

Process Specification

Structural Rehabilitation & Corrosion Protection for Circular Structures in Wastewater Collection Systems

SECTION 1: GENERAL

1.01 DESCRIPTION

This specification includes all work, materials and equipment required for the structural rehabilitation of circular structures. The purpose is to eliminate infiltration, repair voids, restore structural integrity and provide corrosion protection by the application of a spray-applied monolithic resin liner to the wall and bench surfaces of brick/concrete structures or structures produced with any other masonry construction material. These structures include, but are not limited to manholes, wet wells, lift stations and pump stations.

1.02 QUALITY ASSURANCE

- A. Furnish materials of quality required by the American Society for Testing and Materials (ASTM) standards or other approved standards and specifications.
- B. Provide guarantee against defective materials and workmanship in accordance with the requirements of these specifications.
- C. The contractor installing the finished protective liner will be a certified trained applicator of the specified process.
- D. Provide verifiable independent third party creep test results documenting no less than 70% retention of flexural modulus of elasticity after 50 years of service. The third party testing firm may not be affiliated with the manufacturer in any way.

1.03 REFERENCES

American Society for Testing and Materials (ASTM) Annual Book of Standards:

- A. ASTM D638-91: Test Method for Tensile Properties of Plastics.
- B. ASTM D790-91: Test Methods for Flexural Properties of Unreinforced and reinforced Plastics and Electrical Insulating Materials.

1.04 PROJECT/SITE CONDITIONS

Co-ordinate with the Construction Manager for traffic control during rehabilitation work at each designated location.

1.05 SEQUENCING

All required interruptions of flow through manholes, wet wells, pump stations or any other portion of the plant sanitary sewer system shall be coordinated with and approval received from the Facility Manager or Construction Manager prior to the interruption.

SECTION 2: PRODUCTS

2.01 MATERIALS

I. Infiltration Control mix:

A. Minor Infiltration.

1. Cementitious Grout (De Neef Industrial Products)

A rapid-setting cementitious grout or chemical grout specifically formulated for leak control should be used to stop minor water infiltration. It should be mixed and applied according to the manufacturer's recommendations and should meet the following minimum requirements.

Compressive strength	ASTM C 109	1,800 psi @ ½ hr 4,000 psi @ 24 hrs 5,000 psi @ 7 days
Tensile strength	ASTM C 190	300 psi @ 7 days 350 psi @ 28 days

B. Very Active Infiltration

1. Chemical Grout (De Neef Industrial Chemicals)

a. A chemical grout must be used for stopping very active infiltration, filling voids and should be mixed and applied according to manufacturer's recommendations. The cementitious grout should be volume stable having a minimum 1 day compressive strength of 50 psi and a 28 day compressive strength of 250 psi.

b. Chemical grouts can be used for stopping very active infiltration and should be mixed and applied per manufacturer's recommendations.

II. Patching and profiling mix:

A. Cementitious Compound (Strong Seal or equivalent product)

A quick setting cementitious material can be used to bring the substrate to profile by filling voids, cracks, missing mortar and other substrate defects. It should be mixed and applied according to the manufacturer's recommendations and should meet the following minimum requirements.

Compressive strength	ASTM C 109	1000 psi @ 1 hr 3500 psi @ 48 hrs 5000 psi @ 28 days
Tensile strength	ASTM C 307	200 psi @ 24 hrs 300 psi @ 7 days

III. Resin Based Liner:

- A. The resin based material shall be used to form the sprayed on/structural enhanced monolithic liner covering all interior surfaces of the structure including benches and inverts of manholes. The finished liner shall be SprayWall® as manufactured by Sprayroq, Inc. or approved equal and conform to the minimum physical requirements listed below.

Compressive strength	ASTM D 695	10,500 psi
Tensile strength	ASTM D 638	7,000 psi
Flexural strength	ASTM D 790	12,000 psi
Bond		Shall exceed tensile strength of substrate
Flexural modulus (initial)	ASTM D 790	735,000 psi
Density		87 ± pcf

- a. The finished structure shall be corrosion resistant to: Hydrogen Sulfide; 20% Sulfuric Acid; 17% Nitric Acid; 5% Sodium Hydroxide as well as other common ingredients of the sanitary sewage environment.
- b. The wall of the resin based liner will be structurally designed to withstand the hydraulic load generated by the groundwater table & restore structural integrity. The long term (50 yr.) value of the flexural modulus of elasticity will be a minimum of 500,000 psi and is an integral part of the engineering equation used to design the wall thickness of the structural liner.

For this reason the value of the long term flexural modulus of the proposed product will be certified by an independent, third party testing lab and submitted with the design calculations for each individual structure.

Definition- Long term value will be identified as initial flexural modulus less the reduction in value caused by Creep over a fifty (50) year minimum period and verified by DMA testing.

- B. Other Materials: Because of the advantages associated with rapid cure and infinite thickness capabilities, no resin based materials other than polyurethane shall be used to achieve the structural enhancement without prior approval of the Construction Manager.

SECTION 3: EXECUTION

3.01 INSPECTION

- A. Evaluation of Atmosphere: Prior to entering structures, an evaluation of the atmosphere will be conducted to determine the presence of toxic, flammable vapors or possible lack of oxygen. The evaluation shall be in accordance with local, state or federal safety regulations.

3.02 PREPARATION

- A. Place covers over all pipe openings to prevent extraneous material from entering the sewer system. All foreign material shall be removed from the structures' wall and bench/floor using a pressure water spray (minimum 2500 psi). The use of acid for cleaning purposes,

no matter how dilute, will not be allowed. Loose or protruding brick, mortar and concrete shall be removed by using a mason's hammer and chisel. Fill any large voids with quick setting patch mix as described in Paragraph (2.01 IIA). The surface to be repaired must be clean and free of any loose materials.

- B. Minor leaks shall be stopped using the quick-setting specially formulated infiltration control mix (paragraph 2.01 IA) and shall be mixed and applied per manufacturer's recommendations. When severe infiltration is present, drilling may be required in order to pressure grout outside the structure using either a cementitious or chemical grout (paragraph 2.01 IB). Manufacturer's recommendations shall be followed when pressure grouting is required.

3.03 INSTALLATION/APPLICATION

- A. Application Temperatures: Application of liner shall not be made unless the ambient temperature inside the structure is 50 degrees or higher.
- B. Bench/Invert Repair:
 - 1. The manhole bench must be sprayed but depending on availability and future plans, some judgment consideration will have to be made regarding the invert. Important issue here is the necessity to insure a monolithic system is achieved.
 - 2. After blocking flow through the structure and thorough cleaning/preparatory work has been achieved. The sprayed on resin-based liner shall be applied to the invert, bench and wall areas in the same manner as specified for the liner application below. The spray shall be applied such that the entire structure receives a structurally enhanced monolithic liner.
 - 3. The finished invert surfaces shall be smooth, free of ridges and will be sloped in the direction of flow. Special care shall be used to insure a smooth transition between the new manhole invert and intersecting pipeline inverts such that flow will not be impaired.
- C. Liner Application: The resin based liner shall be manually sprayed on to all surfaces by a trained technician who is experienced in the application of a spray applied resin and has been certified by the manufacturer. Appropriate personal protection equipment shall be utilized but in every case when applying the liner, the sprayer and personnel in direct contact with the spray atmosphere, will always be protected by supplied air.

The minimum thickness of the material applied is to be no less than 250 mils (1/4") in order to support structural integrity. No other products such as cement or grouts may be used as part of the structural reinstatement, however, said products may be used as part of the repair process prior to sprayed application of the structure as specified in 2.01 IIA.

Application of the spray applied material must be completed in one (1) mobilization in order to minimize the disruption and cost of excessive bypassing, pipeline plugging, traffic control and all other support services.

The finished manhole must be returned to full service immediately after the spray application is complete.

- D. Curing: The structure should be allowed to cure for 24 hours and return to ambient temperature prior to any physical testing, including vacuum testing.

3.04 FIELD QUALITY CONTROL

- A. The following test/inspection will be performed by the Construction Manager.
 - 1. Visually verify the absence of leaks from infiltration.
- B. The following tests shall be performed by the Contractor.
 - 1. Vacuum Test: A vacuum test conforming to the requirements of ASTM C1244 shall be performed for every lined manhole or circular structure where practical.