



# INSTALLATION PRACTICE

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## REHABILITATION OF MANHOLE CHIMNEY'S USING A STRETCHABLE CURED-IN-PLACE LINER

INSTALLED UNDER PRESSURE AND CURED UNDER AMBIENT CONDITIONS

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## **Installation Practice for Rehabilitation of Manhole Using A Stretchable Cured-In-Place Liner**

### Installed Under Pressure And Cured Under Ambient Conditions

#### 1. Significance and Use

This specification is for the use by designers, engineers who specify, regulatory agencies, owners and inspection organizations who are involved in the rehabilitation of manholes through the use of a resin-impregnated stretchable liner. As for any specification, modifications may be required for specific job conditions.

#### 2. Intent

This specification covers requirements and test methods for the rehabilitation of manholes without excavation. The manhole is accessed through the existing manhole cover. The rehabilitation is accomplished by the installation of a one-piece resin impregnated stretchable liner that is cured under pressure. The liner is pressed against the existing manhole by a pressurized bladder until the thermo-set resins have cured ambiently. The liner shall start at the manhole cover seat and extend to a pre-determined length shy of the manhole bench. The cured-in-place manhole liner shall be bonded to the contours of the existing structure, significantly increase structural integrity, eliminate inflow and infiltration, and provide a surface resistant to sewer gases.

#### 3. General

The rehabilitation is accomplished using a stretchable, coated non-woven textile tube of particular length and a thermo-set resin with physical and chemical properties appropriate for the application. The liner is vacuum-impregnated (saturated) on-site with the thermo-set resin. The saturated liner is then lowered into the manhole and is temporarily held in position. The installation device is then lowered and properly positioned inside of the liner. The bladder on the installation device is then pressurized so that the liner is pressed against the existing structure. Once the resin-saturated liner is cured, the installation device is removed. The liner is then trimmed flush with the manhole cover seat.

#### 4. Material

4.1 The liner shall be continuous in length and consist of one or more layers of a stretchable absorbent textile material. The liner is designed to prevent I&I, withstand hydrostatic pressures, bridge missing mortar or brick segments, withstand freeze / thaw cycles, and conform to the contours of the existing structure. The saturated liner shall have uniform thickness and have excess resin distribution that when compressed at installation pressures will meet or exceed the design thickness after cure.



4.2 The exposed layer of the stretchable liner shall be coated with an impermeable, translucent, flexible membrane. The liner shall be marked correlating to the address or manhole identification number, and date of installation.

4.3 The liner shall be a one-piece assembly sewn in the shape of a tube at a predetermined length to seal the casting and manhole structure. The sewn seams shall be sealed using a tape compatible with the liner coating. The liner wall thickness shall be uniform throughout. The liner will be capable of conforming to offset bricks and grade rings, missing mortar gaps, and disfigured and deteriorated chimneys.

5. Resin System

The resin system shall be a corrosion resistant silicate resin and catalyst system that when properly cured within the stretchable liner, forms a tenacious bond with well prepared surfaces, withstands freeze/thaw cycles without cracking, and meets the physical properties stated herein.

Table 1 Cured-In-Place Manhole Structural Properties

Property	Test	Minimum Value
Compressive	ASTM D 695	1500psi
Bond	Peel Test	Concrete Failure
Hardness	ASTM D 2240	74
Freeze/Thaw Resistance	Simulated Freeze/Thaw	No cracking or bond failure

6. Design Considerations

6.1 The existing structure is carrying the soil and live loads.

6.2 The liner will only be subjected to hydrostatic pressure; therefore the pressure exerted on the liner will be uniform around the structure, placing the liner in compression.

Therefore, the minimum liner thickness ( $t_{min}$ ) shall be based on the following formula;

$$t_{min} = \frac{(.036\text{lbs/in}^3 * H * D * FS)}{2(C)}$$

H = Height of liner in inches

D = Diameter of liner in inches

FS = Factor of safety (2 is suggested)

C = Compressive strength of liner in psi

0.036lbs/in<sup>3</sup> unit weight of water

7. Installation Recommendations

7.1 Safety – All precautions for safety will meet or exceed OSHA regulations. Areas of concern are traffic, PPE, confined space (if necessary), and small tool safety. MSDS sheets for the resin and first aid kit shall be kept on site.



- 7.2 Preparation – All surfaces to be lined must be stringently pressure washed with a minimum of 5000 psi @ 5 gal/min pressure washers. Other alternatives to clean the structure may be used along with pressure washing such as abrasive blasting. The existing casting shall be cleaned using a grinder or by sand blasting. Large voids and missing bricks shall be filled with hydraulic cement to provide an area that liner can press up against. Smaller voids and missing mortar may go un-patched, since these areas will be filled with excess resin. Steps that are located in the area to be lined shall be removed.
- 7.3 Vacuum Impregnation – The liner shall be vacuum-impregnated (saturated) on-site under controlled conditions. The resins shall be measured onsite to provide 5% to 7% excess resin for migration. The volume of resin used shall be sufficient to fill all voids in the liner material at nominal thickness and diameter. No dry or unsaturated areas in the liner shall be acceptable upon visual inspection.
- 7.4 Installation Device – Once liner is placed in the manhole the installation device is inserted inside the liner. Spacing rings on top of the manhole allow the installation device to rest at the correct depth. Once inserted, the installation device bladder is pressurized. The installation device stays in place and pressurized until the liner is cured.
- 7.5 Curing – The liner is cured at ambient temperatures as it is pressed firmly against the structure. The curing time must take into consideration the resin system, ground conditions and weather conditions. Typically, two hours is needed to cure the liner. A curing log shall be used to document the cure time, pressure, resin usage, and other pertinent information.
- 7.6 Trimming – Once cured, the installation device is removed and the liner is trimmed at the manhole cover seat.

#### 8. Completed Liner

The finished cured-in-place manhole liner shall be continuous from the manhole cover seat to a predetermined measurement shy of the manhole bench. The liner shall provide a smooth surface that conforms to the existing structure. The liner shall be free of dry spots and delamination. The finished product must provide an air and watertight corrosion resistant liner protecting the manhole.

#### 9. Recommended Inspection and Testing Practices

- 9.1 It is recommended that the liner be subjected to several freeze/thaw cycles either in the field or simulated in a freezer with no cracking or bond breakage.
- 9.2 The liner shall be visually inspected to insure bonding, resin saturation, complete cure, and a smooth surface free from cracks or significant hollow spots.

#### 10. Payment

Price includes manhole preparation, permits, and water usage. Unit prices shall be submitted for the following items:

- 10.1 Mobilization Lump Sum
- 10.2 Traffic Control Lump Sum
- 10.3 Manhole Chimney Rehabilitation per each (12" minimum)
- 10.4 Manhole Chimney Rehabilitation additional footage (.25 foot increments)