

# T-Liner® Submittal

## Product Review Application

### ITEM 1.

**Manufacturer Company Name:** LMK Enterprises, Inc.

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Product Submittal: This submittal is for the T-Liner® process specifically designed to renew lateral pipes and provide a structural, verifiable non-leaking connection to the mainline pipe.

Only Certified Licensed Installers by LMK® are authorized to install the LMK T-Liner® system.

### ITEM 2.

**T-Liner® by LMK®** has been used extensively throughout the United States, Canada, Mexico, Germany, Denmark and Singapore to effectively renew over 30,000 Lateral Sewer Pipes.

**LMK Enterprises, Inc., is the owner of Trademarks: T-Liner® and LMK®.** LMK Enterprises, Inc. is owned and operated by President Larry W. Kiest, Jr., designer of the T-Liner Repair Process.

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

Inventor of more than 60 issued patents teaching methods and apparatuses for the Rehabilitation of Underground Pipes, Conduits and 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, Board Member of NASSCO, Chairman of NASSCO Lateral Committee, Active Board Member NASSCO 2008-2010, Member of NASTT, Member of AWWA Standards Committee, Member of WEF, Member of MSTT, Active Board Member MSTT 2008-2010, 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.

### LMK's Management Team

General Manager: Bruce Kamin  
Purchasing Manager: Karen Hougas  
National Sales Manager: Rick Gage  
Assistant to National Sales Manager: Kara Kamin  
Sales Consultant: Wally Huber  
LMK Fabrication Manager: Jason Mathey  
Accounting: Lori Lohnes  
Shipping/ Receiving Manager: Barry Chalus

Assistant to President/CEO: Amber Sibley  
Technical Trainer: Clint Peterson  
Technical Field Trainer: Joe Catlin  
Manufacturing Manager: Sharon Biagoni  
Marketing Manager: Kristina Kiest  
Reception: Kristin Kiest  
Treasurer: Joan Blythe  
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### **ITEM 3.**

#### **References:**

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#### **ITEM 4.**

<b>4.0 The Technique</b>	<p>The T-Liner Shorty™ repair structurally renews the entire main/lateral fitting and extends up into the lateral pipe. The repair consist 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”.</p> <p>See LMK’s T-Liner Shorty Installation Specification Sheet</p>
<b>4.1 A brief description of the operation and technique; including materials and methods of installation.</b>	<p>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.</p> <p>The composite of the materials above will, upon installation inside the host pipe, exceed the minimum test standards specified by the American Society for Testing Methods F1216-07 and F2561-06.</p> <p><b><u>Minimum Test Standards for CIPP</u></b></p> <p style="text-align: center;">FLEXURAL STRENGTH -ASTM D-790 4,500 PSI FLEXURAL MODULUS -ASTM D-790 250,000 PSI</p>
<b>4.2 Intended use: Structural Repair Crack/Joint Sealing of Root Intrusion and Water Infiltration</b>	<p>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.</p>
<b>4.3 EXISTING SEWER  (Main and Lateral)</b>	<p>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 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. The mainline portion is cylindrically shaped producing a structural Main/Lateral fitting.</p>
<b>4.4 Diameter Ranges</b>	<p>Lateral: 3 – 8 inch diameters.</p> <p>Main: 6-inch through 30-inch.</p>
<b>4.5 Transitioning Diameters</b>	<p>The liner can transition from one pipe size to another ensuring adequate liner thickness throughout the lining.</p>
<b>4.6 Circular and/or Non-Circular Capability</b>	<p>The system can accommodate pipe ovality up to -20%.</p>

<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: 3.0mm for 4 inch diameter pipe 4.5mm for 5 inch diameter pipe 4.5mm for 6 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. 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.
<b>4.13 Physical Properties</b>	Flexural Strength 4,500-PSI "Minimum" Test Method: ASTM 790 Flexural Modulus 250,000-PSI "Minimum" Test Method: ASTM 790
<b>4.14 Corrosion attack</b>	Chemical Resistance Testing. Test Method: ASTM D5813 and F1216  See Independent Laboratory Testing: Microlab Corrosion Test.
<b>4.15 Resin Saturation Method</b>	The lining tube is positioned within the translucent inversion bladder forming a liner/bladder assembly. The assembly is vacuum impregnated with a thermoset resin. The bladder is translucent, allowing the installer and inspector to visually verify the lining tube has 100% resin saturation.
<b>4.16 Installed at one-time</b>	The system allows only one (1) lateral at a time to be renewed within a MH-MH reach. The quick cure time allows many laterals to be renewed in a day. The manhole access, conditions and number of laterals within a manhole run greatly determine the number of laterals that can be renewed in one-day, though the typical number of laterals renewed in one-day is five (5).
<b>4.17 Missing Pipe Sections</b>	The liner can span small missing sections of pipe.
<b>4.18 Effects of Line and Grade</b>	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.
<b>4.19 Protruding Lateral Pipes</b>	It is recommended that protruding laterals are trimmed so not to protrude more than ½-inch into the main pipe.
<b>4.20 Reduction in Pipe</b>	The liner exhibits a slick and typically smooth interior with a co-efficient that

<b>Diameter, and its Effect</b>	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.
<b>4.21 Affects on Homeowners</b>	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.**

<b>5.0 Sewer preparation involves cleaning and a flow stoppage or diversion period.</b>	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.
<b>5.1 Mainline Service</b>	Typical time for plugging the mainline is one-hour (1) or less.
<b>5.2 Specific Requirements</b>	✓ Accesses to the upstream and downstream manholes are mandatory.
<b>5.3 Cleanout System</b>	The Shorty process does not require a clean-out to be accessible.
<b>5.4 Installation Crew and Equipment</b>	A typical crew consists of (3 to 4) 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.
<b>5.5 Handling Sewer Access (i.e., existing manholes)</b>	Certified and Licensed 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.
<b>5.6 Inversion/Inflation Method</b>	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.
<b>5.7 Maximum Length</b>	Maximum length for a continuous lateral lining is three (3) feet for main to lateral connection where no cleanout exists.
<b>5.8 Curing Method</b>	The Resin/Catalyst packages are proprietary to LMK, Enterprises, Inc. 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.
<b>5.9 Removal of Inflation Device</b>	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.

<b>5.10 Equipment Removal</b>	Once cured, the equipment is removed from the mainline pipe.
<b>5.11 Document Final Video and Testing Procedures</b>	A final video inspection is performed from the main if the termination point of the liner can be seen with zoom cameras.
<b>5.12 Design Life</b>	50 - 100 Year Service Life, based physical properties, chemical resistance and extrapolations. upon

**ITEM 6.**

**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 3'.**
- **Curing system as fast as 30-minutes.**
- **Structural CIPP.**
- **10,000 hour chemical resistance testing.**
- **Flexible construction.**
- **Remote installation where no excavation is required.**
- **Gasket Sealing Technology (hydrophilic O-rings).**

**Respectfully Submitted By:**

**Larry Kiest, Jr.**

Larry Kiest, Jr. President LMK Enterprises, Inc.