



PRODUCT SUBMITTAL DOCUMENT  
INFORMATION

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CIPP LATERAL RENEWAL  
CONNECTION SYSTEM  
T-LINER®, SHORTY™  
AND/OR  
VAC-A-TEE® CLEANOUT SYSTEM

10-16-17

## Product Submittal

### **ITEM 1.**

**Manufacturer Company Name:** LMK Technologies, LLC

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### ***Product Submittal:***

### **INSTALLATION PRACTICE FOR REHABILITATION OF A FULL-LENGTH SEWER SERVICE LATERAL USING A ONE-PIECE MAIN AND LATERAL CURED-IN-PLACE LINER ASSEMBLY INSTALLED BY MEANS OF AIR INVERSION**

Only Licensed and Trained Distributor-Contractors/Installers are authorized to install the LMK T-Liner, Shorty and/or VAC-A-TEE systems.

### **ITEM 2.**

#### ***INTENT:***

This specification covers material requirements, installation practices, and test methods for the reconstruction of a sewer service lateral pipe and the main connection without excavation. The lateral pipe is remotely renovated from the main pipe to a specified distance ranging from 3-feet to 200-feet. The pipe renovation shall be accomplished by the inversion and inflation of a resin impregnated, single-piece lateral and main connection liner assembly. The liner assembly is pressed against the lined main pipe and lateral pipe by inflation of a bladder and held under pressure until the thermo-set resin has cured. When cured, the liner extends over a predetermined length of the service lateral and the full circumference of the main pipe at the connection and forms a continuous, single-piece, tight fitting, corrosion resistant and verifiable non-leaking Main/Lateral cured in-place pipe (CIPP) outfitted with gasket seals. The Materials and Installation practices shall, at a minimum, adhere to the requirements of ASTM F2561-16 "Standard Practice for Rehabilitation of a Sewer Service Lateral and its Connection to the Main Using a One-Piece Main and Lateral Cured-in Place Liner".

**The T-Liner/Shorty Main-to-Lateral Connection System** has been installed extensively throughout the United States, Canada, Mexico, Germany, Denmark and Singapore.

**LMK Technologies, LLC is the owner of Trademarks:** T-Liner®, LMK®, Shorty™ and VAC-A-TEE®.

#### **Larry Kiest, Jr., President/Founder**

Inventor of more than 110 worldwide issued patents for methods and apparatuses for the Rehabilitation of Underground Pipes, Conduits and similar Structures. Mr. Kiest is a Licensed Plumber in the State of Illinois, Advisory Board Member of Trenchless Technology Center Louisiana Tech University, Member of ASCE/ PINS Lateral Committee, served 2-terms Board Member of NASSCO (2008-2012), Original chairman that initiated the NASSCO Lateral Committee, Active Board Member NASTT (2012-current), Member of No-Dig Planning Committee, Member of AWWA Standards Committee, Member of WEF, Member WEF Collections Committee, V.P. and active board member 2010-current) of MSTT, Member of ASTM, and Chairman of Task Committee F17, subcommittee 17.67 standard practice for rehabilitation of a sewer service lateral using a one piece main and lateral cured-in-place liner installed by means of air inversion. Mr. Kiest has conducted business in the field of Trenchless Pipe Renewal Systems since 1985.

### **ITEM 3.**

#### **References:**

The LMK T-Liner® project and contact reference list is available upon request. \*

\*LMK Technologies certifies that the average length of T-Liner laterals is 30 ft. With over 10,000 liners installed during the time frame from Jan. 2012 to Dec. 2015, over 300,000 linear feet of liner has been installed.

### **ITEM 4.**

#### **4.0 The Technique**

The T-Liner/Shorty repair structurally renews the entire main/lateral fitting and extends up into the lateral pipe. The repair consists of a one-piece, continuous main and lateral lining that is vacuum impregnated with thermo-set resins, air inverted from the main up into the lateral by the action of a translucent bladder assembly; hereby referred to as a "Liner/Bladder Assembly".

See LMK's T-Liner or Shorty Installation Specification Sheet

#### **4.1 A brief description of the operation and technique; including materials and methods of installation.**

The reconstruction will be accomplished using a non-woven fabric tube of particular length and a thermo-set resin with physical and chemical properties appropriate for the application. The lateral tube within a translucent inversion bladder is vacuum impregnated with the resin and then placed inside a protective launching device. The main liner sheet is formed as a tube by wrapping around the main bladder. The launching device is winched into the existing sewer. When the launching device is properly positioned and aligned with the lateral connection, the main liner is inflated and the resin-saturated tube is inverted up through the old lateral pipe by the action of an inversion bladder. The resin saturated tube is cured and the inversion bladder and launching device are removed. The end result is a one-piece structural lateral lining and main pipe fitting that provides a verifiable non-leaking connection with all mainline pipe types by incorporating two hydrophilic O-rings at each side of the mainline connection or a compression connection gasket in lieu of the O-rings on the mainline and an O-ring at the upper terminal end of the lateral.

The lateral tube length will be:

T-Liner – 3 ft. to 200 ft.

Shorty – 15 ft. or less

The cured finished materials as described above will, upon installation inside the host pipe, exceed the minimum test standards specified by the American Society for Testing Methods F1216-09 and F2561-16.

#### Minimum Test Standards for CIPP ASTM F1216 Appendix X1

FLEXURAL STRENGTH - ASTM D-790 4,500 PSI

FLEXURAL MODULUS - ASTM D-790 250,000 PSI

#### **4.2 Intended use: Structural Repair Crack/Joint Sealing of Root Intrusion and Water Infiltration**

The system is designed for fully deteriorated pipe conditions. Typical installations are a direct result of ground water infiltration, root intrusion and structural defects such as open joints, offset joints, broken or missing pipe sections and hammer taps. The new pipe exhibits a smoothbore interior that typically increases flow rates.

<b>4.3 EXISTING SEWER (Main and Lateral)</b>	The system is compatible with most all types of pipes; V.C.P., Concrete, Cast Iron, P.V.C and existing main pipes that have been renewed by a CIPP process. Typically, full-length lining systems utilize an inner coating or film. Films may range from PVC, PU to PE. The system is compatible with all pipe materials due to the use of hydrophilic sealing O-rings embedded between the main pipe and lining at each terminal end of the Main/Lateral lining, or the use of the connection compression gasket in lieu of the O-rings on the mainline with an O-ring at the terminal end of the lateral tube. The mainline portion is cylindrically shaped producing a structural Main/Lateral fitting.
<b>4.4 Diameter Ranges</b>	Lateral: 3 – 8 inch diameters. Main: 6-inch through 24-inch.
<b>4.5 Transitioning Diameters</b>	The liner can transition from one pipe size to another ensuring adequate liner thickness throughout the lining.
<b>4.6 Circular and/or Non-Circular Capability</b>	The system can accommodate pipe ovality up to -20%.
<b>4.7 Maximum Length Between Access Points</b>	Typical MH-MH lengths are 500 feet. Extensions can be added.
<b>4.8 Material Limitations</b>	This system is designed for gravity sewers and low pressure piping.
<b>4.9 Lining Material Composition and Construction</b>	Needle punched felt or proprietary kitted tubes coated with a chemically resistant impervious film. The tube is stitched using Nomex®, high-temp, high-strength thread. The tube is air-tight and flexible in design to reduce inversion pressures. Minimum finished wall thickness: 4.0mm for 4 inch diameter pipe 4.5mm for 5 inch diameter pipe 4.5mm for 6 inch diameter pipe 5.0mm for 8 inch diameter pipe
<b>4.10 Main/Lateral Jointing System</b>	The lining material is constructed as a one-piece cylindrically shaped Main/Lateral fitting. The main and lateral lining tubes are stitched with high-temp Nomex® thread and thermally sealed. Therefore, there is no joining of two separate liners during the installation process. The end product is a one-piece structural Main/Lateral cured-in place pipe.
<b>4.11 Resin System</b>	Resin Systems include: LMK656 Non Filled ISO Polyester Resin. LMK656EN Filled ISO Polyester Resin. LMK700 Series Steam Cured Epoxy Resin. LMK770 Series Ambient Cured Epoxy Resin. LMK100 Series VOC Free Vinyl Ester Resin... 4-inch tube requires .92lbs of resin per lineal foot. 5-inch tube requires 1.40lbs of resin per lineal foot. 6-inch tube requires 1.90lbs of resin per lineal foot.
<b>4.12 Mechanical Properties</b>	Excess resin migrates into pipe defects allowing a mechanical anchoring.

- 4.13 Physical Properties** Flexural Strength 4,500-PSI “Minimum” Test Method: ASTM 790  
Flexural Modulus 250,000-PSI “Minimum” Test Method: ASTM 790
- 4.14 Corrosion attack** Chemical Resistance Testing. Test Method: ASTM D5813 and F1216  
See Independent Laboratory Testing: Microbac Corrosion Test.
- 4.15 Resin Saturation Method** The lining tube is positioned within the translucent inversion bladder forming a liner/bladder assembly. The assembly is vacuum impregnated with a thermo-set resin. The bladder is translucent, allowing the installer and inspector to visually verify the lining tube has 100% resin saturation.
- 4.16 Gasket Seals** **The mainline connection** shall include a seamless molded flange shaped gasket attached to the main liner tube by use of stainless steel snaps. The gasket will be a minimum of 2.5mm and will retain this minimum thickness under installation pressures. Alternatively, the mainline liner tube shall include 4 hydrophilic O-rings (2 on each side of the service pipe). **The lateral tube** shall include two compression O-ring gaskets attached six-inches from the terminating end of the lateral tube.
- 4.17 Gasket Seals Test Data** The hydrophilic gasket seals shall include test data that supports substantial expansion properties so to form a watertight compression end seal at the terminating ends of the CIP-lateral liner. The test protocol shall simulate subterranean conditions and hydraulic loading at surface. Gasket seal submittals must include tests data simulating hydration/ dehydration conditions for a period of 10,000-hours and the test results must successfully demonstrate and document long-term performance without deterioration, loss of material, flexibility, and expansion of the gasket during repeated cycles of hydration and dehydration.
- 4.18 Installed at one-time** The system allows only one (1) lateral at a time to be renewed within a MH-MH reach. The steam cure resin system allows many laterals to be renewed in a day. Conditions and number of laterals within a manhole run greatly determine the number of laterals that can be renewed in one-day, though a typical number of laterals renewed in one-day is five (5).
- 4.19 Missing Pipe Sections** The liner can span small missing sections of pipe.
- 4.20 Effects of Line and Grade** There are no effects caused by grade changes since air pressure is used to inflate the liner. The liner is flexible during insertion and can accommodate and negotiate 22, 45 and 90 degree bends.
- 4.21 Protruding Lateral Pipes** It is recommended protrusions into the main pipe are limited to ½-inch.
- 4.22 Reduction in Pipe Diameter, and its Effect** The liner exhibits a slick and typically smooth interior with a co-efficient that increases flow-rate. Minor wrinkling may occur at bends of 45-degrees and greater and some wrinkling may occur based on actual inner pipe diameter, inner surface, pipe configuration and conditions.
- 4.23 Homeowner Impact** Homeowners and building occupants at a minimum will receive a door knob notice bulletin 48 hours prior to the scheduled work and personal contact is attempted to be made the day of the scheduled work. The notice bulletin summarizes the scope of work, tentative time of service disruption and home/building owner cooperation for non-use of water/sewer for a 2-hour period or less. A brief explanation of “Dry Fixture Traps” is also included.

## **ITEM 5.**

- 5.0 Sewer preparation involves cleaning and a flow stoppage or diversion period.** The main and the laterals are cleaned utilizing high-pressure water and mechanical cleaning tools. Pressures may range from 2,000 to 4,000 PSI removing all roots, debris and obstructions. Cleaning of the lateral is performed robotically from the main pipe. Any protruding service connections will be removed prior to liner insertion. The current condition of the pipe will be compared to the original designed condition to verify that design parameters have not changed. Normal mainline flows are plugged or by-passed during the process, depending on flow.
- 5.1 Mainline Service** Typical time for plugging the mainline is one-hour (1) or less.
- 5.2 Specific Requirements** Accesses to the upstream and downstream manholes are mandatory.
- 5.3 Cleanout System** Lateral lengths 15-feet and less can be renewed without the need for a cleanout. Lengths greater than 15-feet require a TEE shape, or back to back WYE shaped cleanout fittings located a minimum of two-feet (2') upstream from the terminal end of the lateral CIPP liner.
- The VAC-A-TEE® System is used to install a TEE shaped cleanout utilizing vacuum excavation. The saddle is specifically designed to snap fit to the host pipe as the lower most portion of the saddle extends beyond the spring-line of the pipe. This tight fitting snap firmly holds the saddle until the adhesive sealant is cured. The adhesive/sealant is specifically designed to adhere the PVC saddle to a variety of pipe materials. Each cleanout saddle is hydrostatically tested. The VAC-A-TEE System is ASTM F3097-15 compliant.
- See Specification LMK's VAC-A-TEE Installation Specification.
- 5.4 Installation Crew and Equipment** A typical crew consists of four technicians. A mobile wet out unit is required for onsite vacuum impregnated of the liner. Traffic disruption is minimal. The installation process is typically quick, efficient and non-disruptive when compared to open cut replacement methods.
- 5.5 Handling Sewer Access (i.e., existing manholes)** The technicians remotely carry out the installation. Internal pipe cleaning, inspection and insertion of the lining are typically performed without the need for confined space entry. Entry into a manhole may be required in order to insert a sewer plugs or to assist insertion of equipment in small diameter manholes or where drop inlets exist. If confined entry is required, Federal, State and local laws apply.
- 5.6 Inversion/Inflation Method** Air pressure is applied to launching device causing the Liner/Bladder Assembly to inflate the mainline portion and invert the lateral portion into the lateral pipe. The bladder extends past each terminal end of the lining assembly so the ends remain open and no cutting is necessary.
- 5.7 Maximum Length** Maximum length for a continuous lateral lining is 200 feet.
- 5.8 Curing Method** The Resin/Catalyst packages are proprietary to LMK Technologies. The resin systems are either cured at ambient temperatures or steam cured.  
Polyester/Vinyl-ester Ambient: One hour pot time/One hour cure time.  
Polyester/Vinyl-ester Steam: 2-hour pot time/30-minute cure time.  
Epoxy Ambient: One hour pot time/Two hours cure time.  
Epoxy Steam: 2-hour pot time/30-minute cure time.

- 5.9 Removal of Inflation Device** The bladder is re-inverted peeling away from the new cured in-place pipe. During the removal process, the bladder is drawn back into the launching device.
- 5.10 Equipment Removal** Once cured, the equipment is removed from the mainline pipe.
- 5.11 Document Final Video and Testing Procedures** A final video inspection is performed from the main if the termination point of the liner can be seen with zoom cameras.
- 5.12 Design Life** 50-Year Design Life based on assumption described in ASTM F1216 Appendix X1 and long-term creep as described in ASTM D2990.

**ITEM 6.**

- 6.1 Technology Introduced** T-Liner has been commercially available since December of 1996.
- 6.2 Installed Locations** USA, Canada, Mexico, Denmark, Sweden, Germany and Singapore
- 6.3 Quantity of Installations to Date** 60,000 plus. See addendum for project reference list (not a comprehensive listing).
- 6.4 Licensed and Trained Distributor/Contractors**
- Arold Construction, Kingston, NY  
 Berotech, Haderslev,, Denmark  
 C & L Water Solutions, Littleton, CO  
 CK Masonry, Nashville, TN  
 D.M. Robichaud Assoc., Oshawa, Ontario  
 Fast Pipe Lining, LaSalle, IL  
 Fuquay Construction, Inc., New Braunfels, TX  
 Haas GmbH & Co. KG, Remseck, Germany  
 Hoerr Construction, Peoria, IL  
 Humbard Contracting, Inc., Green Forest, AR  
 IVIS, Edmonton, Alberta  
 Kissick Construction, Kansas City, MO  
 LMK Pipe Renewal, Ft. Lauderdale, FL  
 Midlands Contracting, Kearney, NE  
 Mitchell Contracting, Madisonville, LA  
 Mocon Corporation, Honolulu, HI  
 Musson Brothers, Rhinelander, WI  
 Performance Pipelining, Ottawa, IL  
 Pipe Services, LLC., Clive, IA  
 Prism Contractors & Engineers, Inc., Yorktown, VA  
 Quam Construction, Willmar, MN  
 Rapid Flow, Chelsea, MA  
 RBP Industries, Spruce Grove, AB  
 South Baldwin Plumbing (SBP Inc.), Pensacola, FL  
 SWERP, Bristol, PA  
 Telerep Groupe SARP-France, Ecquevilly, France  
 The Iron Horse Group, Fairview, OR  
 United Pipe Renewal, Johnston, IA  
 United Survey, Inc., Bedford, OH  
 Victoria Drain Services, Ltd., Victoria, BC  
 XL Contracting, St. Peters, MO

**ITEM 7.**

**7.1 Advanced Materials**

Translucent Inversion Bladder  
Liner/Bladder Assembly  
Vacuum Impregnation  
Installed from the main pipe up into the lateral  
Full circle one-piece Main/Lateral Lining  
Continuous lengths up to 200'  
Curing system as fast as 30-minutes  
Structural CIPP  
10,000 hour CIPP chemical resistance testing ASTM D29990  
Flexible construction  
Remote installation where no excavation is required  
Gasket Sealing Technology (hydrophilic and/or compression gaskets)  
10,000 hour hydration/dehydration gasket sealing test

**Respectfully Submitted By:**

*Larry Kiest, Jr.*

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Larry Kiest, Jr., President, LMK Technologies, LLC.

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