

**TECHNICAL SPECIFICATION  
FOR  
CURED-IN-PLACE MANHOLE REHABILITATION LINER SYSTEM**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

Furnish all materials, labor, equipment, tools and required incidentals for providing and installing a resin impregnated custom fabricated liner by means of air inflation into an existing manhole, wet well, pump station, or catch basin. The liner is installed from the top of the casting to the top of the channel which includes; shim rings, casting chimney interface, chimney, cone, wall and bench. The channel can be included as directed by the owner. When cured, the liner will provide a durable monolithic chemical resistant barrier that will protect the existing substrate from further deterioration. The finished liner will also stop any water from either entering or exiting from the lined surfaces of the original substrate.

**1.02 REFERENCE STANDARDS**

American Society for the Testing of Materials (ASTM):  
F2414 – Standard Practice for Sealing Sewer Manholes Using Chemical Grouting.  
D790 – Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

**1.03 SUBMITTALS**

Furnish the following to the owner when required;

- A. Detailed installation procedures, including substrate preparation, liner wet out, resin mixing, liner insertion, curing, cut-out, and edge sealing.
- B. Shop Drawing showing structure configuration, diameter, and length.
- C. Resin information including, Technical Data Sheets (TDS), Safety Data Sheets (SDS), and published physical properties.
- D. Liner information including, TDS, SDS, and composition of the respective layers.
- E. Certified independent laboratory tests on the proposed resin impregnated Liner showing values for Flexural Modulus of Elasticity, Flexural Strength, Tensile Strength, and Adhesion Testing.
- F. PH of the original substrate shall be taken. Third Party Chemical Resistance test results shall be submitted showing acceptable results of the Liner's ability withstand the determined PH. For lined channels testing must be in accordance with ASTM F1216 Appendix X2.1.

- G. Stamped design for wall thickness. See Section 1.05.
- H. A warranty certificate provided by the installer for material and labor.

**1.04 QUALIFICATIONS**

A qualified bidder shall be a Certified Installer of the Liner System Manufacturer and shall have a minimum of two years experience installing the Liner System. If Certified Installer does not have a minimum of two years experience then a representative of the Liner System Manufacturer that has two years experience shall be onsite during liner installations.

**1.05 DESIGN**

- A. In order to maintain its water tightness the Liner shall be bonded to the original substrate in a way that does not allow water to find a pathway behind the Liner and enter into the waste stream. For the areas that are bonded the bond strength must be greater than the hydrostatic pressure. For areas that are not bonded a maximum radius of unbonded area and maximum distance (height) the Liner can be pushed off the substrate shall be established. It is recommend that the maximum radius of any one unbonded area be 6 inches and the maximum height be 1 inch. Therefore the minimum thickness can be determined by the following Roark's Formula for Stress and Strain 7<sup>th</sup> Edition Table 11.2, 10b ;

$$h = 464$$

Where;

- $h_{max}$  = Maximum lift of unbonded area (in.)
- $p$  = Hydrostatic Pressure (psi)
- $r_u$  = Radius of the largest unbonded area (in.)
- $D = Et^3(12(1-\nu^2))$  Bending Stiffness of Liner

Where;

- $E$  = Modulus of Elasticity (psi)
- $t$  = Minimum Liner thickness (in.)
- $\nu$  = Poisson's Ratio of the Liner

Rearranging the formula and substituting the recommended values for  $r_u$  and  $h_{max}$  and calculating for minimum thickness;

$$t = 243 \sqrt[3]{1 + \frac{h}{6}}$$

- B. In order to prevent cracking in the chimney portion of the Liner in geographical areas of freeze thaw and/or areas of traffic loading, at least one layer of 24oz per square yard woven roving fiberglass shall be incorporated into the chimney portion of the Liner. The fiberglass shall extend 4 inches below the last joint of the chimney.

**PART 2 MATERIALS**

## **2.01 LINER**

- A. The Liner shall be composed in one of the following two configurations;
  - 1 Single Layer - Non-Porous Membrane
    - a. Non-Porous Membrane is to be a gas and liquid impermeable membrane of special non-porous materials with felt mechanically embedded on both sides. Membrane is to be custom fabricated to fit to the inside dimensions of each structure.
  - 2 Multiple Layers - Non-Porous Membrane and fiberglass.
    - a. Non-Porous Membrane is to be a gas and liquid impermeable membrane of special non-porous materials with felt mechanically embedded on both sides. Membrane is to be custom fabricated to fit to the inside dimensions of each structure.
    - b. Fiberglass shall be a coated woven roving style to allow for resin adherence. The weight of the fiberglass and amount of layers required shall be based on the manufactured published data and the stamped design for minimum wall thickness.

## **2.02 RESIN SYSTEM**

- A. Resin shall be 100% solids epoxy formulated to withstand a typical domestic wastewater sewer system including high sulfide areas near force mains and wet wells. The resin must be compatible with both the non-porous membrane and the fiberglass. The resin must have a minimum of 250psi bond strength to wet or dry brick and concrete surfaces.

## **PART 3 EXECUTION**

### **3.01 PREPARATORY PROCEDURES**

- A. PH of the original substrate shall be determined.
- B. Contractor will perform preliminary cleaning of the structure with high-pressure water-blasting at a minimum of 4000psi and 4gpm to obtain the desired concrete surface profile (CSP) of 3 or greater.
- C. If the desired CSP is not achieved by high-pressure water-blasting other methods of obtaining the surface profile such as abrasive blasting and acid etching shall be used.
- D. The Contractor shall remove all the existing manhole steps. The metal portion of all steps will be removed to within 1/2" of the manhole interior wall surface. The remaining protruding metal portion of the step shall be

covered with a cementitious material to provide a smooth surface on and around the protrusion for the liner to bond.

- E. All open joints, voids, holes, cracks, and missing bricks larger than 3 inches in diameter or equivalent shall be patched with a cementitious material to provide a smooth surface for the liner to bond. All loose, cracked or disintegrated material shall be removed from the area to be patched exposing a sound substrate. The cementitious patch material shall be allowed to cure according to the manufacturer's specifications before continuing with the Liner installation process.
- F. Bench shall be sloped so that water will flow back into channel.
- G. All active water leakage shall be stopped for a minimum of 30 minutes prior to installation to allow time to insert and pressurize the Liner. This prevents resin washout and allows proper curing and bonding. Leaks may be stopped with fast setting cement or chemical grout injection.
- H. When the channel is required to be lined the Contractor shall plug the inlet pipe, inspect for infiltration leaks around the inlet and outlet pipes and in the channel. All leaks present shall be stopped by the use of chemical grout injection and/or by the use of fast-setting cement.
- I. Contractor shall remove any incoming pipes to within 2 inches of the wall. The pipe outside circumference shall be cemented with an approximate 60° taper, forming a filet between the structure wall and the pipe making a smooth transition for the liner to bond.
- J. The final prepared surface shall have a concrete surface profile of 3 or greater and have a smooth uniform appearance.
- K. After the above-mentioned procedures the surface shall be cleaned with degreaser or other solvents, as needed, in order to remove any film, grease, loose patching material, chemical grout or residue on the surface. Structure shall then be pressure rinsed with water.

### **3.02 GENERAL INSTALLATION PROCESS**

- A. Contractor shall verify that the liner intended for the structure matches the dimensions of the structure by measuring the dimensions of the structure and the liner prior to installation.
- B. All resin intended for the liner shall be mixed properly.
- C. Contractor shall apply mixed resin evenly onto both the inside and outside of the entire liner with rollers. There shall be no white spots (dry Liner) on either sides of the Liner including seams and bottom disk(s). Areas of heavily saturated resin shall be spread out to cover areas that are deficient of resin.

- D. Liner can be installed to include or omit the structure channel depending upon the intention of the owner.
- E. For Liner installation that does not include the channel, a temporary subfloor shall be constructed to keep liner from inflating into the channel and to allow the sewer to flow unobstructed without bypass pumping. A saturated bottom disk or disks are installed onto the subfloor, bench, and up the wall about 6 inches.
- F. For channel lining the incoming and outgoing pipes are plugged. This may require bypass pumping. Two or more bottom disks are placed into the channel, onto the bench, and 6 inches up the wall.
- G. Resin saturated Liner is lowered into the structure and positioned properly to line up any offsets.
- H. Liner is pressurized with air or water to a minimum of 3psi. Contractor shall verify proper position of the liner from the inspection portal located on the installation canister. If Liner is not positioned properly the Liner can be raised, lowered or rotated to desired position. In some cases it may be necessary to enter the structure to hand position portions of the liner.
- I. The liner is cured with steam, hot water, or ambiently. Cure times vary according to, cure method, Liner thickness, structure size, ambient temperatures, and resin formulation. Typically, curing takes about an hour with steam. Contractor may use the exposed portion of the Liner above the frame as an indicator. When steam is used a cool down period is needed equaling about 25% of cure time.
- J. Liner shall be cut and trimmed to allow for all incoming and outgoing pipe to flow without obstruction. If channel is unlined the subfloor shall be removed.
- K. All cut edges shall be sealed with an epoxy mastic material that is compatible with the Liner System.

### **3.03 FINISHED LINER**

- A. The finished CIP Liner System shall be continuous over the entire length of the structure from the cover seat to the top of the channel, or shall include the channel as required. The Liner shall be smooth with minimal wrinkling.
- B. Liner shall be bonded to the structure, as required by design, and in such a way as to not allow any water to flow behind the liner and enter back into the waste stream.

### **3.05 QUALITY ASSURANCE TESTING**

- A. The contractor shall visually inspect the Liner from inside the structure and report to the Owner any defects that may affect performance of the liner. All defects shall be fixed to conform with these specifications.
- C. The Contractor shall spark test the entire Liner in accordance with the spark testing equipment specifications. All defects must be repaired using an epoxy mastic that is compatible to the Liner system.
- D. Adhesion Testing shall be performed on the first manhole of a project in two locations; a location on the wall within 6 inches from the bench and a location on the bench. Projects over 30 manholes shall require an additional manhole to be tested.

### **3.06 CLEANUP**

Clean up the entire project area after the work is completed and all testing accepted. Remove and dispose of all excess material and debris not incorporated into the permanent installation.

### **3.07 MAINTENANCE**

Any defects shall be repaired in accordance with the manufacturers' recommendations on an as needed basis.

### **3.08 WARRANTY**

Manufacturer and Installer of the Liner system shall provide a 10 year warranty on materials and labor.

**END OF SECTION**