**SECTION 0000**

**REHABILITATION OF UNDERGROUND STRUCTURES**

**WITH EPOXY COATINGS**

# PART 1 - GENERAL

1.01 DESCRIPTION

1. This specification covers work, materials and equipment required for protecting and/or rehabilitating concrete and masonry manholes and other underground vaults or structures. This shall be accomplished by the monolithic spray-application of a high-build, solvent-free epoxy coating.

1.02 REQUIREMENTS

* 1. Epoxy Coating - After prepatory steps are made, the structures included in this project shall be sprayed or otherwise rehabilitated by the Contractor to eliminate infiltration, provide corrosion protection, repair voids and enhance structural integrity. Procedures for surface preparation, cleaning, application and testing are described herein,
	2. Traffic Control – The Contractor shall be solely responsible for all signage, flagging, cones, personnel and any other item or personnel required for traffic control. All costs for traffic control shall be incidental to the project, unless otherwise specified in the contract documents.

1.03 RELATED SECTIONS **INSERT RELATED SECTIONS HERE**

1.04 REFERENCES

1. ASTM D638 - Tensile Properties of Plastics.
2. ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastics.
3. ASTM D695 - Compressive Properties of Rigid Plastics.
4. ASTM D4541 - Pull-off Strength of Coatings Using a Portable Adhesion Tester.
5. ASTM D2584 - Volatile Matter Content.
6. ASTM D543 - Resistance of Plastics to Chemical Reagents.
7. ASTM C109 - Compressive Strength Hydraulic Cement Mortars.
8. ACI 506.2-77 - Specifications for Materials, Proportioning, and Application of Shotcrete.
9. ASTM C579 - Compressive Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars.
10. SSPC SP-13/NACE No. 6 – Surface Preparation of Concrete.
11. ASTM - The published standards of the American Society for Testing and Materials, West Conshohocken, Pennsylvania.
12. NACE - The published standards of National Association of Corrosion Engineers (NACE International), Houston, Texas.
13. SSPC - The published standards of the Society of Protective Coatings, Pittsburgh, Pennsylvania.
14. Los Angeles County Sanitation District – Evaluation of Protective Coatings for Concrete.
15. SSPWC 210-2.3.3 - Chemical resistance testing published in the Standard Specifications for Public Works Construction (otherwise known as “The Greenbook”).

1.05 SUBMITTALS

1. Safety Plan –The Contractor shall provide a safety plan and identify designated safety supervisory personnel to the Engineer. The plan shall include confined space entry provisions and training, listing of personal protective equipment, and a traffic control plan (if applicable),
2. Qualifications and Product Information - The following items shall be submitted by the Contractor to the Engineer prior to beginning the epoxy coating process:
	1. Technical Data - Technical data sheet on each product used,
	2. Product Data - Material Safety Data Sheets (MSDS) for each product used,
	3. Contractor Qualifications - The Contractor shall also document its qualifications for applying the specied product(s) by submitting the following:
		* 1. Current documentation from coating product Manufacturer certifying Contractor’s training and equipment complies with the Quality Assurance requirements specified herein; and
			2. Five (5) recent references of Contractor indicating successful application of coating product(s) of the same material type as specified herein, applied by spray application within the municipal wastewater environment.

1.06 QUALITY ASSURANCE

1. Coating Products - Coating product(s) shall be capable of being installed and curing properly within a manhole environment. Coating product(s) shall be resistant to all forms of chemical or bacteriological attack found in municipal sanitary sewer systems and capable of adhering to the manhole structure substrates,
2. Spray Equipment - Contractor shall utilize equipment for the spray application of the coating product(s) which has been approved by the coating product Manufacturer; and, Contractor shall have received training on the operation and maintenance of said equipment from the coating product Manufacturer,
3. Certifications and Training - Contractor shall be trained by, or have their training approved and certified by, the coating product Manufacturer for the handling, mixing, application and inspection of the coating product(s) to be used as specified herein,

1.07 DELIVERY, STORAGE, AND HANDLING

1. Storage - Materials are to be kept dry, protected from weather and stored under cover,
2. Temperatures - Protective coating materials are to be stored between fifty degrees Farenheit (50°F) and ninety degrees Farenheit (90°F). Materials shall not be stored near flame, heat or strong oxidants, and
3. Handling - Protective coating materials are to be handled according to their material safety data sheets (MSDS).

1.08 SITE CONDITIONS

1. Regulation - The Contractor shall follow all local, state and Federal regulations including those set forth by OSHA, RCRA and the EPA and any other applicable authorities vis-à-vis this project, and

# PART 2 - PRODUCTS

2.01 EXISTING PRODUCTS

1. Concrete Curing – Standard Portland cement or new concrete (not quick setting high strength cement) must be cured a minimum of twenty-eight (28) days prior to application of the coating product(s),
2. Removal of Existing Coatings – The Contractor shall remove existing coatings prior to application of the new coating product(s) when these existing coatings may affect the performance and adhesion of the newly applied coating product(s), and
3. Preparation of Existing Coatings – The Contractor shall thoroughly clean and prepare existing products to effect a seal with the newly applied coating product(s).

2.02 COATING PRODUCTS

1. Manufacturer(s): The following are approved Manufacturer(s) of epoxy products:

	1. Raven Lining Systems, Inc., Broken Arrow, Oklahoma 800.324.2810; or
	2. Approved equal(s).
2. Product(s): The following are approved products for this project:

	1. Raven 405 – 100% solids, solvent-free ultra high build epoxy system, or
	2. Approved equal(s).
3. Product Characteristics: The approved product(s) shall be an epoxy coating system. Said coating system shall be one hundred percent (100%) solids, solvent-free two-component epoxy resin system thixotropic (i.e. the property exhibited by certain gels of becoming liquid when stirred or shaken) in nature. Said product shall be filled with select fillers to minimize permeability and provide sag resistance they shall also have the following characteristics:

|  |  |
| --- | --- |
| **PRODUCT TYPE** | Amine Cured Epoxy |
| **VOC CONTENT** (ASTM 2584) | 0% |
| **COMPRESSIVE STRENGTH PSI** (ASTM D638) | 18,000 (minimum) |
| **TENSILE STRENGTH PSI** (ASTM D638) | 7,500 (minimum) |
| **FLEXULAR MODULUS PSI** (ASTM D790) | 600,000 (mimimum) |
| **ADHESTION TO CONCRETE, MODE OF FAILURE** (ASTM D4541) | Substrate (concrete) failure |
| **CHEMICAL RESISTANCE** **FOR:**(ASTM D543/G20) | Municipal sanitary sewer environment,Sulfuric acid (30%),Sodium hydroxide (5%) |
| **SUCCESSFUL PASS** | Sanitation District of L.A. County Coating Evaluation Study or SSPWC 210.2.3.3 (Greenbood “Pickle Jar” Chemical resistance test) |

2.04 COATING APPLICATION EQUIPMENT

1. Spray Equipment – The Contractor shall use Manufacturer(s)’ approved heated plural component spray equipment and proper hand tools for hard-to-reach areas, primer application, and touch ups.

2.05 REPAIR AND RESURFACING PRODUCTS

1. Acceptable Material - The following products may be accepted and approved as compatible repair basecoat materials for epoxy topcoating for use within these specifications:
	* + 1. Grout – Acceptable products shall be 100% solids (i.e. have the same thickness after drying as when applied wet), solvent-free epoxy grout specifically formulated for epoxy topcoating compatibility. The epoxy grout Manufacturer(s) shall provide instructions for trowel or spray application and for epoxy topcoating procedures, and
			2. Mortar - Factory blended, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar that can be trowelled or pneumatically spray applied may be approved if specifically formulated to be suitable for epoxy topcoating. Such repair mortars should not be used unless their Manufacturer(s) provide(s) information as to its suitability for topcoating with an epoxy coating.

**PART 3 - EXECUTION**

3.01 EXAMINATION

1. Acessibility - All structures to be coated shall be readily accessible to the Contractor.
2. Preparation – New Portland cement concrete structures shall have endured a minimum of twenty-eight (28) days since manufacture prior to commencing coating installation.
3. Temperatures - Temperature of the surface to be coated shall be maintained between 40° F and 120° F during application,.
4. Exposure – The specified surfaces shall be shielded to avoid exposure to direct sunlight or other intense heat sources. Where varying surface temperatures do exist, coating installation shall be scheduled when the temperature is falling versus rising.
5. Inspection Prior to Application – Prior to commencing surface preparation, the Contractor shall inspect all surfaces specified to receive the coating and notify the Owner or Engineer, 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.

3.02 SURFACE PREPARATION

1. Contaminents - All contaminants including oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed by the Contractor before coating begins.
2. Damaged Material - All concrete or mortar damaged by corrosion, chemical attack or other means of degradation shall be removed by the Contractor so that only sound substrate remains.
3. Methods of Preparation - Surface preparation method(s) shall be based upon the condition of the structure and concrete or masonry surface, potential contaminants present, access to perform work, and required cleanliness and profile of the prepared surface to receive the coating product(s).
4. Infiltration - Infiltration shall be stopped by using a material which is compatible with the repair products and is suitable for topcoating with the specified coating product(s).
5. Manhole Chimney Joint and Casting – The area between the manhole and the manhole ring and the manhole casting shall be a termination point of the specified coating product(s).

3.03 APPLICATION OF REPAIR AND RESURFACING MATERIALS

A. Repair materials shall be used to fill voids, structurally reinforce and/or rebuild surfaces, etc. as determined to be necessary by the Engineer and the protective coating used by the Contractor. Repair materials must be compatible with the specified epoxy coating and shall be applied in accordance with the Manufacturer(s)’ recommendations.

3.04 APPLICATION OF PROTECTIVE COATING

1. Procedures - Application procedures shall conform to the recommendations of the protective coating Manufacturer(s), including material handling, mixing, environmental controls during application, safety, and spray equipment,
2. Spraying - Prepared surfaces shall be coated by spray application of the coating product(s) described herein to a minimum wet film thickness of eighty (80) mils when applying to new concrete. When application is for rehabilitation of existing concrete surfaces, the minimum wet film thickness shall be one hundred twenty-five (125) mils.
3. Additional Coatings - If necessary, subsequent topcoating or additional coats of the protective coating shall be within the product(s)’ recoat window. Additional surface preparation procedures shall be required if this recoat window is exceeded,
4. Product Interface - Coating product(s) shall interface with adjoining construction materials throughout the manhole structure to effectively seal and protect concrete or masonry substrates from infiltration and attack by corrosive elements. Procedures and materials necessary to effect this interface shall be as recommended by the coating product(s) Manufacturer(s),
5. Termination of Coating - Termination points of the coating product(s) shall be made at the manhole chimney joint and one inch (1”) below normal flow levels at the bench or within the invert [unless invert is specified to receive coating].

3.05 TESTING AND INSPECTION

1. Gage - During application a wet film thickness gage 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 the Contractor for submission to the Owner,
2. Holiday Detection - After the coating product(s) have set in accordance with the Manufacturer instructions, all surfaces shall be inspected for holidays (i.e. pinholes, voids, or metal particles) with high-voltage holiday detection equipment. *Reference NACE RPO 188-99 for performing holiday detection.* 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 coating can be hand applied to the repair area. All touch-up/repair procedures shall follow the coating Manufacturer(s)’ recommendations. Documentation on areas tested, results and repairs made shall be provided to the Owner by the Contractor.
3. Final Visual Inspection - A final visual inspection shall be made by the Engineer and/or the Inspector. Any deficiencies in the finished coating shall be marked and repaired according to the procedures set forth herein by the Contractor.
4. Restoration of Service - The municipal sewer system may be put back into non-severe operational service as soon as the final inspection has taken place. However, for severe corrosion duty such as high concentrations of acids, bases or solvents, three (3) to seven (7) days and/or force cure by heat induction to the coated surfaces may be necessary prior to returning to service. The Contractor shall consult the coating Manufacturer(s) for further details.

**PART 4 - DELIVERABLES AND PAYMENTS**

* 1. MEASUREMENT
1. Units for Payment - All manholes receiving epoxy material shall be submitted for payment on a “per vertical foot” basis.
	1. ACCEPTANCE
2. Defective Work – Within sixty (60) days of the final delivery of written reports, the Engineer shall notify the Contractor of any defective work. Defective work (if any) shall be corrected by the Contractor within sixty (60) days of receipt of this written notification. These corrections shall be made to the satisfaction of the Owner and Engineer.
	1. DELIVERABLES
3. Written Reports – As part of the final submittal on this Project, the Contractor shall provide two copies of a bound written report in the approved format. This report shall include a cover page with the name of the Project, scope of the Project, date of submission, and an index page with listings of this Project’s data (if applicable). The written report shall detail the total vertical footage of epoxy material applied per manhole.
4. Incidental Costs – All reports, DVDs, hard drives, printing, copying, software, and other costs associated with developing and rendering these deliverables to the Engineer or Owner shall be considered incidental to the Project.
	1. PAYMENTS
5. Pay Estimates - Pay estimates shall be submitted on a regularly scheduled basis to the Engineer by the Contractor, and
6. Approval of Quantities - The Engineer shall review the quantities submitted by the Contractor, and shall immediately inform the Contractor of its certification or disallowing of any quantities submitted for payment. If the quantities of work in question by the Engineer can’t be immediately resolved to the satisfaction of both parties, the pay estimate shall move forward without those quantities included. Said denied quantities may be resolved and submitted on the next pay estimate.

**END OF SECTION**

**RECOMMENDED PAYMENT SCHEDULE**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item Number** | **Description** | **Est. Qty.** | **Unit** | **Unit****Price $** | **Total Price $** |
|  |  |  |  |  |  |
|  | **GENERAL ITEMS** |  |  |  |  |
|  | Mobilization | 1 | Lump Sum |  |  |
|  | Traffic Control | 1 | Lump Sum |  |  |
|  | **EPOXY COATINGS** |  |  |  |  |
|  | Epoxy Coating 125 mil thickness | 000 | Verticle Foot |  |  |
|  | **OTHER PAY ITEMS** |  |  |  |  |
|  | Bypass Pumping | 000 | Per Each |  |  |
|  | Substraight Coating 500 mil thickness | 000 | Verticle Foot |  |  |
|  | **TOTAL BID** |  |  |  | **00,000.00** |