

**SECTION 09972
CONCRETE & MASONRY COATINGS**

PART 1 GENERAL

1.01 SUMMARY

- A. This specification covers all labor, materials, equipment and services necessary to complete the rehabilitation and installation of corrosion protection for concrete and masonry wastewater structures as herein specified.
- B. Related Sections: Environmental, Health and Safety

1.02 REFERENCES

- A. ASTM D638 - Tensile Properties of Plastics.
- B. ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastics.
- C. ASTM D695 - Compressive Properties of Rigid Plastics.
- D. ASTM D1653 - Water Vapor Transmission of Organic Coating Films
- E. ASTM D4541 - Pull-off Strength of Coatings Using a Portable Adhesion Tester.
- F. ASTM D7234 - Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
- G. ASTM D4787 Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.
- H. ASTM D2584 - Volatile Matter Content.
- I. 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 C579 - Compressive Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars.
- M. SSPC SP-13/NACE No. 6 - Surface Preparation of Concrete.
- N. ASTM - The published standards of the American Society for Testing and Materials, West Conshohocken, PA.
- O. NACE - The published standards of National Association of Corrosion Engineers (NACE International), Houston, TX.
- P. SSPC - The published standards of the Society of Protective Coatings, Pittsburgh, PA.
- Q. Los Angeles County Sanitation District - Evaluation of Protective Coatings for Concrete.
- R. SSPWC 210-2.3.3 - Chemical resistance testing published in the Standard Specifications for Public Works Construction (otherwise known as "The Greenbook").

1.03 SUBMITTALS

- A. Product Data:
 - 1. Technical data sheet on each product used.
 - 2. Material Safety Data Sheet (MSDS) for each product used.

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3. Copies of independent testing performed on the coating product indicating the product meets the requirements as specified herein. Coating product physical properties shall be substantiated through submittal of testing results as documented by an accredited third party laboratory and shall be representative of the actual field applied product and cure mechanism(s) to be employed in the field.
 4. Five (5) references of manufacturer indicating successful coating system performance greater than five (5) years in age of the submitted coating product(s) within the municipal wastewater environment.
 5. Technical data sheet(s) and project specific data for repair materials to be top coated with the coating product(s) including application, cure time, surface preparation procedures and certification from coating manufacturer as to the compatibility of the repair material(s) and coating system.
- B. Contractor Data:
1. Current documentation from coating product manufacturer certifying Contractor's training and equipment complies with the Quality Assurance requirements specified herein (Section 1.04).
 2. Five (5) references of Contractor indicating successful coating system installation performance greater than five years in age of coating product(s) of the same material type as specified herein, applied by spray application within the municipal wastewater environment.
 3. Documentation of requirements of Section 1.06 B & C.

1.04 QUALITY ASSURANCE

- A. Coating product(s) shall be capable of being installed and curing properly within the specified environment(s); specifically within environmental conditions of a typical sanitary sewer. 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 substrates and repair product(s).
- B. Repair product(s) shall be fully compatible with coating product(s) including ability to bond effectively to the host substrate and coating product(s) forming a composite system.
- C. 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. Written certification of such approval(s) and training shall be submitted by the coating product manufacturer.
- D. Contractor and contractor personnel shall be certified 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. Written

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certification of such training shall be submitted by the coating product manufacturer and shall include the individual contractor personnel to be employed on the project.

- E. Inspectors shall be trained in the use of testing or inspection instrumentation and knowledgeable of the proper use, preparation and installation of the coating product(s) to be used as specified herein.
- F. Contractor shall initiate and enforce quality control procedures consistent with the coating product(s) manufacturer recommendations and applicable NACE or SSPC standards as referenced herein.
- G. Pre-construction meeting shall take place no less than two weeks prior to Contractor mobilization. All parties to have physical presence on the project during construction shall be present. At this meeting responsibilities and authorities during construction shall be discerned; comments and questions regarding materials and execution of these specifications shall be presented and addressed.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Materials are to be kept dry, protected from weather and stored under cover.
- B. Protective coating materials are to be stored between 50 deg F and 90 deg F. Do not store near flame, heat or strong oxidants.
- C. Protective coating materials are to be handled according to their material safety data sheets.

1.06 SITE CONDITIONS

- A. Contractor 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. Confined space entry program and other required safety training certifications shall be submitted by Contractor to Owner as necessary to perform the specified work.
- C. Flow diversion and/or bypass plans shall be submitted by Contractor to Owner as necessary to perform the specified work.

1.07 WARRANTY

- A. Contractor shall warrant all work against defects in materials and workmanship for a period of one (1) year, unless otherwise noted, from the date of final acceptance of the project. Contractor shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship which may develop during said one (1) year period, and any damage to other work caused by such defects or the repairing of same, at his own expense and without cost to the Owner.
- B. Coating product supplier shall warrant all coating materials for a period of one (1) year from the date of final acceptance, unless otherwise noted, to be free of manufacturing defects and products will meet current published physical properties when applied and

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tested in accordance with the manufacturer's standards. If, within said one (1) year period, any product does not meet the physical properties or is defective in manufacture the manufacturer will either replace the defective product or refund the purchase price.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Standard Portland cement or new concrete (not high early strength cement) must cured a minimum of 28 days prior to application of the coating product(s).
- B. Remove existing coatings prior to application of the coating product(s) which may affect the performance and adhesion of the coating product(s).
- C. Thoroughly clean and prepare existing products to effect a seal with the coating product(s).

2.02 REPAIR AND RESURFACING PRODUCTS

- A. Repair products shall be used to fill voids, bug holes, and/or smooth transitions between components prior to the installation of the coating product(s). Repair materials must be compatible with the specified coating product(s) and shall be used and applied in accordance with the manufacturer's recommendations.
- B. Resurfacing products shall be used to fill large voids, lost mortar in masonry structures, smooth deteriorated surfaces and rebuild severely deteriorated structures.
- C. The following products may be accepted and approved if approved by the manufacturer(s) for suitability and compatibility in top coating with the specified coating product(s) for use within the specifications:
 - 1. 100% solids, solvent-free epoxy grout, including the specified coating product(s) enhanced with Raven 200 or approved equal.
 - 2. Factory blended, rapid setting, high early strength, non-shrink repair mortar that can be trowelled or pneumatically spray applied.
 - 3. Polymer modified or enhanced cementitious repair materials, including high strength repair mortars enhanced with Raven 155 or approved equal.

2.03 COATING PRODUCTS

- A. 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.
- B. Manufacturer: RLS Solutions Inc., Broken Arrow, Oklahoma 800-324-2810, 918-615-0020 or FAX 918-615-0140 or approved equal.
- C. Product: Raven 405 – 100% solids, solvent-free ultra high-build epoxy system or approved equal, exhibiting the following characteristics:

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1. Product Type: amine cured epoxy
2. VOC Content (ASTM D2584): 0%
3. Compressive Strength, psi (ASTM D695): 18,000 (minimum)
4. Tensile Strength, psi (ASTM D638): 7,500 (minimum)
5. Flexural Modulus, psi (ASTM D790): 700,000 (minimum)
6. Adhesion to Concrete, psi/mode of failure (ASTM D4541/7234): 200 psi (minimum) with substrate (concrete) failure
7. Chemical Resistance (ASTM D543/G20) immersion service for:
 - a. Municipal sanitary sewer environment
 - b. Sulfuric acid, 30%
 - c. Sodium hydroxide, 10%
8. Water Vapor Permeance, WVP, metric perms (ASTM D1653 Method B, Condition C @ ≤ 80 mils DFT): < 0.002 metric perms
9. Successful Pass: Sanitation District of L.A. County Coating Evaluation Study or SSPWC 210.2.3.3 (Greenbook "Pickle Jar" Chemical Resistance test)

2.04 COATING APPLICATION EQUIPMENT

- A. Manufacturer approved heated plural component spray equipment.
- B. Hard to reach areas, primer application and touch-up may be performed using hand tools.

PART 3 EXECUTION

3.01 EXAMINATION

- A. 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.
- B. All structures to be coated shall be readily accessible to Contractor.
- C. New Portland cement concrete structures shall have endured a minimum of 28 days since manufacture prior to commencing coating installation. Should earlier coating be required, coating product manufacturer shall recommend specifications including appropriate cure assessment testing and use of specialty primers and sealers such as Raven 155, 110, or 120 or approved equal.
- D. Any active flows shall be dammed, plugged or diverted as required to ensure all liquids are maintained below or away from the surfaces to be coated.
- E. Temperature of the surface to be coated should be maintained between 40 and 120 deg F.
- F. Specified surfaces should be shielded to avoid exposure of direct sunlight or other intense heat source. Where varying surface temperatures do exist, coating installation should be scheduled when the temperature is falling versus rising.
- G. Prior to commencing surface preparation, Contractor shall inspect all surfaces specified

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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.

3.02 SURFACE PREPARATION

- A. 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.
- B. Concrete and/or mortar damaged by corrosion, chemical attack or other means of degradation shall be removed so that sound substrate remains.
- C. Choice of surface preparation method(s) should 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).
- D. Surface preparation method, or combination of methods, that may be used include high pressure water cleaning, water jetting, abrasive blasting, shot blasting, grinding, scarifying, detergent water cleaning, hot water blasting and others as referenced in NACE No. 6/SSPC SP-13 Surface Preparation of Concrete. Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound clean neutralized surface suitable for the specified coating product(s).
- E. Resulting surface profile shall be at least a CSP 4 in accordance with ICRI Technical Guideline No. 03732.
- F. Prior to the application of the coating product, all infiltration shall be eliminated by use of appropriate repair material(s), such as hydraulic cements or chemical grouts, compatible with the repair products and suitable for top coating with the coating product(s).

3.03 APPLICATION OF REPAIR AND RESURFACING PRODUCTS

- A. Areas where rebar has been exposed shall be repaired in accordance with the Project Engineer's recommendations or at the minimum shall be prepared in accordance with Section 3.02, , and abrasive blasted according to SSPC-SP10 prior to coating with the coating product specified or other approved primer as specified by the coating product manufacturer.
- B. Repair products shall be used to fill voids, bug holes, and other surface defects which may affect the performance or adhesion of the coating product(s).
- C. Resurfacing products shall be used to repair, smooth or rebuild surfaces with rough profiles to provide a concrete or masonry substrate suitable for the coating product(s) to be applied. These products shall be installed to minimum thickness as recommended within manufacturers published guidelines. Should structural rebuild be necessary, these products shall be installed to a thickness as specified by the Project Engineer.

Note: Structural rebuild should be specified in advance of bid whenever feasible,

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change orders may otherwise result.

- D. Repair and resurfacing products shall be handled, mixed, installed and cured in accordance with manufacturer guidelines.
- E. All repaired or resurfaced surfaces shall be inspected for cleanliness and suitability to receive the coating product(s). Additional surface preparation may be required prior to coating application as per Section 3.02.

3.04 APPLICATION OF COATING PRODUCT(S)

- A. Application procedures shall conform to the recommendations of the coating product(s) manufacturer, including environmental controls, product handling, mixing, application equipment and methods.
- B. Spray equipment shall be specifically designed to accurately ratio and apply the coating product(s) and shall be in proper working order.
- C. Contractors qualified in accordance with Section 1.04 of these specifications shall perform all aspects of coating product(s) installation.
- D. Prepared surfaces shall be coated via spray application of the coating product(s) described herein unless otherwise recommended by the coating product manufacturer.
- E. Coating thickness shall be in relation to the profile of the surface to be coated as recommended by the coating product manufacturer.
- F. In all cases the coating product(s) shall be applied to a minimum dry film thickness of 80 mils to surface profiles of CSP-4 to CSP-6 or 125 mils minimum DFT to surface profiles of CSP-7 or greater.
- G. Subsequent top coating or additional coats of the coating product(s) shall occur within the product's recoat window or 24 hours, whichever is less. Additional surface preparation procedures will be required if this recoat window is exceeded.
- H. Coating product(s) shall interface with adjoining construction materials/components throughout the manhole structure to effectively seal and protect substrates from attack by corrosive elements and to ensure the effective elimination of infiltration into the sewer system.
- I. Procedures and materials necessary to effect the interface between dissimilar materials and the coating product shall be as recommended by the coating product(s) manufacturer.
- J. Termination points of the coating product(s) shall be made at the manhole frame and chimney joint, 1" below normal flow levels at the bench or within the invert (unless invert is specified to receive coating), and a minimum of 1-inch interfacing with each pipe penetration.
- K. Sewage flow shall be stopped, bypassed or diverted as necessary for application of the

coating product(s) to the invert and interface with pipe materials.

3.05 TESTING AND INSPECTION

- A. 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.

- B. High voltage holiday detection for coating systems installed in corrosive environments, when it can be safely and effectively employed, shall be performed to ensure monolithic protection of the substrate. After the coating product(s) have cured in accordance with manufacturer recommendations, all surfaces shall be inspected for holidays in accordance with 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.
 - 1. Test voltage shall be a minimum of 100 volts per mil of coating system thickness.
 - 2. Detection of a known or induced holiday in the coating product shall be confirmed to ensure proper operation of the test unit.
 - 3. All areas repaired shall be retested following cure of the repair material(s).
 - 4. 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.
 - 5. Documentation of areas tested, equipment employed, results and repairs made shall be submitted to the Owner/Engineer by Contractor.

- C. Adhesion of the coating system to the substrate shall be confirmed in a minimum of 10% of the manholes coated, or for large structures once every 1000 square feet of coated area. 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.
 - 1. For each test manhole a minimum of three 20 mm dollies shall be affixed to the coated surface; one at the cone area, one at the mid section and one near the bottom of the structure.
 - 2. For larger structures a minimum of three 20 mm dollies shall be affixed to the coated surface at random locations within each 1000 square foot area or as otherwise agreed upon.
 - 3. The adhesive used to attach the dollies to the coating shall be rapid setting with tensile strengths in excess of at least twice the anticipated failure point (generally at least 1000 psi) and permitted to cure in accordance with manufacturer recommendations. The coating and dollies shall be adequately cleaned and prepared to receive the adhesive. Failure of the dolly adhesive shall be deemed a non-test and require retesting.
 - 4. Prior to performing the pull test, the coating shall be scored to the substrate, or within 10 mills of the substrate surface, by mechanical means without disturbing

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- the dolly or coating system bond within the test area.
5. Two of the three adhesion pulls in each test area shall exceed 200 psi and shall include substrate adhered to the back of the dolly or no visual signs of the coating product in the test hole. Pulls tests with results between 150 and 200 psi may be acceptable if more than 50 percent of the substrate in the test area is adhered to the dolly.
 6. Should a structure, or area, fail to achieve two successful pulls as described above, additional testing shall be performed at the discretion of the Owner or Project Engineer. Any areas detected to have inadequate bond strength shall be evaluated by the Project Engineer. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Contractor.
 7. All adhesion testing shall be performed by qualified personnel using calibrated equipment as specified by the applicable ASTM standard(s).
 8. All adhesion testing shall be documented and submitted in a consistent format detailing location, test values, description of the failure point/mode, scoring method employed, adhesive used, cure time of coating and adhesive and other data as deemed necessary by the owner/engineer.
 9. All adhesion test locations shall be repaired by the Contractor at no cost to the Owner.
- D. Visual inspection shall be made by the Project Engineer and/or Inspector. Any deficiencies in the finished coating effecting 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.
- E. The municipal sewer system may be returned to full operational service as soon as the final inspection has taken place and all coating materials have been adequately cured according to the coating product(s) manufacturer's recommendations.

END OF SECTION