volts for 125 mils) applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). Retest until no holidays are identified or until it is determined that a holiday test cannot be performed due to unreliable or faulty readings. All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional PCM can be hand applied to the repair area. All touch-up/repair procedures shall follow the PCM manufacturer's recommendations. (Note: This procedure is sometimes difficult or impossible to perform in tight manhole or vault structures or may provide unreliable readings when testing coatings applied to concrete).

**PART 6: METHOD OF MEASUREMENT AND PAYMENT**

Payment for Water Meter Vault Protective Lining as specified in this section shall be incidental and inclusive in the applicable unit price bid item.

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