

## SECTION 09801 — MANHOLE LINING

### PART 1 - GENERAL

#### 1.1 WORK OF THIS SECTION

- A. The Work of this section includes the lining of new and existing sewer manholes. The CONTRACTOR shall coordinate his work so as not to interfere with the existing sanitary sewer service. Lining shall consist of preparing the interior surface of each manhole, application of repair mortar where needed to restore damaged surfaces, application of epoxy primer, and polyurethane lining and all incidentals necessary to complete the work contained in these technical provisions in accordance with the Water, Sewer, and Recycled Water Design and Construction Manual (Oceanside Water Utilities Manual) and SSPWC Section 500-2.4.
- B. The CONTRACTOR shall furnish all traffic control, labor, materials, tools, and equipment necessary to complete all work in accordance with these Contract Documents and at the direction of the AGENCY.

#### 1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 – Record Drawings and Submittals
- B. Section 02960 – Temporary Bypass Pumping
- C. Section 03740 – Concrete Rehabilitation
- D. Section 09800 – Painting and Coating
- E. City of Oceanside Water, Wastewater, and Recycled Water Design and Construction Manual (Oceanside Water Utilities Manual)

#### 1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with the requirements set forth in the standard specifications.
- B. The CONTRACTOR shall submit copies of manufacturer's technical data and installation instructions for protective coating system required.
- C. The Contractor shall submit copies of manufacturer's written instructions for recommended maintenance practices. Include the following information:
  - 1. Product name and number.
  - 2. Name, address and telephone number of manufacturer and local distributor.
  - 3. Detailed procedures for routine maintenance and cleaning.
  - 4. Detailed procedures for repairs.

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### **1.4 QUALITY ASSURANCE**

- A. Packaging: The CONTRACTOR shall store all products to be used in their original packaging. The packaging shall indicate the manufacturer and product contained.
- B. All products to be used in the work covered by this section of the specifications shall be delivered, stored, and handled in accordance with the product manufacturer's written recommendations.
- C. Manufacturer and applicator both shall demonstrate a minimum of five (5) years of experience and five (5) successfully completed projects of similar magnitude and nature as this project. Experience and project references shall include project name, project number where applicable, agency or AGENCY, contact name, phone number, and project description. All Applicators shall be certified or licensed by the protective coating materials manufacturer.
- D. Provide each component of protective coating produced by a single manufacturer, including recommended underlayment and resurfacing compound, filler compounds and corrosion resistant lining.
- E. Upon completion of the Work under this Section, submit a statement to Engineer, signed by Contractor and the protective Coating Applicator stating that the installed protective coating complies with the requirements of the Specifications, and that the installation and materials comply with the manufacturer's printed recommendations related to the condition of installation and use.

### **1.5 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Deliver material in manufacturer's original unopened and undamaged packages. Clearly identify manufacturer, brand name, manufactured date or lot number on each package. Packages showing indications of damage that may affect condition of contents are not acceptable.
- B. Store materials in original packaging under protective cover and protect from damage. Stack and store all containers including fillers at temperatures recommended by the manufacturer.
- C. Handle materials in such a manner as to prevent damage to products or finishes.

### **1.6 JOB CONDITIONS**

- A. Maintain proper substrate and air temperature before, during and after installation as required by Manufacturer and detailed in Manufacturer's technical data sheets and installation instructions or in writing from the Manufacturer. Provide adequate ventilation during application and curing periods.

## **PART 2 - PRODUCTS**

### **2.1 MANHOLE PROTECTIVE LINING**

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- A. Mortar repair materials used for existing manholes to be rehabilitated shall be in accordance with the standard specifications.

### 2.2 MANUFACTURER

- A. The lining material shall be a two-component, 100% solid, non-solvent hybrid polyurethane coating, with a shore "D" hardness of 57 at 77 degree Fahrenheit, such as Sancon 100 as manufactured by Sancon Engineering, Huntington Beach, California.
- B. The lining material shall be a two-component, 100% solid, non-solvent hybrid polyurethane coating, with a shore "D" hardness of 57 at 77 degree Fahrenheit, such as Zebron #386 as manufactured by Zebron Corporation, Newport Beach, California.
- C. Sauereissen SewerGard No.210X lining material shall be manufactured by Sauereissen, Pittsburg, PA (412) 963-0303.

### 2.3 MATERIAL

- A. Sancon 100 and Zebron #386 material shall be the high-build type capable of application thickness, as specified, without runs or sags, and shall be capable of passing ASTM D-1737 for flexibility, using cylinder mandrel of 0.5 inch (12.7 millimeter). The flash point of the fluid mixture shall be 450 degrees Fahrenheit open Zahn cup.

1. The coating material shall meet the following resistive specifications:

<u>Solution</u>	<u>Concentration</u>
Acetic Acid	5%
Sulfuric Acid	20%
Sodium Hydroxide	5%
Ammonium Hydroxide	5%
Nitric Acid	1%
Ferric Acid	1%
Soap	0.1%
Detergent (Limear Alkyl Benzyl Sulfonite or LAS)	0.1%
Bacteriological	BOD not less than 700 PPM
Petroleum Oils and Greases	N/A
Vegetable and Animal Oils	N/A

\* Volumetric percentages of concentrated C.P. grade reagents.

The color shall be white or cream. The complete coating shall be impermeable to sewer gases and liquids and nonconductive to bacterial or fungus, growth. The lining shall be capable of repair at any time during its life.

2. The limits of the newly installed manhole protective lining shall be from 3-inches below the flow line to the base of the manhole frame and cover. The CONTRACTOR shall install a temporary flow through sewer plug or

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another temporary flow bypass system deemed adequate by the CONTRACTOR and as needed to allow the proper installation and curing of the repair mortar, primer, and protective lining.

3. Prior to application of the lining, all surfaces shall receive a one (1) to three (3) mil thickness 100% solids non-solvent, moisture tolerant epoxy primer as manufactured by Sancon Engineering, Inc., Huntington Beach, CA or Zebron Corporation, Newport Beach, CA. Lining must have passed chemical resistance test of the SSPWC.
- B. Sauereissen SewerGard No. 210X.
1. SewerGard No. 210X shall be a complete system for substrate repair, water infiltration prevention and epoxy based corrosion protection including:
    - a. Cementitious resurfacing/ underlayment compound is required, and shall be installed to fill surface irregularities and large voids in the prepared concrete substrate; minimum application thickness 1/8".
    - b. Epoxy filler compound to fill all voids and bug holes in NEW concrete to provide a properly prepared and uniform surface for the epoxy lining.
    - c. 100% solids epoxy, moisture tolerant, polymer lining designed specifically for municipal wastewater exposure at a thickness of 125 mils.
    - d. The applicator shall supply all accessory components such as sealers, infiltration control products or other compounds or products as recommended by the protective lining manufacturer for maximum protective lining adherence to substrate and long-term service performance.
  2. Types of protective lining system components for the corrosion protection work required, including surface treatment of prepared surfaces prior to coating application, shall include, but are not necessarily limited to trowel or gun applied, fast setting, high-early strength cementitious resurfacing/underlayment compounds, epoxy formulation filler compound for new construction application, corrosion-resistant, moisture tolerant, 100% solids epoxy, spray or trowel applied, monolithic protective lining and miscellaneous materials.
    - a. Underlayment Resurfacing Compound: Cementitious resurfacing products shall be used for surface leveling, large bug holes, and for general concrete patching and shall be installed and cured according to Manufacturer's written guidelines as outlined in product technical data sheets. All voids must be completely filled and existing substrate covered in its entirety so that the finish of underlayment resurfacing compound should be uniform in

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appearance. Apply a “broom” finish to resurfacing compound at time of installation to create adhesion profile.

Properties: Sauereisen No. F-121 Trowel Grade

Application Time:	
Working Time at 70F	30 minutes
Initial Set at 70F	3 hours
Color	Tan
Compressive Strength:	
@24 hours	3500 psi
@5 hours	2500 psi
@28 hours	6000 psi
Density:	
Mix Ratio (Powder to Water, by Weight)	9:1
Abrasion Resistance (ASTM C-704) Volume Loss, cm <sup>3</sup>	5.14 cm <sup>3</sup>
Volume Loss, %	0.65%
Freeze-thaw Durability Factor (ASTM C666-A)	87.2

Underlayment shall be a fast-setting, high early strength, Portland/Calcium Aluminate-based resurfacing material. Underlayment shall be trowelable formulation, except where Applicator recommends alternate use of sprayable, castable or gunite formulations by the same manufacturer for intended service application. Underlayment Resurfacing Compound shall to be applied to the entirety of the interior surface to fill all irregularities to provide uniform surface for the application of the epoxy corrosion resistant lining system. The underlayment may be substituted with the Epoxy Filler Compound or High Build Epoxy Filler Compound based upon contractor recommendation and site conditions at time of installation.

- b. Epoxy Filler Compound: Epoxy filler, where required, shall be used for filling small bug holes, static cracks and joints, and for general concrete patching, in NEW concrete and to provide a uniform, void free surface for epoxy lining application

Properties: Sauereisen Epoxy Filler Compound No. 209

Color	Off White
Compressive Strength	10,000 psi
Density (ASTM C-905)	87.2 pcf
Flexural Strength (ASTM C-580)	4000 psi
Modulus of Elasticity (ASTM C-580)	5.2x10 <sup>4</sup> psi
Tensile Strength (ASTM C-307)	2200 psi
Bond Strength to Concrete (ASTM D-4541)	Concrete Failure
Moisture Absorption (ASTM C-413)	<0.25%
Shrinkage (ASTM-531)	<0.2%
Working Time	15 min @ 70F

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Topcoat

3 hrs @ 70F

Filler Compound shall be an epoxy formulation specifically designed to fill voids, irregularities and air pockets in NEW concrete surfaces. The filler compound shall be applied to the interior substrate to provide a uniform surface for the application of the epoxy corrosion resistant lining system. Filler compound shall be confirmed by the Manufacturer as compatible with any underlayment materials and with the protective coating. The filler compound may be substituted with the Underlayment Resurfacing Compound based upon contractor recommendation and site conditions at time of installation.

- c. Epoxy Lining Protective Coating: Epoxy lining protective coating shall be spray applied to the entire interior surface of the sewer manhole including the walls from the manhole base up through the bottom of the manhole lid frame, and the manhole bench from the wall to the channel low flow line and cured on the properly prepared surface in accordance with Manufacturer's written guidelines as outlined in product technical data sheets. The epoxy lining should not overlap the manhole lid frame.

Properties: Sauereisen SewerGard No. 210X

Adhesion (ASTM D4541)	Concrete Failure
Application Time (ASTM C308 modified), Working Time at 70F	30 minutes
Bond Strength to Concrete (ASTM D7234)	Concrete Failure
Bond Strength by Slant Shear (ASTM C882- Modified)	700psi (49.2kg/cm <sup>2</sup> )
Compressive Strength (ASTM D695)	15,500psi (1089.7kg/cm <sup>2</sup> )
Components	2 parts
Elongation (ASTM D638)	12.9%
Flexural Strength (ASTM D700) @28 days	8000psi (562.4kg/cm <sup>2</sup> )
Maximum Service Temperature (Dry)	150F (65C)
Mix Ratio (By Volume)	1 part A (Harder): 3 Parts B (Resin)
Modulus of Elasticity (ASTM D700)	5.1 x 10 <sup>4</sup> psi
Permeability (ASTM D790)	1.32 x 10 <sup>-10</sup>
Shore D (ASTM D638)	95
Tensile Strength @7 days (ASTM D638)	4300psi (302.3kg/cm <sup>2</sup> )
Recommended Thickness	100-125 mils

Epoxy lining shall be a self priming (to concrete), 100% solids, spray-applied epoxy polymer protective coating material specifically designed to protect concrete surfaces in wastewater structures

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subjected to municipal wastewater service conditions, including associated abrasive physical attack and chemical attack mechanisms related to hydrogen sulfide and organic acids generated by microbial sources. (Note: an alternate trowel applied formulation of the identical resin and hardener system with different fillers may be applied at the specified thickness when approved in writing by the Manufacturer.)

### **PART 3 - EXECUTION**

#### **3.1 SURFACE PREPARATION**

- A. Surface preparation shall be performed in accordance with the standard specifications.
- B. Contractor shall remove existing linings in their entirety prior to performing concrete rehabilitation and new lining application.
- C. New and existing concrete structures to receive protective coating system must be capable of withstanding imposed loads. All oil, grease and chemical contaminants must be removed from the surface. Surfaces must be firm, free of standing water, form release agents and existing coating. Suitable surface preparation methods include abrasive blasting, hydro blasting, mechanical scrapping and hand tool grinding to remove surface contaminants.

#### **3.2 WATER TIGHTNESS**

- A. The end cuts of the liner inside the manhole shall be fully sealed to prevent water entering into the space between the host pipe and the liner.

#### **3.3 LINING APPLICATION**

- A. The lining application shall be performed only by workers approved by the manufacturer as trained and experienced with the specified material. The lining shall be applied by high pressure airless equipment approved by the lining manufacturer. The equipment shall be in good working order to insure correct proportioning and mixing of the components.
- B. Protective coating systems shall be installed when ambient air and surface temperature is between 50F and 90F. Store material within a range of 60F to 85F range for 48 hours prior to use. Application and storage temperatures outside of this range will require written instruction from the Manufacturer.
- C. Application in direct sunlight and/or with rising surface temperatures will result in blistering of the materials due to expansion of entrapped air or moisture (out-gassing) in the concrete. In such cases, it will be necessary to postpone the application until later in the day when the temperature of the substrate is falling. Concrete surfaces that have been in direct sunlight must be shaded for at least 24

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hours prior to application and remain shaded until the initial set has taken place. Consult Manufacturer for application schedule guidelines specific to temperature conditions and possible sealer application recommendations to reduce out-gassing.

- D. The lining shall be applied to a thickness of 125 mils (1/8-inch) in one continuous coat without seams, free from any holes or defects. The lining shall be installed from three (3) inches below the low-flow water level to the base of ring and cover. The lining shall be installed over dry concrete below the water level by using appropriate by-pass equipment. Coating in trough shall not be thicker than 125 mils to ensure smooth taper from trough to shelf. A mandrel shall be inserted into upstream and downstream pipe to insure the accessibility.
- E. During lining application, the CONTRACTOR shall take wet gauge thickness readings as required to insure correct lining thickness.
- F. Installed epoxy lining protective coating and shall be tested for pinholes after a minimum 24-hour cure at a temperature of 70F. Pinhole testing shall be accomplished in accordance with ASTM D4787 using a Tinker Razor Holiday Detector, San Gabriel, CA, Model AP/W, or an approved equal device. Test voltage of 100 volts/mil of coating thickness shall be applied. All pinholes shall be marked and repaired using manufacturer's approved Patch Kit, or other approved method.
- G. Adhesion testing shall be performed on a minimum of 1 structure or 15 percent of all coated structures, whichever is greater. Adhesion testing shall be conducted after a minimum 24-hour cure of the Epoxy Lining Protective Coating at 70F. A minimum of two measurement of bond strength of the protective coating to the substrate shall be made. Bond strength shall be measured in accordance with ASTM D7234-05. Prior to the pull test, the tester shall utilize a scoring device to cut through the coating until the substrate is reached. The pull tests in each structure shall meet or exceed 200 psi and shall include substrate adhered to the back of the dolly or no visual signs of coating material in the test hole. Any areas detected to have less than 200 psi bond strength to concrete shall be removed and/or repaired by the CONTRACTOR in accordance with the manufacturer's recommendations. All costs shall be borne by the CONTRACTOR.
- H. The uniform lining shall be free from porosity, without bubbles or pinholes and uniform in color. All areas in question shall be removed and reworked and patched.
- I. Before accepting the finished product, testing with a holiday or porosity detector shall be made by the CONTRACTOR, and any pinholes found shall be patched.
- J. Application of the lining shall not take place when exposed to rain, fog or high winds. It is the CONTRACTOR's responsibility to insure protection of the work from the above mentioned conditions.

### 3.4 ADJUSTMENTS AND CLEANING



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- A. At the completion of the Work, CONTRACTOR shall remove all materials and debris associated with the Work of this Section.
- B. Clean all surfaces not designated to receive protective coating. Restore all other work in a manner acceptable to ENGINEER.
- C. All finished protective coating shall be protected from damage until Final Acceptance of the Work. Protective coating damaged in any manner shall be repaired or replaced at the discretion of Inspector. All costs shall be borne by the CONTRACTOR.
- D. Clean all protective coating as recommended by the manufacturer to provide finished Work acceptable to AGENCY, just prior to Final Acceptance.

### **3.5 TEMPORARY FLOW THROUGH PLUG OR BYPASS SYSTEM**

- A. The CONTRACTOR shall provide, install, maintain, and remove all temporary flow bypassing equipment and materials needed to complete the manhole rehabilitation work in accordance with the Contract Documents and the standard specifications. The CONTRACTOR shall be responsible for selection of all means and methods to bypass flows as necessary to perform the work. The CONTRACTOR shall also install a temporary rack at the manhole directly downstream of the manhole that the temporary bypass equipment is being used to prohibit the passage of any loose or unanchored equipment from entering the downstream sewer system.
- B. The CONTRACTOR shall submit a plan to the AGENCY for approval before beginning work describing the flow bypassing equipment to be used, how it is to be installed, maintained, and removed, including any precautionary measures. Submittal shall show how the CONTRACTOR will monitor and prevent the obstruction of flow in the flow bypass equipment and shall also include the equipment and procedures that will be used to prohibit the passage of any loose or unanchored equipment from entering the sewer system. All products, equipment, and materials used to complete the Work shall be able to withstand the active sewer conditions and shall be able to handle flows specified in the Contract Drawings.

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