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SECTION 02555

PROTECTIVE COATING FOR EXISTING AND NEW

CONCRETE AND MASONRY SANITARY SEWER STRUCTURES

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SECTION 02555

PROTECTIVE COATING FOR EXISTING AND NEW CONCRETE AND MASONRY SANITARY SEWER STRUCTURES

PART 1 – GENERAL

1.01 - GENERAL

- A. This specification covers labor, materials, and equipment required for protecting and/or rehabilitating the interior of concrete sanitary sewer structures by application of a coating to protect the concrete structure from hydrogen sulfide and acid generated by microbiological sources present in the municipal wastewater environment. The protective coating shall also eliminate infiltration, repair voids, and enhance the structural integrity of the sanitary sewer structure. Procedures for surface preparation, cleaning, application and testing are described herein.
- B. Cementitious material will not be allowed for the protective coating, however, it will be allowed for patching operations.
- C. For new sanitary sewer manholes and valve pits: The protective coating shall be an acrylic polymer-base concrete coating and sealant. Procedures for surface preparation and application are described herein.
- D. For force main discharge manholes (including the two (2) manholes downstream of the discharge manhole, for a total of three (3) manholes), drop manholes and lift station wetwells: The protective coating shall be a polymer based polyurethane or a high-build, solvent-free epoxy coating. For small lift stations and at the discretion of the City, the number of manholes requiring coating may be reduced.

For lift station wetwells, the coating limits shall include from the bottom of fillet, wetwell walls, and roof. Coating system shall overlap 1" to 2" where hatches sit on the roof; but shall exclude the wetwell floor. For manholes, the coating limits shall include from the flow line in the trough of the invert up to the ring with a 1" to 2" overlay on the ring.

- E. This specification also covers labor, materials, and equipment required for corrosion protection of the ductile iron discharge pipes and fittings within lift station wetwells.

1.02 - REFERENCES

- A. ASTM D638 - Tensile Properties of Plastics.
- B. ASTM D790 - Flexural Properties of Unreinforced/Reinforced Plastics.
- C. ASTM D695 - Compressive Properties of Rigid Plastics.
- D. ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gauges
- E. ASTM D4541 - Pull-off Strength of Coatings Using a Portable Adhesion Tester.
- F. ASTM D2584 - Volatile Matter Content.
- G. ASTM D2240 - Durometer Hardness, Type D.
- H. ASTM D543 - Resistance of Plastics to Chemical Reagents.
- J. ASTM C109 - Compressive Strength Hydraulic Cement Mortars.
- K. ACI 506.2-77 - Specifications for Materials, Proportioning, and Application of Shotcrete.
- L. ASTM C478 - Bond Strength to Concrete: Concrete Failed.
- M. ASTM C496 - Tensile Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars.
- N. ASTM C579 - Compressive Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars.
- O. ASTM - The published standards of the American Society for Testing and Materials, West Conshohocken, PA.
- P. NACE - The published standards of National Association of Corrosion Engineers (NACE International), Houston, TX.
- Q. SSPC - The published standards of the Society of Protective Coatings, Pittsburgh, PA.
- R. ASTM C396 - Compressive Strength of Cement Mortars.
- S. ASTM C580 - Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concrete.
- T. ASTM D4541 - Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement.
- U. ASTM D4787 - Standard Practice for Continuity Verification of Liquid or Sheet Depth Applied to Concrete Substrates.

1.03 - SUBMITTALS

A. Product Data:

1. Technical data sheet on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.
2. Material Safety Data Sheets (MSDS) for each product used.
3. Project specific guidelines and recommendations.
4. Warranty Certificate in accordance with Part 1.08 of this Section.
5. For Lift Station Wetwells:
 - a. Provide reference documentation to confirm that the proposed coating system has a proven record of performance when used in the intended application, including a list of at least five (5) successful installations that have been in service for a period of ten (10) years. The reference list shall include the name of the facility, the application date, a contact person, and a telephone number.
 - b. Applicator Qualifications:
 - 1) Manufacturer certification that Applicator has been trained and approved in the handling, mixing and application of the products to be used.
 - 2) Certification that the equipment to be used for applying the products has been manufactured or approved by the concrete rehabilitation products manufacturer, protective coating manufacturer, and certified for proper use for this specific application.
 - 3) Written documentation of four (4) recent references of Applicator (involving wetwells with surface area of approximately 3,000 square feet) indicating successful application of a polyurethane or a high-build solvent-free epoxy coating.
 - 4) Applicator must provide written documentation of having installed a minimum of 40,000 square feet of protective coating similar to that specified within the last two (2) years.

- 5) Any project specific guidelines for the project.
- 6) Design details for any additional ancillary systems and equipment to be used in site and surfaced preparation, application and testing.

1.04 - QUALITY ASSURANCE

- A. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM, NACE and SSPC standards and the protective coating manufacturer's recommendations.
- B. Coating Manufacturer's authorized field representative shall be on site prior to the application of the coating system to verify that the substrate has been properly prepared, and during the application of the coating system to certify that the coating system has been properly applied. The authorized field representative will provide the Owner with an accurate and objective written report stating inspection observations on the preparation, application, and final inspection verifying adherence to coating manufacturer recommendations, industry standards, and the written specifications.

1.05 - DELIVERY, STORAGE, AND HANDLING

- A. All materials are to be kept dry, protected from weather and stored under cover.
- B. Protective coating materials are to be stored according to manufacturer's recommendations. Do not store near flame, heat or strong oxidants.
- C. Repair and protective coating materials are to be handled according to their material safety data sheets.

1.06 - SITE CONDITIONS

- A. Applicator shall conform with all local, state and federal regulations including those set forth by OSHA, RCRA and the EPA and any other applicable authorities.
- B. Method statements and design procedures are to be provided by the Contractor when confined space entry is required.
- C. During coating operations of existing manholes and lift station wetwells, Contractor shall provide temporary flow bypassing of the structure if required by the City.

1.07 - ACCESS TO THE WORK SITE

- A. Contractor shall provide proper facilities for such access and observation of the Work and also for any inspection or testing by others. If any Work is covered contrary to the request of the City of Savannah (COS) Representative, it must, if requested by the COS Representative, be uncovered for observation and replaced at the Contractor's expense.
- B. Contractor shall provide access to site inspection.

1.08 - WARRANTY

- A. Sanitary Sewer Manholes and Valve Pits:

All materials and workmanship shall be warranted to the owner for a period of five (5) years.

- B. Force Main Discharge Manholes, Drop Manholes and Lift Station Wetwells:

- 1. Materials

The top coat manufacturer shall warrant the manufacturer's materials used on wastewater structures against failure of the system resulting in biogenic corrosion caused by exposure to sanitary sewer environment for the period of ten (10) years from the date of certified inspection and acceptance by the Owner. Within sixty (60) days of receiving written notice from the Owner, the manufacturer shall replace any defective product and the approved application contractor shall repair defects in materials and/or workmanship which may develop during the warranty period.

- 2. Application

The applicator shall warrant that all coating work performed shall be free of significant defects in materials and/or workmanship for a period of ten (10) years from the date of certified inspection and final acceptance by the Owner. Applicator shall remove, replace, or repair as he/she deems appropriate, such defective work.

- 3. Bypassing

In the event of liner failure, the City of Savannah Conveyance Department shall assist application contractor make the necessary repairs by bypassing the structures to be repaired. The City shall not bear any additional costs of coating repairs, such

as dewatering and cleaning structures, providing coating underlayment or top coat materials, or applying the coating system.

PART 2 - PRODUCTS

2.01 - REPAIR MATERIALS

- A. Cementitious patching, repair, and structural restoration materials used shall be only those specified and pre-approved. Project specific submittals shall be provided including application, cure time and surface preparation procedures which permit optimum bond strength with protective coating.
- B. Repair materials shall be used to fill voids, structurally reinforce and/or rebuild substrate surfaces, etc. as determined necessary by the engineer and protective coating applicator. Quick blending, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar that can be trowelled or pneumatically spray applied must be compatible with the specified protective coating and shall be applied in accordance with the manufacturer's recommendations.
- C. The following products are accepted and approved as compatible repair basecoat materials for protective topcoating for use within the specifications.

1. Infiltration Control

All fast setting materials furnished shall be applied directly to active leaks under hydrostatic pressure from the exterior of the concrete in wetwell structures or control by dewatering methods. Materials shall consist of rapid setting cements and various accelerating agents. Material shall not contain chlorides, gypsum, or metallic particles.

Should groundwater be encountered, Contractor shall be responsible for utilizing a dewatering system(s) to remove water from the excavations.

2. Repair, patching, and structural restoration

All material furnished shall be designed to fill voids and to repair or reconstruct where no hydrostatic pressure exists. Material shall consist of rapid setting cements, NSG aggregates, and various accelerating agents. Material shall not contain chlorides, gypsum, or metallic particles.

All structural restoration materials shall be specifically designed for the rehabilitation of wastewater pump station wetwells and other related concrete structures. Materials shall contain poly fiber reinforcement, fused calcium aluminate, and chemical admixtures.

D. Structural Restoration Material Properties:

Product types	Fused Calcium Aluminate Cement OR Underlayment concrete approved by top coat system manufacturer
Cure Time	< 48 hours
Curing gases	Non-toxic
Compressive Strength	5,000 psi
Tensile Strength	500 psi
Flexural Strength	600 psi
Shrinkage	0% at 90% Relative Humidity

2.02 - SANITARY SEWER MANHOLES AND VALVE PITS

A. Interior and Exterior Coating Material

The interior and exterior of all manhole and valve pit structures shall be coated with three coats of a factory or field applied acrylic polymer-base concrete coating and sealant that is neither asphalt nor coal tar based. Acceptable coating is ConSeal CS-55, colors gray or black, as manufactured by Concrete Sealants, New Carlisle, Ohio or equal. The total dry film thickness shall be 3.5 mils. Coating shall be applied to the tongue and groove area of the manhole and valve pit sections as well.

B. The coating manufacturer and applicator shall inspect and certify all coatings prior to the coated pre-cast structures leaving the precast facility.

2.03 - FORCE MAIN DISCHARGE MANHOLES, DROP MANHOLES, AIR RELEASE VALVE MANHOLES & LIFT STATION WETWELLS

A. Structural Restoration & Coating Products:

1. Raven Lining Systems Products
2. Sauereisen Lining Products

3. Spectrashield Liner System Products
4. Or approved equal (2) weeks prior to bid date

B. Protective Coating Material:

Product type	Polyurethane or solid Epoxy
Color	Light
Compressive Strength	15,000 psi
Tensile Strength	1,500 psi
Hardness	Type D 60
Bond Strength – Concrete	> Tensile Strength of Concrete
Dry Film Thickness	125 mils

2.04 - APPLICATION EQUIPMENT

Structural restoration mortars and protective coatings shall be applied with manufacturer approved equipment.

PART 3 - EXECUTION

3.01 - ACCEPTABLE APPLICATORS

- A. Repair mortar must be applied by manufacturer trained and approved applicators. The repair mortar shall be applied according to manufacturer's recommendations.
- B. Protective coating must be applied by a Certified Applicator of the protective coating manufacturer and according to manufacturer specifications.

3.02 - EXAMINATION

- A. Appropriate actions shall be taken to comply with local, state and federal regulatory and other applicable agencies with regard to environment, health and safety.
- B. All bidders are required to verify that they have visited the jobsite, and are familiar with the conditions and the entire scope of work. Bidders shall field verify the attached plans and perform their own quantity measurements prior to bidding.
- C. Contractor shall provide a minimum 24 hour notice to the COS Inspector / Representative for the following conditions:

1. After final surface preparation is completed but before structure rehabilitation;
 2. After patching operations have cured, and
 3. After each coating layer is applied.
- D. Installation of the protective coating shall not commence until the concrete substrate has properly cured in accordance with these specifications.
- E. Temperature of the surface to be coated should be maintained between 60° F and 100° F during application. Prior to and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the structure being coated. Where varying surface temperatures do exist, care should be taken to apply the coating when the temperature is falling versus rising (i.e., late afternoon into evening vs. morning into afternoon).

3.03 - SURFACE PREPARATION

- A. Applicator shall inspect all surfaces specified to receive a protective coating prior to surface preparation. The existing piping, valves, and appurtenances shall be protected during structural rehabilitation and protective coating application.

The pipes and connectors are to be top coated with 30-50 mils DFT nominal. The pipes and connectors are to be primed by the fabricator with epoxy primer (not cold-tar or asphaltic base) that is compatible with the protective coating. After installation, the pipes are to be pressure washed using at a minimum 5,000 PSI and 4 GPM washer and/or abrasive blast cleaned to an SSPC-SP7 'brush-off' specification as necessary for the window of overcoating of the primer.

Wetwell piping and connectors coated with the Zinc/Epoxy exterior coating system per City of Savannah Section 02554 - "Wastewater Collection System" Part 1.01 D, (Ductile Iron Pipe - Exposed Highly Corrosion Applications), shall not require top coating unless otherwise directed by the Engineer or Owner.

- B. All contaminants including: oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.
- C. All concrete or mortar that is not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface or replaced.
- D. Old concrete must be firm and structurally sound as specified by the Engineer.

- E. Surface preparation method(s) should be based upon the conditions of the substrate, service environment and the requirements of the protective coating to be applied.
- F. Surfaces to receive protective coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a strong bond between the protective coating and the substrate. At a minimum, this will be achieved with a low pressure water cleaning equipment using a 0 degree rotating nozzle at a minimum 3,500 psi and 4 GPM. Other methods such as high pressure water jetting (refer to NACE Standard No. 6 /SSPC-SP 13), abrasive blasting, shot-blasting, grinding, scarifying and/or acid etching may also be used. In addition, detergent water cleaning and hot water blasting may be necessary to remove oils, grease or other hydrocarbon residues from the concrete. The method(s) used shall be performed in a manner that provides a uniform, sound clean, neutralized surface that is not excessively damaged.

3.04 - APPLICATION OF REPAIR MATERIALS

- A. Areas where structural steel has been exposed or removed shall be repaired in accordance with the Project Engineer's recommendations.
- B. Repair/Structural Restoration materials shall meet the specifications here and as described in part 2.01 A of these specifications. The materials shall be applied utilizing proper equipment on to specified surfaces. The structural restoration material shall match the original undamaged surface.
- C. Infiltration shall be stopped by using a material which is compatible with the specified repair mortar, waterproof quick setting mortar-type that is suitable for topcoating with the specified protective coating. Contractor shall completely identify the types of grout, mortar, and sealant for repair of leak defects and provide case histories of successful use.
- D. Infiltration areas that require crack injection shall be covered in this scope of work. Injection holes shall be drilled through the wetwell at 120° angles from each other at the same plane of elevation. Rows shall be separated no more than three vertical feet, and the holes shall be staggered with the holes in the rows above and below. Provide additional injection holes near observed defects and pipe seals. A minimum of 6 injection holes shall be provided per defect.

Grout shall be injected through holes under pressure with a suitable probe. Injection pressure shall not cause damage to the wetwell structure or surrounding surface

features. Grout shall be injected through the lowest holes first. Grouting from the ground surface will not be allowed. Provide additional injection holes if necessary to ensure grout travel, verified by field observation of grout at adjacent defects or holes. Patch injection holes using a waterproof quick setting mortar after cleaning with a drill.

- E. The approved repair materials shall provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive the protective coating. No bug-holes or honeycomb surfaces should remain after the final trowel procedure of the repair mortar.
- F. The repair materials shall be permitted to cure according to manufacturer recommendations. Curing compounds should not be used unless approved for compatibility with the specified protective coating.
- G. After required cleaning and repair is performed, all surfaces shall be inspected for remaining laitance prior to protective coating application. Any evidence of remaining contamination or laitance shall be removed by additional abrasive blast, shot-blast or other approved method. If repair materials are used, refer to these specifications for surface preparation. Areas to be coated must also be prepared in accordance with these specifications after receiving a repair mortar and prior to application of the protective coating.

3.05 - APPLICATION OF PROTECTIVE COATING

- A. Application procedures shall conform to the recommendations of the protective coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment.
- B. The equipment shall be specifically designed to accurately ratio and apply the specified protective coating materials and shall be regularly maintained and in proper working order.
- C. The protective coating material must be applied by an applicator certified by the protective coating manufacturer.
- D. Specified surfaces shall be coated by a moisture tolerant, solvent-free, protective coating properties as described in these specifications.
- E. Application equipment approved by the coating manufacturer shall be used to apply each coat of the protective coating.

- F. If necessary, subsequent topcoating or additional coats of the protective coating should occur as soon as the basecoat becomes tack free, ideally within 12 hours but no later than the recoat window for the specified products. Additional surface preparation procedures will be required if this recoat window is exceeded.

3.06 - TESTING AND INSPECTION

- A. 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 to ensure a uniform thickness during application.
- B. After the protective coating has set hard to the touch it shall be inspected with high-voltage holiday detection equipment meeting ASTM D4787 – Standard Practice for Continuity Verification of Liquid or Sheet Depth Applied to Concrete Substrates. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied. 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 protective coating material can be hand applied to the repair area. All touch-up/repair procedures, for areas that do not meet the specified thickness, shall follow the protective coating manufacturer's recommendations.

An SSPC Certified Coatings Inspector or NACE Certified Coatings Inspector must be present and monitor the holiday testing (and repairs, if necessary). The final inspection report is to include the holiday testing results.

- C. A final visual inspection shall be made by the Inspector and manufacturer's representative. Any deficiencies in the finished coating shall be marked and repaired according to the procedures set forth herein by Applicator.

END OF SECTION 02555