North American Society for Trenchless Technology (NASTT)
NASTT's 2016 No-Dig Show

Dallas, Texas
March 20-24, 2016

WM-T3-05

Sealing the Connection for Large Diameter Pipes, Trenchlessly

Mike Czipar, Vice President, Business Development, LMK Technologies, Ottawa, IL
Amana Arayan, Marketing Manager, LMK Technologies, Ottawa, IL

1. ABSTRACT

Previous trenchless rehabilitation solutions have not been able to adequately repair large diameter lined or unlined pipe connections to the lateral. The large diameter connection liner uses patent pending technology that creates a water-tight connection to the CIPP lining or to the original host pipe. This system and methodology produces a mechanically anchored connection liner utilizing molded gaskets made of hydrophilic rubber. The verifiable non-leaking connection system consists of a non-woven fabric tube of the desired length with a factory stitched and sealed fabric brim, and thermo-set CIPP resin system. The mainline brim and lateral tube are vacuum impregnated with the resin, the molded, hydrophilic gaskets are installed, and then the liner is mechanically placed inside the pipes via man entry into the mainline. The connection stays in place with a stainless steel compression ring that is mechanically fastened to the main pipe to create a one-piece main to lateral lining in large diameter and odd shaped mainline pipes.

2. INTRODUCTION

The Man-Entry Lapel Liner repair renews the main/lateral connections and extends up into the lateral pipe for a designated length. The repair consists of a one-piece, continuous main and lateral lining that is vacuum impregnated with thermo-set resin; hereby referred to as a "Lapel Liner."

This paper covers material requirements, installation practices, and methods for the reconstruction of a sewer service lateral pipe and the main connection without excavation. The pipe renovation shall be accomplished by insertion and inflation of a resin impregnated, single-piece lateral and main, and gasket sealed connection liner assembly. The main connection and hydrophilic gasket are fastened in place and the lateral liner is inserted into the lateral pressed against the lateral pipe by inflation and held under pressure until the thermo-set resin has cured. The lapel portion is pressed against the mainline pipe and then mechanically fastened to the host pipe with a stainless steel compression ring using non-corrosive concrete fasteners. When cured, the liner extends over a predetermined length of the service lateral and a portion 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). The Man-Entry Lapel Liner can rehabilitate main line diameters from 27 inches and greater as well as large odd shaped pipes, where a robotically positioned connection liner is not feasible. The technician mechanically anchors the brim with fasteners that are engineered to withstand the hydraulic loading. The lateral diameters range from 4 inches to 24 inches with a standard length of eighteen inches. However, longer lateral repairs can be made. At the terminating end of the lateral hydrophilic O-rings are used to ensure a verifiable water-tight seal.

Figure 1: Man-Entry Lapel Liner

3. KEY TECHNOLOGY FEATURES

Continuous Tube-The lateral portion of the Lapel Liner consists of a one-piece continuous lining 24 inches in length, longer customized lengths are available. The mainline brim and lateral tube are stitched together in a factory, then sealed with an adhesive which is quickly cured by an ultra-violate light and randomly vacuum tested to ensure an airtight seal prior to distribution. The mainline brim and lateral tube are vacuum impregnated on the jobsite by the trained technicians with the thermos-set resin and then placed via man entry into the mainline. First the lateral tube is pushed up into the lateral pipe, then the compression ring is anchored to the mainline interface and lastly the lateral liner is pressed against the lateral pipe using an inflation device and air pressure is maintained until it is cured.

Figure 2: Lateral Portion of the Lapel Liner

Insignia Hydrophilic Connection Hat- The Insignia™ Hydrophilic Connection Hat is utilized to provide a positive compression seal at the main/lateral junction when using a main to lateral CIPP connection system. This molded hat provides a 360 degree lateral seal that extends over the connection and into the mainline; thus preventing water from tracking behind the liner and back into the collection system. The Insignia Hydrophilic Connection Hat creates a compression gasket at the main source of infiltration ensuring that this sealing technology, along with a structural CIPP repair is the most effective solution for rehabilitating the main/lateral connection. The Insignia product line used in conjunction with CIPP lining is more than just a structural repair where the CIPP lining will provide a 50 plus year design life while the molded gasket provides a 50 plus year service life. Now these CIPP repairs with the use of molded gaskets can provide a design life that is parallel to its service life. The Connection Hat is used for 4" and 6" laterals only. End seal and flange gaskets are used in all other sizes.

Figure 3: Insignia™ Hydrophilic Connection Hat

Stainless Steel Compression Flange- The Lapel Liner does not depend upon the resin bonding to the CIPP lining or to the host pipe. Instead it utilizes a stainless steel compression ring that is mechanically fastened to the main pipe. This mechanically anchored connection liner can't fall away from the mainline liner like "brim style" liners that are installed by using resin only. It does not matter which thermoset resin is used because it will not adhere to a wet surface. Also note that prior to mainline installation the coating side of the liner is thoroughly saturated with a lubricant. Then to add one more layer of difficulty, the coating of the mainline liner is made of polyethylene and or polypropylene. Therefore, the mechanically fastened compression flange removes all the concerns of bonding. The end result is a one-piece lateral lining and sealed connection.

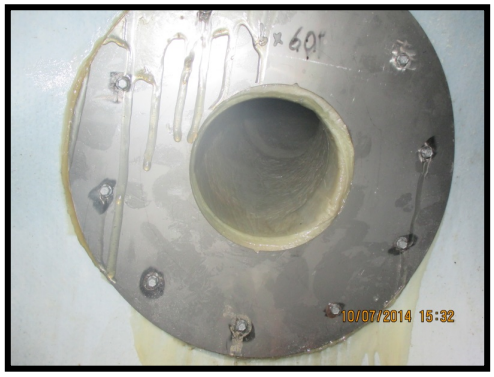

Figure 4: Stainless steel compression flange

4. OPERATION AND TECHNIQUE

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 mainline lapel and lateral tube are vacuum impregnated with the resin and then placed inside the lateral pipe via man-entry into the mainline. The liner is then placed inside of the lateral and the lapel is pressed against the mainline. The lapel and hydrophilic gasket are held in place with an appropriately sized stainless steel compression ring which is anchored into place. The lateral tube is pressed against the lateral pipe wall by using a rubber inflation device. The liner is then cured at ambient

temperature. Once cured, the lateral inflation device is removed. The end result is a one-piece structural lateral lining and mechanically fastened connection to the main that provides a verifiable non-leaking connection with all mainline pipe types by incorporating a molded gasket at the connection and molded gaskets (O-rings) at the terminating end of the lateral.

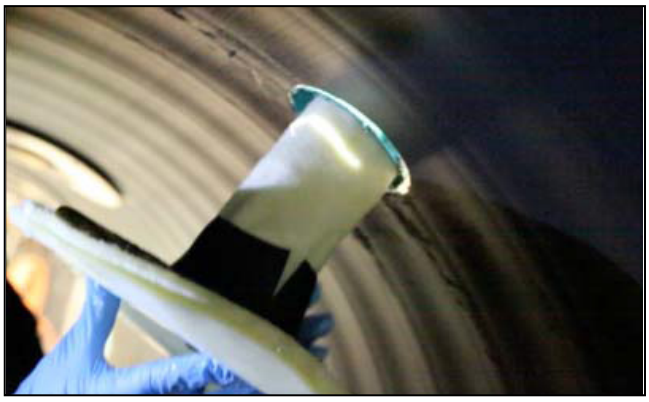

Figure 5: Lapel Liner inserted into service line

Figure 6: Anchor installation onto the brim through the steel ring

Shown in the table below are the components described above of the Lapel Liner:

Table 1. Lapel Liner Components

Item #	Part	Description	Quantity
1	Lapel Liner	Non-woven Lateral Tube and Coated Felt Brim, stitched and UV sealed	1
2	Lapel Flange	Stainless Steel	1
3	Tapcon Screw	Stainless Steel	Varies per Size
4	Hydrophilic Gasket Sealing	Hydrohat for 4" and 6" Laterals, End Seal and O-Ring Gaskets	2

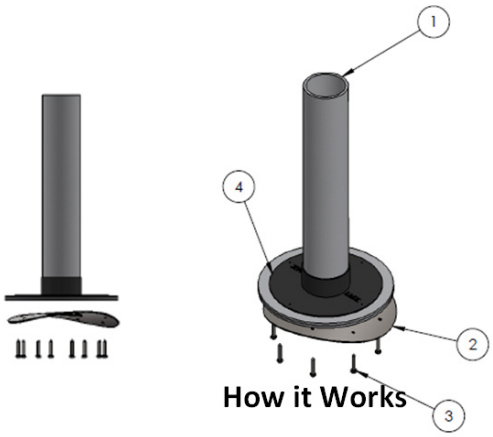

Figure 7: Lapel Liner Components

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 F1216-07, please refer to Table 2. Minimum Test Standards below:

Table 2. Minimum Test Standards
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

5. INTENDED USEAGE AND SYSTEM COMPATIBILITY

This rehabilitation method can be utilized for any of the following issues, 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.

The system is compatible with all types of pipes; vitrified clay, Concrete, Cast Iron, P.V.C, Brick and existing main pipes that have a cured-in-place liner. Typically, full-length lining systems utilize an inner coating or film. Films may range from poly vinyl chloride, polyurethane to polyethylene. The system is compatible with all pipe materials because adhesion is not part of the design but due to the use of a mechanically fastened hydrophilic sealing connection compression gasket at the mainline/lateral connection.

The system can accommodate pipe ovality up to -20% and is designed for gravity sewers and low pressure piping.

6. SEWER PREPARATION

Sewer preparation involves cleaning and flow stoppage or a 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 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. Due to the nature of this process where a technician or technicians will enter the main pipe all safety processes are thoroughly followed and in some cases even doubled. Typical time for plugging the mainline is three-hours (3) or less. In some cases by-pass pumping will be required and used.

7. CURING METHOD AND DESIGN LIFE

The selected resin systems are cured at ambient temperatures. Properly formulated Polyester Ambient Cure Resin has a one hour pot time and a one hour cure time. The 50-Year Design Life is based on the assumption described in ASTM F1216 for the lateral lining. Appendix X1 and long-term creep are as described in ASTM D2990.

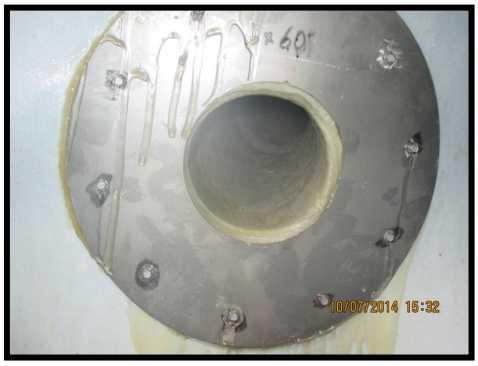

Figure 8: Cured Lapel Liner Installation

Figure 9: Cured Lapel Liner Installation

8. CONCLUSIONS

Until now, lateral connection repairs in large diameter and odd-shaped mainlines were not effectively repaired and therefore in most cases ignored. This system is quickly and effectively installed once proper safety procedures have been strictly followed for man-entry into the buried pipeline. A properly outfitted crew in the right conditions can install six to seven per day. The Man-Entry Lapel Liner System successfully renews the lateral to a predetermined length and seals the connection water-tight with a 50 plus year design life and a 50 plus year service life.

Figure 10: 8 inch cured Lapel Liner Installation

Figure 11: 12 inch cured Lapel Liner Installation

Figure 12: 15 inch cured Lapel Liner Installation

9. REFERENCES

ASTM F1216-07, Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube, ASTM International, West Conshohocken, PA, 2007, www.astm.org.

ASTM D790-10, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials, ASTM International, West Conshohocken, PA, 2010, www.astm.org.

ASTM D2990-09, Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics, ASTM International, West Conshohocken, PA, 2009, www.astm.org.