



## Why choose the AltLiner™ CIPM™ liner?

*The AltLiner™ CIPM™ Liner is superior to other cured-in-place liners with respect to resistance to sulfuric acid, and the AltLiner™ can be uniquely designed to withstand specific ground water pressure by means of liner thickness.*

Briefly, this submittal addresses how we established what is important with respect to lining a manhole.

**We selected the materials that survive over the long term in a sewer environment. PVC has a proven life expectancy of over fifty years. Sizing the material thickness based on structural values and failure analyses followed.** Preservation of the initial assumptions is important to reach reliable performance. Therefore, we explain how to preserve these values in a corrosive environment. Our warranty conditions spell out the integrity of our liner both in legal and business terms.

**The AltLiner™ derives its durability from three principal sources.**

1. Structural preservation and integrity of the liner shell, which in a circular manhole develops an arch shaped free body diagram.
2. Bonding of the resin to the host structure.
3. Chemical stability in a sewer environment because of the *PVC layer that is in direct contact with the sewer gas.*

### **Designed Liner Strength**

In practice, it is reasonable to assume that the liner will not bond to all manhole surfaces because of trapped air or open joints in the host structure. However, the sum total of bonding is responsible for stopping virtually all infiltration through the lined surfaces.

Where the liner is not bonded, water pressure may build up between the liner and the host structure. This is where the liner will develop resistance to the water pressure because of its arch shape, thickness and material characteristics.

The key characteristics are:

- Compressive Strength in lbs/in<sup>2</sup>
- Modulus of elasticity lbs/in<sup>2</sup>. According to ASTM D-695, we found the values applicable to our liner.

Other values such, as tensile strength, flexural strength etc, serve no merit in defining what preserves our liner's free body diagram. For that reason we do not test for other values. We use a formula to select a necessary liner thickness at a specific diameter and hydrostatic head. The attached "*Patent002 w\_illus*" sheet shows the values and correlations.

All the above is only good if the values are stable. We know that in a sewer environment the chemical stability of structural materials are at great risk because sewer gases induce the forming of sulfuric acid. *We know from the points discussed below that in the Los Angeles County Sanitation district test-environment, epoxy does not survive. Henceforth we put the PVC in direct contact with the sewer gas. This idea also received a patent for the AltLiner™ on April 1, 2003.*

### **Custom-Made Liners**

Every liner we supply is prefabricated to the specific dimensions of a real-world structure; that is, each is “tailor-made”. Our installers travel to specific sites to measure specific structures and to note specific site conditions.

### **Heat & Pressure Curing**

A key application benefit comes from curing our liners under pressure and with heat. Each custom made liner is saturated with resin and lowered into the parent structure, and aligned using factory-applied marks. Pressure is introduced with air, which forces the resin into the crevices and pores of the host structure. Heat is introduced with steam so that the liner cures in a state of compression to the wall. Spray applied products tend to pull away from the wall the moment after application and then cures in a state of tension away from the wall. We believe a compression cure is better.

### **Skilled and Certified Installers**

Alternative Lining Technologies only certifies select installers to install our AltLiner™ CIPM™ Lining System. In total, our installers have the most cured-in- place manhole lining experience than any similar company in the country.

### **Acid Resistance**

The Los Angeles County Sanitation District’s “Redner tests” for the *Evaluations of Protective Coatings for Concrete* put perspective on the survivability of liners in their acid bath test. The difference between the AltLiner™ and like liners is unmistakable.

The 2002 Update results show clearly that the AltLiner™ (test unit C-91) preserves the epoxy and fiberglass sandwiched behind the PVC. This means the AltLiner™ had lost nothing of its original design materials; it was 100% of what it was new. PVC has a proven life expectancy in sewer environments of over 50 years.

Page 31 of the August 1998 Update describes the performance of the epoxy-coated fiberglass test unit C-73. The inner layer of fiberglass is shown not to be a dependable layer because it actually crumbles away over the long term. Once that layer is gone, the liner is virtually 50% of what it was new.

The data also describes that the impact of sulfuric acid on the epoxy resin of our test units C-85 and C-86 (listed on page 13 of the 2002 Update) matched the description of the performance of the C-73 test liner mentioned above.

For this reason, and because it is unilaterally true that PVC has better chemical stability than the epoxy tested in liners C-73, C85 and C-86 we made a significant design

change: In test liner C-91, we moved our highly functional PVC from its sandwiched position (between epoxy-coated fiberglass layers) to the *first-line-of-defense* position: directly facing the acid bath. **Its performance in the testing showed the PVC of the AltLiner™ preserved the epoxy and fiberglass components protected behind it.**

It is important not to dismiss sewer gas corrosion as less important than infiltration prevention. Imagine the effect that reduced infiltration will have on developing hydrogen sulfide gas. Absent infiltration-water, the sewage will go septic due to the higher waste concentration. The higher the acid levels, the faster you will lose the structural integrity of the epoxy / fiberglass layer that is not protected by PVC (as described above). All of the layers of our AltLiner™ CIPM™ lining system are protected by PVC; we do not manufacture or install epoxy-coated fiberglass, PVC-sandwich style liners.

*In this way, by protecting all fiberglass and epoxy with PVC, our patented AltLiner™ CIPM™ Liner outperforms other CIP liners that protect only half of their epoxy and fiberglass layers.*

#### **Non-Prorated Warranty Backed by Company History**

Alternative Lining Technologies set the standard with our 20-year non-prorated warranty and we'll be here if you ever have a problem with any of our products.

#### **Maintain Your Asset Value**

Alternative Lining Technologies's 20-year, non-prorated warranty can be a great value to a utility owner, since GASB 34 (Government Accounting Standards Board) requires municipalities to place asset values on their infrastructure. With a non-prorated warranty, the asset value remains fixed at least at the cost of rehabilitation for the entire warranty period. This also allows the rehabilitation costs to be amortized over the same period.



# ALTERNATIVE LINING TECHNOLOGIES

Concept: In a virtual round structure such as a typical manhole or pump station the following formula is developed to estimate the required liner thickness to resist the design hydrostatic pressure for a given structure radius. The installation technique permits the assumption that the free body diagram of the liner retains its shape under load. In determining the thickness of the liner, we ignore the adhesion of the liner to the substrate. In reality adhesion occurs and is responsible for the watertight seal between the liner and the structure<sup>1</sup>.

Liner Model: **CIPM™ 58**

$\bar{F}'_{PU}$  = ULTIMATE COMPRESSIVE STRENGTH OF COMPOSITE = 21,088 PSI<sup>2</sup>.

$E_P$  = ELASTICITY MODULUS OF COMPOSITE = 1,277,000 PSI.

$F'_C$  = 0.4 x  $f'_C$  = 1,200 PSI. (Match safety factor of concrete)

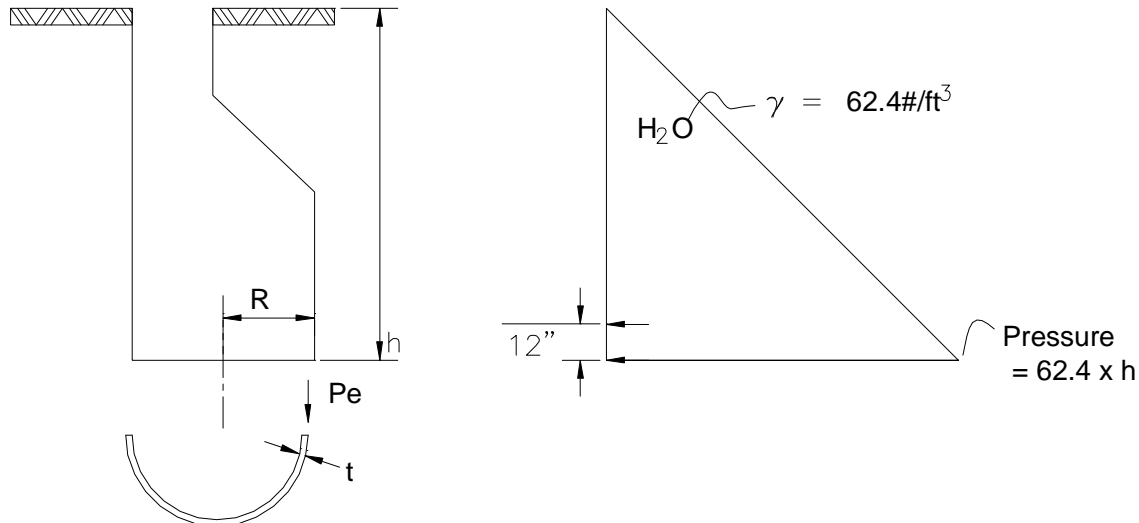
$E'_C$  = 57,000  $\sqrt{f'_C}$  = 3,122,019 PSI.

t = LINER THICKNESS IN MILS.

h = HYDROSTATIC HEAD IN FEET.

R = RADIUS OF THE STRUCTURE IN FEET.

$\gamma$  = WATER DENSITY = 62.4 # / CUBICFOOT.



Allowable stress in the composite is:

$$F'_{pu} \therefore \frac{0.4 \times F'_{pu} \times E_p}{E'_C} = \frac{R \times \gamma \times h \times 1,000}{t \times 12} \text{ this means: } t = \frac{15,600 \times E'_C \times R \times h}{F'_{pu} \times E_p}$$

For above material value the thickness of the liner in mils is:  **$t = 1.81 \times R \times h$**

<sup>1</sup> Comments from Hans de Bruijn, Sales Engineer.

<sup>2</sup> ASTM D-695



# ALTERNATIVE LINING TECHNOLOGIES

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Liner Model: **CIPM™ 106**

$\bar{F}'_{PU}$  = ULTIMATE COMPRESSIVE STRENGTH OF COMPOSITE = 24,034 PSI<sup>2</sup>.

$E_P$  = ELASTICITY MODULUS OF COMPOSITE = 1,453,000 PSI.

$F'_C$  = 0.4 x  $f'_C$  = 1,200 PSI. (Match safety factor of concrete)

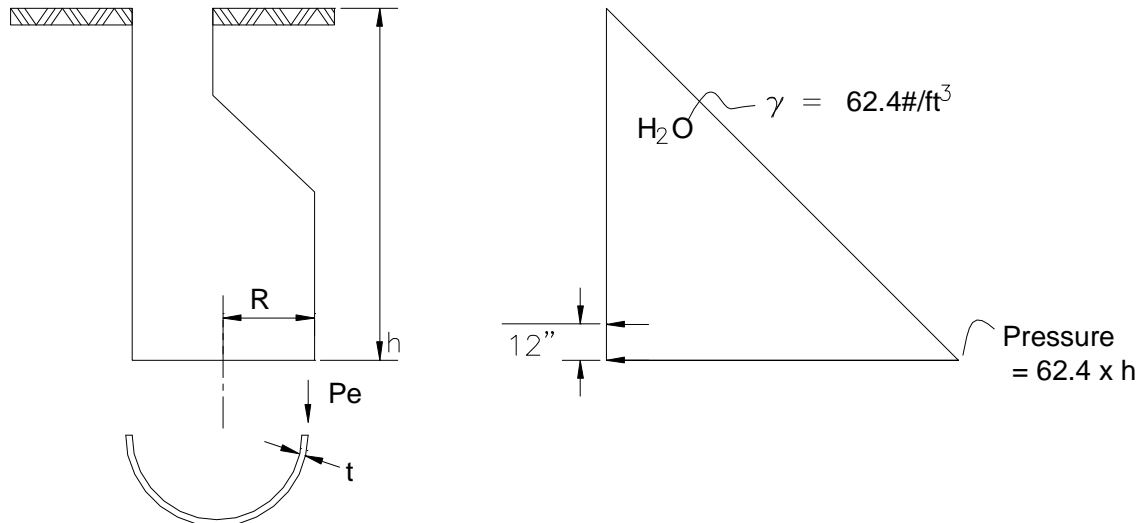
$E'_C$  = 57,000  $\sqrt{f'_C}$  = 3,122,019 PSI.

t = LINER THICKNESS IN MILS.

h = HYDROSTATIC HEAD IN FEET.

R = RADIUS OF THE STRUCTURE IN FEET.

$\gamma$  = WATER DENSITY = 62.4 # / CUBICFOOT.



Allowable stress in the composite is:

$$F'_{pu} \therefore \frac{0.4 \times F'_{pu} \times E_p}{E'_C} = \frac{R \times \gamma \times h \times 1,000}{t \times 12} \text{ this means: } t = \frac{15,600 \times E'_C \times R \times h}{F'_{pu} \times E_p}$$

For above material value the thickness of the liner in mils is:  **$t = 1.39 \times R \times h$**

<sup>1</sup> Comments from Hans de Bruijn, Sales Engineer.

<sup>2</sup> ASTM D-695



**Real-World AltLiner™ CIPM™ Liners in Severe Conditions**

**Severe Deterioration**

Before



After



**Severe Infiltration**

Before



After







# ALTERNATIVE LINING TECHNOLOGIES

## ***Real-World AltLiner™ CIPM™ Liners***

*The patented protection of Alternative Lining Technologies AltLiner™ protects all liner components, therefore protecting the parent structure from infiltration and corrosion.*

Before



After



Before



After



Before



After





# ALTERNATIVE LINING TECHNOLOGIES

## **AltLiner™ CIPM™ LINER**

### **FEATURES Proven**

- *Cured in Place technology has proven itself in pipelining rehabilitation; it makes sense to use it for manhole and wet-well rehabilitation.*
- *PVC has a proven life expectancy in sewers of fifty years.*

### **Complete Acid Protection**

- *The AltLiner™ extends from the sewage flow line, or below, to the support lip of the manhole cover; all gas-exposed surfaces are lined.*

### **Stops Infiltration**

- *The AltLiner™ stops infiltration through grade rings, at cracks and joints, and can be used to line completely to the invert bottom when infiltration problems exist there.*
- *The liner can be designed to withstand ground water pressure that builds up between it and the host structure.*

### **Stops Exfiltration**

- *The AltLiner™ stops exfiltration of the waste-stream into the local environments of both municipalities and industry.*

### **Cured-in-Place Technology with Pressure Installation**

- *The AltLiner™ is cured under pressure at 180+ degrees Fahrenheit to promote high bonding strength to the substrate. The application pressure, similar to the pressure of a screw clamp pressing glue between two pieces of wood, helps the resin penetrate the substrate to form epoxy anchors, while the heat helps to make the PVC more plastic allowing greater conformity to the host structure.*

### **Non-Prorated Warranty**

- *When certified installers install the AltLiner™ we warrant that the lined surfaces will remain corrosion free, and will prevent groundwater infiltration. This is a non-prorated warranty.*

### **Maintains Asset Value**

- *With our non-prorated warranty, your asset value remains fixed at least at the cost of rehabilitation for the entire warranty period. This also allows the rehabilitation costs to be amortized over the same period.*



### **Like No Other**

- *We tailor the AltLiner™ to fit any type of shape configuration.*
- *We use our patented technology to solve your problems.*

### **Consistency**

- *We design and manufacture all liners in our quality controlled production facility.*
- *Our tailor-made, factory-produced AltLiner™ CIPM™ liner has a constant thickness that does not depend on the skill, or mood of the applicator.*
- *The liner does not depend on the initial adhesive strength of its epoxy resin, because its inflation bladder provides application pressure.*
- *Because the AltLiner's™ 25 mil PVC will not crack, the liner will not lose its corrosion resistance and infiltration-stopping ability.*
- *The flexible PVC will bridge potential cracks caused by future settling, dynamic traffic flow and freeze-thaw conditions.*
- *The AltLiner's™ fiberglass reinforcement reduces the likelihood of cracks forming in the liner.*

### **Other Benefits**

- *The AltLiner™ CIPM™ lining system is a trench-less technology. This means no-dig, and minimal disruption to sewer and traffic flow.*
- *The AltLiner™ protects any structural repairs we make to the host structure.*
- *The AltLiner™ does not significantly reduce the access opening into the host structure. Typically, no more than ½" access diameter is lost.*
- *The AltLiner™ stops soil seepage into the manhole through the freeze-thaw cycle, and the resultant dimpling in the asphalt around the frame and cover.*
- *The AltLiner's™ high installation temperature pasteurizes the substrate.*
- *The AltLiner's™ PVC is white, which results in a brighter manhole, creating easy access and inspection.*
- *Grease build-up on AltLiner's™ PVC is easier to clean than from typical substrates (concrete or brick).*

**AltLiner™**  
**BY**  
**Alternative Lining Technologies, LLC.**  
**PO Box 123**  
**Byron Center, MI 49315**  
E-Mail: [info@altliner.com](mailto:info@altliner.com)  
Web: [www.altliner.com](http://www.altliner.com)  
Phone: 800-747-4282  
This specification is available on disk.

## **PART I- GENERAL**

### **1.1 DESCRIPTION OF WORK**

- A.** This work shall include the furnishing of all labor, materials, and equipment for the rehabilitation of an existing manhole with a cured-in-place PVC composite liner.
- B.** The manhole liner shall be manufactured to the shape of the manhole. The fibrous portion of the liner shall be saturated with a modified epoxy resin, then pressurized and cured in-place.
- C.** Fused seams will allow the liner to be inflated and pressurized between ½ - 8 pounds per square inch, with or without an inflation bladder.
- D.** The seams of the liner shall be sealed with fusion welding equipment. The design shall be as described in US Patent 6,540,438 B2.
- E.** The exposed surface of the liner shall be **white PVC**.

### **1.2 LINER PERFORMANCE REQUIREMENTS**

- A.** Liner shall be of the type that allows rehabilitation of a concentric, eccentric or flat top manhole without removing the manhole ring and top section or corbel.
- B.** The liner shall be installed and cured in place via controlled curing by heat and pressurization in the manhole to complete the curing process.
- C.** The lining of the manhole shall result in a structure to the shape and contour of the existing manhole. The liner shall be installed and substantially bond to the interior manhole substrate and be watertight, free of any joints or openings other than pipe inlets, outlets and the cover frame opening.

- D. Where indicated on the manhole schedule the lining shall be designed with independent structural hoop strength for full height hydrostatic pressure as if the liner were a secondary vessel inside the existing manhole. The manufacturer shall design adequate liner thickness into the system with or without additional fiberglass layers.
- E. Where indicated on the manhole schedule the inverts shall be lined.

### **1.3 QUALITY ASSURANCE**

- A. Reference Standards: Comply with applicable provisions and recommendations of the following:
  - 1. ASTM D 695-10 Standard Test Method for Compressive Properties of Rigid Plastics.

### **1.4 SUBMITTALS**

- A. Copies of the manhole dimensions, installation instructions, and manufacturer's product data sheet to be submitted for the Engineer's review.
- B. If required, calculations for the round manhole lining that demonstrate hoop strength under maximum hydrostatic conditions. The calculation shall assume zero liner adhesion to the existing structure, but assume lateral support from the existing wall. The calculated hoop stress shall be less than 11% of the compressive strength as determined by appropriate ASTM test method.

## **PART 2-PRODUCTS**

### **2.1 MATERIALS**

- A. Manhole interior walls and benches shall be patched with cementitious patching/plugging compounds as manufactured by Pre-Blend Products, Inc., or approved equal.
- B. Channel reconstruction cement shall be Speed Plug as manufactured by Euclid Chemical, formed cement concrete of 4,000-psi compression strength, or approved equal.
- C. As a minimum the manhole liner systems shall be composed of a multiple layered composite. The primary layer shall be manufactured from 25 mils PVC with 10 ounce per square yard polyester fleece. The surface hairs of the fleece must be embedded in the molten PVC during the manufacturing

process of the material. Glued laminates are not allowed. Multiple Layers of fiberglass are added to increase thickness and strength.

- D. The fibrous body will be impregnated with a modified epoxy resin. Add fiberglass and resin, for additional liner thickness.

AltLiner™ models:

CIPM™ 46	25 mil PVC, 10 oz Fleece & x2 18 oz Fiberglass
CIPM™ 58	25 mil PVC, 10 oz Fleece & x2 24 oz Fiberglass
CIPM™ 106	25 mil PVC, 10 oz Fleece & x2 24 oz Fiberglass
CIPM™ X	25 mil PVC, 10 oz Fleece & Fiberglass as needed

- E. Liner Thickness: The anticipated hydrostatic head “h” in feet above the bottom of the invert and the Radius “R” in feet of the structure shall determine the necessary liner thickness “t” in mils.

## 2.2 APPLICABLE MANUFACTURERS

- A. Products specified by named manufacturers are specified as a standard of quality.
  - 1. AltLiner™.
  - 2. Approved equal.

## 2.3 ACCEPTABLE LINER INSTALLERS.

- A. Certified installers of Alternative Lining Technologies, LLC. (the manufacturer of the AltLiner™. U.S. Patent number 5,106,440, 6,540,438 B2 and 6,540,439 B2. Phone: 800-747-4282.
- B. Approved equal.

## PART 3-EXECUTION

### 3.1 MAINTAINING WASTEWATER FLOWS

- A. The OWNER shall be fully responsible for restricting the normal sewage flow through the manhole where the specified rehabilitation work demands such flow restriction. The CONTRACTOR will plan his work in order to maintain flows and not interrupt sewer service. This may include night work. The cost of any night work required will be included in the contract price of

the applicable item. The CONTRACTOR shall not perform work to manholes until plans for bypass pumping or flow restriction have been submitted by the OWNER and accepted by the CONTRACTOR. Additionally, no plugging of existing Utility System Gravity Mains will be made without the approval of the Utilities Department.

- B. Unlined flow channel. Install a bridge or flow through tube and cut the liner bottom near the flow line in the channel to expose the flow channel and give access to the pipes. Plug the pipes entering the manhole through the wall and trim the pipe opening to restore flow.
- C. Lined flow channel. Plug the pipes entering the manhole and line the flow channel to the edge of the pipe. Trim all pipe openings and restore the flow.

### **3.2 PRE-INSPECTION**

- A. In general, the OWNER assumes responsibility for the structural integrity of existing structure. Prior to beginning work, the manhole shall be visually inspected and any areas of apparent structural damage shall be reported to the OWNER for restoration.

### **3.3 CLEANING**

- A. All surfaces of the manhole shall be cleaned with a high-pressure water-jet sprayer with an operating pressure of at least 5,000 psi. Pressure wash the manhole to remove all dirt, grease, sand, and surface contaminants on the wall and floor leaving a clean damp surface.
- B. Badly deteriorated and pitted pre-cast manholes and brick manholes, with missing bricks and grout, shall be mudded back to form a smooth compatible surface for the liner.

### **3.4 PLUGGING RECONSTRUCTION**

- A. The stopping of active hydrostatic infiltration shall be accomplished by using Speed plug as manufactured by Euclid Chemical or approved equal.
- B. Water infiltration can also be stopped using expansion type grouts such as Avanti or Seal Guard II.

### **3.5 CHANNEL RECONSTRUCTION**

- A. Remove all loose grout and rubble of existing channel. Rebuild channel if required by shaping and repairing slope of shelves or benches. Work shall



include alignment of inflow and out flow ports in such manner to prevent the deposition of solids at the transition point. All inverts shall follow the grades of the pipe entering the manhole. Changes in direction of the sewer and entering branch or branches shall have a true curve of as large a radius as the size of the manhole will permit. Channels shall be shaped to allow entrance of maintenance equipment into pipes including buckets, TV camera, etc.

- B. Inverts shall only be lined where indicated on the plans “lined inverts”.

### **3.6 LINER INSTALLATION**

- A. Installation shall be by an installer that is qualified by the liner manufacturer. The CONTRACTOR shall include the furnishing of all materials, equipment, tools, and labor as required for the rehabilitation of the manholes selected, including the installation of the interior liner.
- B. The installation of the approved liner system shall be in strict accordance with the manufacturer’s instructions. This shall include the preparation, installation, inflation, curing, and finishing operations, required for the completion of the manhole rehabilitation process.
- C. All safety rules and regulations, applicable laws and insurance requirements shall be observed in storing, handling, use and application of the liner materials, resins and any solvents.
- D. Ventilation shall be provided to the workers at all times.

### **PART 4-WARRANTY, MEASUREMENT AND PAYMENT**

- A. The MANUFACTURER shall warrant to the OWNER in writing the performance of the liner for a period of twenty years.
- B. Payment for the rehabilitation of the structure shall be made at the contract vertical foot price and shall include all necessary labor, material and equipment to clean, seal off any water infiltration, prepare the walls, provide and install the liner completely. The vertical foot measurement is defined as the distance between bottom of invert and top of cover. Payment value is the product of vertical foot price and vertical foot measurement.

**END OF SECTION**

Subject: **Limited Warranty** <sup>(1)</sup>  
Reference:

File number:

To Whom It Concerns:

Alternative Lining Technologies, LLC provides a twenty-year performance Limited Warranty

(2) that the AltLiner™ CIPM™ liner:

- a. Will stop deterioration of the lined surfaces <sup>(3)</sup> by sewer gas induced corrosion;
- b. Will prevent infiltration <sup>(4)</sup> of ground water into the collection system through the lined surfaces;

This Limited Warranty will commence upon completion of the installation of the AltLiner™.

Respectfully submitted,  
**Alternative Lining Technologies, LLC.**

David Van Dyken  
Vice President

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**<sup>1</sup> THIS WARRANTY IS LIMITED BY AND UNDER SUBJECT TO THE TERMS AND CONDITIONS ON THE REVERSE HEREOF, WHICH ARE INCORPORATED HEREIN BY REFERENCE.**

<sup>2</sup> The licensed installer shall separately provide a general “One Year” warranty and shall pass through any extended warranty provided by the manufacturer. Alternative Lining Technologies provides this limited manufacturer’s warranty in conjunction with the Licensed installer. This Limited Warranty is not available as a bonded warranty underwritten by a surety company.

<sup>3</sup> The definition of the “lined surfaces” is the area within the boundaries of the liner edges. All cut edges will be coated with mastic. We exclude secondary intentions such as satisfactory appearance, voids behind the liner, folds and other claims that do not directly affect the twenty-year performance warranty.

<sup>4</sup> Neither Alternative Lining Technologies nor its installer certify the structural integrity of the host structure or claim that the lining system enhances the structural integrity of the host structure sufficiently to comply with ASTM C478 design and other applicable specifications.

Additionally any breach arising out of movement of the host structure is expressly excluded.

**A. THIS LIMITED WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ANY AND ALL OTHER WARRANTIES, WHETHER THEY ARE WRITTEN, ORAL, EXPRESS OR IMPLIED, INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR PURPOSE, AND WHETHER CREATED STATUTORILY, OR OTHERWISE. THERE ARE NO OTHER WARRANTIES, LIMITED, EXPRESS, OR IMPLIED, WHICH EXTEND BEYOND THOSE CONTAINED HEREIN.**

B. This warranty is valid under normal use of the manhole. Material changes, such as holes or cuts, void the warranty unless authorized in writing by the Manufacturer.

C. When the liner is required to retain ground water pressure, consult with Manufacturer to assume proper liner thickness.

D. This Limited Warranty does not cover damage to the liner resulting from: misuse or abuse of the liner or reckless negligent acts of any person; acts of God (including, but not limited to, earthquake and flood); damage caused by the host structure or other materials or components installed in the host structure.

E. I. All claims for breach of this Limited Warranty contained herein shall be made in writing to the Manufacturer within ten (10) days of the time the breach is discovered or should have been discovered after reasonable diligence.

2. THE MANUFACTURER WILL NOT HONOR ANY WARRANTY CLAIM MADE PRIOR TO PAYMENT IN FULL BY THE PURCHASER OR GENERAL CONTRACTOR FOR THE WARRANTED PRODUCT.

3. Warranty service must be performed by the Manufacturer or the Manufacturer's authorized agent. Upon validation by the Manufacturer of any claim for breach of the Limited Warranty contained herein, the Manufacturer will, as its sole and exclusive option perform one of the following:

- a. repair the failed or defective liner;
- b. deliver a replacement liner to the point of original delivery by the Manufacturer; or
- c. refund the original purchase price of the liner as was collected by the Manufacturer.

4. The provisions contained in the previous section constitute purchaser's sole and exclusive remedy under any claim or theory of liability, including any claim based upon failure of, or defect in, the liner, whether such claim, however instituted, is based upon contract, indemnity, warranty, tort (including negligence), strict liability or otherwise.

a. The Manufacturer shall not be liable for direct, indirect, consequential or incidental claims, damages or costs of any nature including, without limitation, labor costs of any kind relating to the removal of a failed or defective liner and/or installation of replacement liner or damages, claims or costs otherwise arising from, or in connection with, breach of this Limited Warranty.

b. The manufacturer shall not be liable for any pollution or other adverse environmental claims arising out of the failure of the liner or from consequential damages related thereto.

F. 1. This Limited Warranty is extended to the original purchaser of the liner from the Manufacturer only and may not be assigned by such purchaser to a third party without prior, written authorization of the Manufacturer. Assignment of this Limited Warranty without prior, written authorization of the Manufacturer will void the Limited Warranty.

2. In order for the Manufacturer to perform warranty service or repairs, the host structure must be reasonably accessible. The manufacturer will not be responsible for costs or damages to the liner or to purchaser's property as a result of liner inaccessibility for warranty repair or service.

G 1. The adjudication of any dispute arising under this Limited Warranty must be commenced no later than one (1) year from the date the breach is discovered or should have been discovered. Any adjudication shall be governed by the law of the Commonwealth of Pennsylvania and venue shall be exclusively in the Court of Common Pleas, Lancaster County, Pennsylvania or the US District Court, Eastern District of Pennsylvania.

H. This Limited Warranty contains the complete understanding of the Manufacturer and purchaser and may be modified only in writing signed by the President of Alternative Lining Technologies.



## **Manufacturer's Installation Instructions**

### **for the installation of the AltLiner™ CIPM™ Lining System**

- A. ***"Lining preparations"***; US Patents 6,540,438, and 6,540,439 make the process we use possible. The preparations are as following:

The resins and prefabricated liner are shipped to the job site. All manhole liners are factory marked at the cap-strip with MH ID's. Also attached to the cap-strip is a copy of the original field measuring sheet with any notes of significance.

Only an Alternative Lining Technologies' certified installer is approved to use the AltLiner™ CIPM™ lining system.

An installation truck is self-contained. All necessary tools, such as hand tools, crane, electric generator, high and low pressure pneumatics, hot water generator, power wash equipment, water tank, and the transfer canister are on the truck. A second pickup truck typically carries miscellaneous materials.

Alternately, especially useful in off-road applications is a modified trailer equipped with water tank, generator, pressure washer, portable blower and miscellaneous power and hand-tools as necessary to successfully complete installation of the AltLiner™ CIPM™ lining system.

- B. Peripheral Considerations:

1. Traffic: All local, state, and federal traffic regulations and permitting are to be known and abided by.
2. By-pass: In some cases, by-pass pumping of wastewater will be necessary. The proper use standards of pumps, hoses and related equipment must be understood and followed by the personnel performing such operations.

- C. Safety:

1. It is expected that all field personnel follow standard OSHA procedures for working in a confined space environment. This includes, but is not limited to, the use of a 4-gas detector<sup>1</sup>, fall-safe equipment (harness, tripod, cable, etc.), attendant, fresh air ventilation, etc.
2. Confined space logs must be kept for every manhole lined and be readily available.

- D. Manhole Preparation:

1. Once the site safety concerns are dealt with, the cover of the manhole is removed, the manhole is re-examined<sup>2</sup>, and a plan of action is confirmed for the lining of the manhole.
2. Manufacturer supplied cure logs are started and must be maintained in real time throughout the lining. Copies of these logs are to be sent to the manufacturer ASAP for every liner installed. The manufacturer's material warranty will not be applied to any liner without a complete and accurate log.
3. If the manhole is not too dirty, the installer might start preparation immediately by cutting

- steps and other protrusions.
4. Steps shall be cut back as close to the substrate as possible and not be left protruding more than 1". Any protruding steps must be flattened or rounded-over so that no sharp edges remain. Non-shrink grout must then be applied in about 4" diameter and profiled to ensure a good mechanical bond with the CIPM™ liner.
  5. If the manhole is fairly dirty, or once initial cut-out is performed, the installation will start with the power-washing of the interior of the manhole at a minimum of 3500 PSI.
  6. Steps and other protrusions are removed (if not already done).
  7. Pipes and protrusions are filleted to assure a good liner fit and to limit void spaces. All incoming laterals and sewer main line openings shall be properly trimmed and grouted with hydraulic or other acceptable non-shrink grout forming a radius fillet (not less than a 6 inch radius) between the structure wall and each pipe. Such application of grout shall extend at least four inches from the outlet onto the wall area making a smooth transition for the liner connection to the pipe openings, and shall be brushed to achieve a profile to ensure a mechanical bond to the liner.
  8. Leaks are stopped and other cracks are patched.
  9. Prior to patching severe defects in the manhole, all loose and deteriorated material shall be removed and disposed of by the Installer.
  10. Any other filling or shaping of structure to assure best lining is done at discretion of installer.
  11. Benches and flow channels may be rebuilt.
  12. If the channel & invert are to be lined, the channel should be patched and reshaped as needed to ensure good flow characteristics and pipe accessibility<sup>3</sup>.

#### E. Liner Wet-Out

1. Surfaces around the structures are protected as needed and a temporary lay-down area is created (typically with plywood and plastic).
2. Liner resin A and B are mixed at a 50:50 volume ratio. Electric drill mixers are used until a homogenous, non-streaked blend is apparent. A 2-minute *minimum* mix time is required for a 5-gallon mix.
3. The installer will have a listing of manufacturer's resin quantity estimates for each liner.
4. It is the installer's responsibility to ensure all resin-carrying fibers of the lining system are completely saturated. Though manufacturer estimates are given based on surface area of general shape, it is known that specific structure geometry and ambient site conditions will affect resin usage or need.
5. The liner is readied by pulling all outer layers up and away from the fleece of the innermost CIPM™ main liner layer. This process is called "unsocking".
6. The mix is applied to the exposed fleece of the CIPM™ liner and spread with paint rollers until it has a semi-gloss and textured appearance. The art is to reach saturation, avoid loss of excess resin, and to avoid meager application areas.
7. The outer layers are socked back one at a time and wet-out as needed. No layer shall consist of more than 2-ply of any material (fiberglass and/or felt).
8. All areas intended to bond to the structure must receive resin.
9. When properly wet-out, the excess resin in the fleece saturates up to two-ply fiberglass when it pushes against the structure surface.
10. Liners with greater than two-ply fiberglass will require additional wet-out steps.

#### F. Liner Attachment to Installation Canister and Setting of Liner

1. The liner's cap-strip will be strapped to the installation canister using truck straps placed and tightened in such a manner as to assure a tight seal and one which will not allow the liner to "blow-off" the canister during the cure cycle. Special indicators help the installer



- preserve angular alignment.
2. Liner shall then be lowered into manhole at installer's discretion to ensure the liner's best fit.
  3. Adjustable legs shall be clamped to the canister to maintain the level.
  4. The canister lid will then be set.
  5. Connect the blower hose for initial inflation.
  6. All valves on the installation manifold must be open to ensure a slow and consistent inflation of the liner.
  7. *It is critical to allow the air between the substrate and the liner to escape up the walls as the liner inflates from the bottom, up. Too quick an inflation will trap air and cause issues with the liner.*
  8. The installer will manipulate the air and liner itself to achieve initial setting of the liner.
  9. It may be necessary at times for the installer to enter the liner itself, through the installation canister, to adjust the liner for fit.
  10. Once satisfied with the initial set, the inflation bladder will be introduced through the canister lid *and inflated slowly so as to minimize air entrapment between it and the liner.*
  11. In some cases, the inflation bladder may be factory-inserted into the liner.
  12. Pressure will be increased gradually until the friction of the liner with the surface is greater than the upward pull force from the canister. A slight lift at the support legs is acceptable. These legs should be readjusted as needed so that they sit on the ground. This is critical when the cure cycle is complete and pressure is relieved. Otherwise, the weight of the canister will come down upon the newly cured liner.

#### G. Liner Cure Cycle

1. The boiler will be started to prepare for the introduction of hot water into the bladder cavity. The inspection port in the canister lid is clear until hot water is allowed to enter the bladder. This enables the installer to inspect and if necessary to enter the cavity to manually correct misalignments.
2. The foreman decides when to introduce the hot water spray. The pressure may increase to a maximum of 5 PSI – 3 PSI is more typical.
3. The cure time "Start" is recorded as the time the temperature at the canister reaches 150 degrees Fahrenheit.
4. The cure temperature must reach a minimum of 180 degrees Fahrenheit at the canister gauge. Occasionally the air valve is closed to make up a pressure loss.
5. Typical cure heat is 200 F.
6. Adjust the support legs down to make up the lift of the canister.
7. The curing time depends on the size of the structure, ambient temperature and purpose of lining. The minimum cure time in all cases unless described in writing by the manufacturer is 1 hour<sup>4</sup>.
8. When the foreman is satisfied with the resin condition just below the capping strip, he will lower the heat at the boiler to start the COOL DOWN cycle.
9. When the temperature reaches 170 F to 180 F, the boiler is turned off and the canister valves are opened<sup>5</sup>.
10. Next, the blower is stopped.
11. When the pressure has dropped to -0-, the lid of the canister can be removed.
12. The legs will support the canister when the pressure is off.
13. Some initial cooling of the inside of the liner (through the inflation bladder) will be achieved with the use of a high volume/low pressure blower fan.
14. A submersible pump will be introduced to remove the condensate from the bladder.
15. The canister and bladder will be cut away from the liner.

#### H. Cutting of the Cured Liner

1. Cut all excess liner material from the manhole. This means trim slightly below the support lip of the cover. Trim the pipe entry points. Trim at the flow channel / bench edge, or at the inlet and outlet pipes if invert lining.

#### I. Site Clean-Up

1. The work site should be cleaned to as-good-as or better-than when-found condition.

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1. Carbon monoxide (CO), hydrogen sulfide (H<sub>2</sub>S), oxygen (O<sub>2</sub>), & combustible gases (LEL).
  2. An initial site visit and manhole examination has to be performed before liner is produced.
  3. It should be understood that once the channel is lined, it's typically assumed that the installer is responsible for the condition of the channel.
  4. The curing rate of the epoxy is accelerated with the energy the hot water releases. The curing is usually stopped when the resin near the canister is non-tacky. Prolonging the cure is entirely up to the installer and benefits the hardness of the resin. A longer cure and cool down period under pressure is needed if hydrostatic back-pressure is expected.
  5. It is important to open the air valve to avoid a vacuum inside the liner.