Sealing the Connection for Large Diameter Pipes, Trenchlessly

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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.
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-violet 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 1: Man-Entry Lapel Liner

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.

![Insignia™ Hydrophilic Connection Hat](image)

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

![Stainless steel compression flange](image)
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](image)

![Figure 6: Anchor installation onto the brim through the steel ring](image)

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

<table>
<thead>
<tr>
<th>Item #</th>
<th>Part</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lapel Liner</td>
<td>Non-woven Lateral Tube and Coated Felt Brim, stitched and UV sealed</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Lapel Flange</td>
<td>Stainless Steel</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Tapcon Screw</td>
<td>Stainless Steel</td>
<td>Varies per Size</td>
</tr>
<tr>
<td>4</td>
<td>Hydrophilic Gasket Sealing</td>
<td>Hydrohat for 4&quot; and 6&quot; Laterals, End Seal and O-Ring Gaskets</td>
<td>2</td>
</tr>
</tbody>
</table>

![Figure 7: Lapel Liner Components](image)
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

<table>
<thead>
<tr>
<th>Test Standard</th>
<th>Minimum Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexural Strength</td>
<td>4,500 PSI</td>
</tr>
<tr>
<td>Flexural Modulus</td>
<td>250,000 PSI</td>
</tr>
</tbody>
</table>

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.
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.

9. REFERENCES

