INSTALLATION 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
(as provided by LMK Enterprises)

1. *SIGNIFICANCE AND USE*

This specification is for use by designers, engineers who specify, regulatory agencies, owners, and inspection organizations who are involved in the rehabilitation of sewer service laterals through the use of a resin-impregnated tube installed within an existing sewer lateral. As for any specification, modifications may be required for specific job conditions.

2. *INTENT*

This specification covers requirements and test methods for the reconstruction of a sewer service lateral pipe and a short section of the main pipe without excavation. The lateral pipe shall be remotely accessed from the main pipe and from a cleanout. This shall accomplished by the installation of a resin impregnated one-piece main and lateral lining by means of air inflation and inversion. The liner is pressed against the host pipe by pressurizing a bladder that is held in place until the thermo-set resins have cured. When cured, the liner shall extend over a predetermined length of the service lateral and a particular section of the main pipe as a continuous, one piece, tight fitting, corrosion resistant and verifiable non-leaking cured in-place pipe. The Main/Lateral Lining shall be in accordance with ASTM F2561-06 "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"

3. *GENERAL*

The reconstruction shall be accomplished using a non-woven textile tube of particular length and a thermo-set resin with physical and chemical properties appropriate for the application. The lateral tube located within a translucent inversion bladder is vacuum impregnated with the synthetic resin and is then placed inside of a protective carrying device. The mainline portion of the liner is physically attached to the lateral portion and is affixed around a rigid "T" launching device. The protective "T" launching device is winched into the existing sewer. When the "T" launching device is properly positioned at the lateral connection, the mainline bladder is inflated by pressurized air that presses the main liner against the host pipe. The lateral portion is then, inverted up through the lateral service line by the action of the inversion bladder. Once the resin-saturated liner is cured, the inversion bladder and launching/carrying devices are removed.

4. *MATERIAL*

4.1 The liner assembly shall be continuous in length and consist of one or more layers of absorbent textile material i.e. needle punched felt, circular knit or circular braid that meet the requirements of ASTM F1216 and ASTM D5813 Sections 6 and 8. The textile tube and sheet shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe segments, and flexibility to fit irregular pipe sections.

The wet-out textile tube and sheet shall meet ASTM F 1216, 7.2 as applicable, and shall have a uniform thickness and 5% to 10% excess resin distribution that when compressed at installation pressures will meet or exceed the design thickness after cure.

4.2 The outside layer of the textile tube (before inversion) and interior of the textile sheet shall be coated with an impermeable, translucent flexible membrane. The textile sheet before insertion shall be permanently marked as a "Lateral Identification" correlating to the address of the building and the lateral pipe services. The sheet and tube shall be surrounded by a second impermeable, flexible translucent membrane (translucent bladder) that will contain the resin and facilitate vacuum impregnation while monitoring of the resin saturation during the resin impregnation (wet-out) procedure.

4.3 The mainsheet and lateral tube shall be a one-piece assembly formed in the shape of a "T" or WYE. No intermediate or encapsulated elastomeric layers shall be in the textile that may cause de-lamination in the cured in-place pipe. The main sheet will be flat with one end overlapping the second end and sized accordingly to create a circular lining equal to the inner diameter of the main pipe. The lateral tube will be continuous in length and the wall thickness shall be uniform. The lateral tube will be capable of conforming to offset joints, bells, and disfigured pipe sections.

5. ***RESIN SYSTEM***

5.1 The resin/liner system shall conform to ASTM D5813 Section 8.2.2 - 10,000-hour test.
5.2 The resin shall be a corrosion resistant polyester, vinylester, epoxy or silicate resin and catalyst system that when properly cured within the composite liner assembly, meets the requirements of ASTM F1216, the physical properties herein, and those which are to be utilized in the design of the CIPP, for this project.
5.3 The resin shall produce CIPP, which will comply with the structural and chemical resistance requirements of ASTM F1216.

Table 1 CIPP INITIAL STRUCTURAL PROPERTIES

Property	ASTM Test	Minimum value____	
		psi	(MPa)
Flexural Strength	D 790	4,500	(31)
Flexural Modulus	D 790	250,000	(1,724)

6. ***DESIGN CONSIDERATIONS***

6.1 The CIPP shall be designed per ASTM F1216, Appendix X1.
6.2 The CIPP design for the lateral tube shall assume no bonding to the original pipe.

7. ***INSTALLATION RECOMMENDATIONS***

7.1 *Access Safety* – Prior to entering access areas such as manholes, an excavation pit, performing inspection or cleaning operations, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen shall be undertaken in accordance with local, state, or federal safety regulations.
7.2.1 *Cleaning and Inspection* – As per NASSCO Standards.

7.2.2 *Accessing the Lateral* – A cleanout is required to be located on the exterior of the building. The cleanout fitting must be either TEE shaped or back to back WYE shaped where the lateral meets the cleanout riser pipe. The cleanout shall be located no less than within two (2) feet of the finished liner.
7.2.3 *Plugging* – The upstream side of the cleanout shall be plugged during insertion and curing of the liner assembly ensuring no flows enter the pipe and no air, steam or odors will enter the building. When required, the main pipe flows will be by-passed. The pumping system shall be sized for normal to peak flow conditions. The upstream manhole shall be monitored at all times and an emergency deflating system will be incorporated so that the plugs may be removed at any time without requiring confined space entry.
7.2.4 *Inspection of Pipelines* – The interior of the pipeline shall be carefully inspected to determine the location of any condition that shall prevent proper installation, such as roots, and collapsed or crushed pipe sections. These conditions shall be noted. Experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television shall perform inspection of pipelines.
7.2.5 *Line Obstructions* – The existing service lateral shall be clear of obstructions that prevent the proper insertion and expansion of the lining system. Changes in pipe size shall be accommodated, if the lateral tube is sized according to the pipe diameter and condition. Obstructions may include dropped or offset joints of no more than 20% of inside pipe diameter.
7.3 *Resin Impregnation* – The lateral tube and mainline sheet shall be encapsulated within the translucent bladder (liner/bladder assembly) shall be vacuum-impregnated with resin (wet-out) under controlled conditions. The volume of resin used shall be sufficient to fill all voids in the textile lining material at nominal thickness and diameter. The volume shall be adjusted by adding 5% to 10% excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe. No dry or unsaturated area in the mainline sheet or lateral tube shall be acceptable upon visual inspection.
7.4 *Liner Insertion* – The lateral tube and inversion bladder will be inserted into the carrying device. The mainline liner and bladder shall be wrapped around the "T" launching device and held firmly by placing four (4) hydrophilic O-rings around the main liner. A adhesive sealant 300ml in volume is applied to the main/lateral interface and shall be applied as a two-inch (2") wide band on the main liner. Both the launching and carrying device are pulled into the pipe using a cable winch. The pull is complete when the open port of the "T" launching device is aligned with the interface of the service connection and mainline pipe. The lateral tube is completely protected during the pull. The mainline liner is supported on a rigid "T" launcher that is elevated above the pipe invert through the use of a rotating skid system. The liner assembly shall not be contaminated or diluted by exposure to dirt, debris, or water during the pull.
7.5 *Bladder* – The main bladder shall be inflated causing the main sheet to unwrap and expand, embedding the hydrophilic O-rings between the main liner and the main pipe as the main liner is pressed tight against the main pipe. The lateral tube is inverted by the action of the lateral bladder through the center of the main liner as it extends up into the lateral pipe to a termination point that shall be no less than 2-feet from the exterior cleanout. The Main/Lateral bladder assembly shall extend past all ends of the liner, as no cutting shall be required.

7.6 *Curing* – After liner placement is complete; pressure is maintained pressing the liner firmly against the inner pipe wall. The liner is chemically cured at ambient temperatures or by a suitable heat source. The heating equipment shall be capable of delivering a mixture of steam and air throughout the liner bladder assembly to uniformly raise the temperature above the temperature required to cure the resin. The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of the soil). The heat source temperatures shall be monitored and logged during the cure and cool down cycles. The manufacturer's recommended cure schedule shall be submitted.

7.7 *CIPP Processing* – Curing shall be done without pressure interruption with air or a mixture of air and steam for the proper duration of time per the resin manufacturer's recommendations. When the heat source is removed and the temperature on both ends of the CIPP reaches 100 degrees Fahrenheit or less, the processing shall be finished

8. ***FINISH***

8.1 *The finished CIPP* – Shall be continuous over the entire length of the rehabilitated sewer service lateral and 16" of the main pipe (5" on either side of a 6" lateral or 6" on either side of a 4" lateral connection). The CIPP shall smooth with minimal wrinkling and increase flow rate. The CIPP shall be free of dry spots, lifts, and delaminated portions. The CIPP shall taper at each end providing a smooth transition for accommodating video equipment and maintaining proper flow in the mainline. After the work is completed, the installer will provide the owner with video footage documenting the repair and the visual markings identifying the sewer lateral address as completed work. The finished product must provide an airtight/ watertight verifiable non-leaking connection between the main sewer and sewer service lateral.

9. ***RECOMMENDED INSPECTION AND TESTING PRACTICES***

9.1 *Sampling* – As designated by the purchaser in the purchase agreement, the preparation of a CIPP sample is required. The sample shall be prepared by securing a flat plate mold using the textile tube material and resin system as used for the rehabilitated pipe.

9.1.1. *Pressure* – The pressure applied on the plate sample will be equal to the highest pressure exerted on the lateral tube during the inversion process.

9.1.2 *Length* – The minimum length of the sample must be able to produce at least five specimens for testing in accordance with ASTM D-790-03.

9.2 *Conditioning* – Condition the test specimens at 73.4 ± 3.6º F (23 ± 2ºC) and 50 ± 5% relative humidity for not less than 40 hour prior to test in accordance with Practice ASTM D 618, for those tests where conditioning is required.

9.3 *Short-Term Flexural (Bending) Properties* – The initial tangent flexural modulus of elasticity and flexural stress shall be measured for gravity and pressure pipe applications in accordance with Test Method D 790 and shall meet the minimum requirements of Table 1.

9.4 *CIPP Wall Thickness* – The minimum wall thickness at any point shall not be less than 87.5% of the specified design thickness as agreed upon between purchaser and seller.

9.5 *Gravity Pipe Leakage Testing* – If required by the owner in the contract documents or purchase order, gravity pipes should be tested using an air test method where a test plug is placed adjacent to the upstream and downstream ends of the main sheet CIPP

and at the upper most end of the lateral tube. This test should take place after the CIPP has cooled down to ambient temperature. This test is limited to pipe lengths with no service connections. The test pressure shall be 4 PSI for a three-minute) minute test time and during this time the pressure shall not drop below 3.5 PSI.

10. ***DESIGN CONSIDERATIONS***

10.1 *General Guidelines* – The design of the cured-in-place lateral liner system is largely a function of the condition of the existing pipeline and the loads stipulated by the customer's specification.

11. ***PAYMENT***

Price includes traffic control, permits, by pass pumping and video documentation.
Unit prices shall be submitted for the following items:

11.1 Mobilization Lump Sum.
11.2 Lateral cleaning/ video inspection from cleanout to main per lineal foot.
11.3 Set-up for each manhole-to-manhole segment.
11.4 T-Liner® Main/Lateral connection and extending 5-feet up into the lateral.
11.5 Additional footage per lineal foot.

12. ***KEY WORDS***

12.1 Sewer lateral lines, cured-in-place pipe, CIPP, main pipe, lateral pipe, main to lateral connection, tube, textile tube, lateral tube, sheet, textile sheet, main sheet, vacuum impregnate, translucent bladder, liner/bladder assembly, continuous, felt, knit, resin, launcher, inversion, inflation, ambient cure, steam cure, transition, one-piece, "T", TEE, WYE, hydrophilic O-rings, epoxy, lateral identification.

13. QUALIFIED BIDDER

A qualified bidder for installing a mainline/lateral connection and lateral repair system shall use a Manufactured System that has a minimum of a five-year history of satisfactory performance and the Manufactured System shall have performed a minimum of 10,000 successful installations during this time period in the U.S., including 300,000 feet of lateral lining. Bidders shall be prepared to submit a list of installation projects, numbers of connections sealed and lateral footage lined providing contact names, addresses, and telephone numbers for reference.