



# Non-Disruptive, Close-Fit Pressure Pipe Rehab System is Best-Fit Solution for Critical Tunnel Project



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# UNDERGROUND CONSTRUCTION TECHNOLOGY

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## What to Expect

- **Project Overview**
  - Project Background
  - Challenges to Overcome
- **Factors for Rehabilitation / Product Selection**
  - Pressure Classes
  - Material Information
- **Installation**
  - Process and Details



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## Project Overview

- Fire suppression & stormwater discharge lines in tunnel
- 8" Cast Iron
- 6,300 LF of close-fit hose-style lining
- Class III – Semi-structural
- 12 Installs – Avg. 570 LF
- 90 psi operating pressure





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## Location

- **Midtown & Downtown Tunnels**

- Connect Norfolk and Portsmouth, VA



- **Elizabeth River Crossings OpCo**

- Finance, deliver, operate, maintain
- Tolls

- **Heavy Traffic Volume**

- At one point was most heavily travelled 2-lane road in East





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## Project Origins

- **2015 – concerns arise**
  - Fear of failure
  - Financial implications
- **2018 – failure in fire suppression line**
  - Fire suppression is critical
  - Short-term fix for now
- **New line was laid via open cut method**
  - EXPENSIVE and time consuming
  - Time to go trenchless



Example of concrete removal



## Challenges to Overcome

- **Limited Access**
  - Two tunnel systems
- **Project Location**
  - Stairs to traverse
- **Tight working area**
  - Beneath roadway in tunnel access





- **Project Needs:**

- Current flow capacity needed to be maintained
- Fully structural solution not required – pipe embedded in concrete
- The pipelines always experienced positive internal pressure.
- Operating pressures of 90 psi
- Keep “excavations” to a minimum
- Challenging access/workspace limitations



## Pressure Classes Overview

- **General Structural Classifications Objectives from Structural Classification of Pressure Pipe Linings**
  - Suggested Protocol for Product Classification
  - AWWA Committee Report

Lining System Characteristic	Non-Structural	Semi-Structural (Interactive)		Fully Structural
	Internal coating	Hole span	Hole span + ring stiffness	Structural resistance for all specified loads (internal & external)
	Class I	Class II	Class III	Class IV
Internal corrosion protection	✓	✓	✓	✓
Long-term adhesion to the host pipe	See Note 1 Below	✓	See Note 2 Below	See Note 2 Below
Hole span at MAOP		✓	✓	✓
Inherent ring stiffness (hydrostatic pressure or vacuum loads only)	See Note 1 Below	See Note 1 Below	✓	✓
Water tightness (positive connection to service taps and sealed at termination points or other discontinuities)		✓	✓	✓
Inherent ring stiffness (all static and dynamic external, hydrostatic, and vacuum loads)				✓
Pressure rating of lining $\geq$ MAOP of host pipe				✓
Lining survives anticipated host pipe failures				✓

*1 The owner/engineer must specify whether vacuum loads exist. This is addressed through reliable adhesion to the host pipe, which is a characteristic of all Class II and some Class I linings, or inherent ring stiffness.*  
*2 For Class III and IV linings, adhesion is not required to develop ring stiffness. However, it may be necessary to achieve a watertight seal (for example, at services and lining terminations). There are also situations where adhesion is not desirable, such as applications with broad temperature swings and in Class IV linings where the host pipe is anticipated to experience brittle failure modes.*



## Class III Liners (Summarized)

- **Class I** – non-structural liners that provide internal corrosion protection or to improve water quality and are bonded to host pipe and provide no water tightness
- **Class II** – interactive and semi-structural lining systems that bond to the host pipe, provide minimal inherent ring stiffness, and relies on a bond the host pipe to prevent collapse if pipe is depressurized, provides some gap spanning
- **Class III** – interactive and semi-structural lining systems that may or may not bond to the host pipe, are sealed to provide hydrostatic integrity, have enough inherent ring stiffness to be somewhat self-supporting if pipe is depressurized, and have better gap spanning capabilities than Class II liners.
- **Class IV** – independent and fully structural lining systems that are structurally equivalent of replacement pipe, can handle all static and live loads, and can survive a variety of failure modes of the host pipe without impact to the liner



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## Why Hose-Style Liners?



Ease of  
installation and  
reconnection



Reduced  
project  
footprint



Speed of  
installation



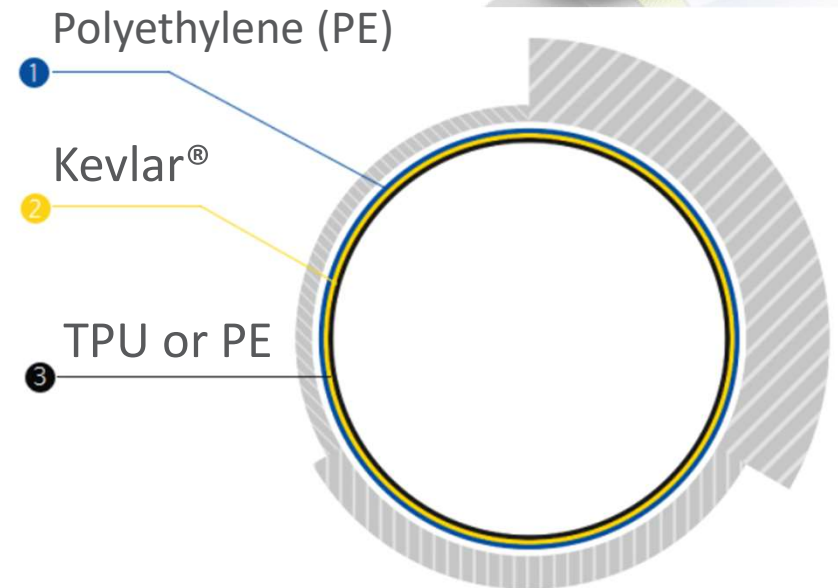
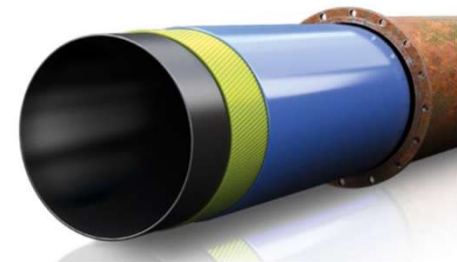
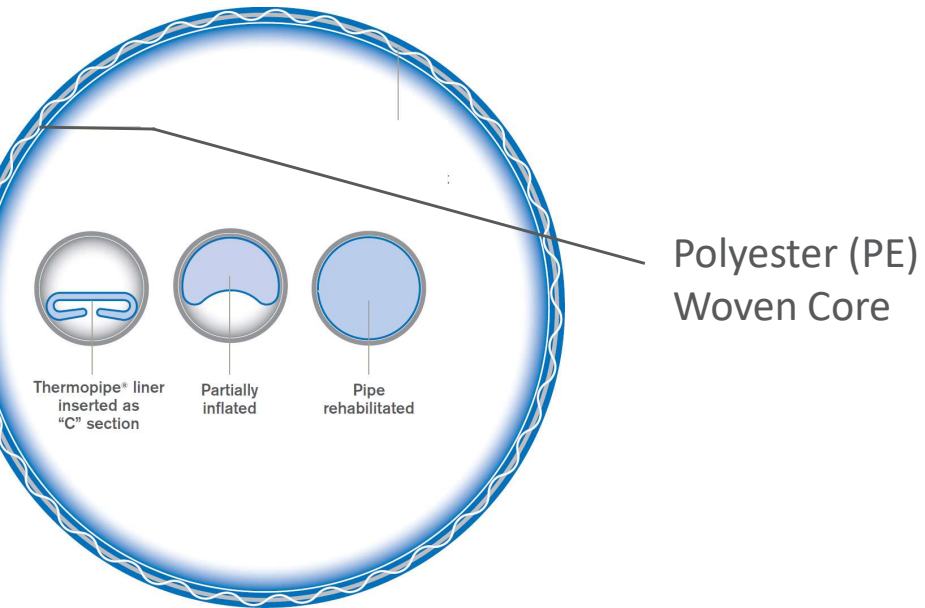
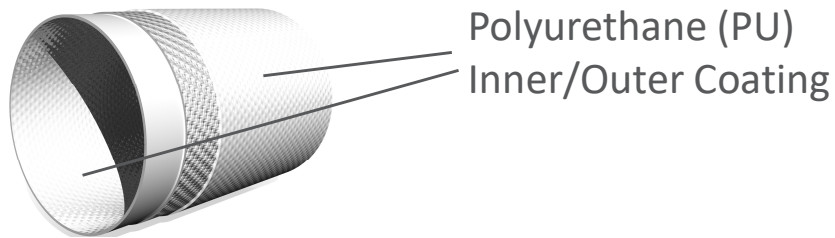
Excellent  
physical  
properties



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## Hose-Style Liner Construction

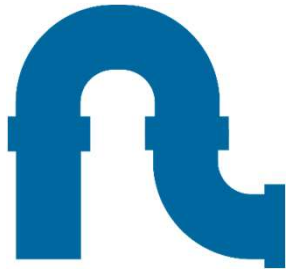




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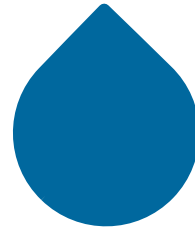
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## Hose-Style Liner Benefits



### Negotiates Bends

Hose can negotiate multiple bends in host pipe



### Maximize Flow

Hazen Number = 150  
Maximum OD for Hose Liner



### Simple Installation

Winch & Air Compressor



### Ease of Reconnection

Mechanical connections using standard waterworks fittings



## **Rehabilitation Process Overview**

- **ACCESS**
- **BYPASS / FLOW DIVERSION**
- **CLEANING / PIGGING**
- **PULL-IN INSTALLATION (NO CURING)**
- **PRESSURE TESTING**
- **END CONNECTIONS / CLOSURE**
- **RESTORATION**



## Materials & Product Development

- **Gen 1**

- Lower Pressure Rating
- Cured material

- **Gen 2**

- No Curing
- Longer Install Lengths

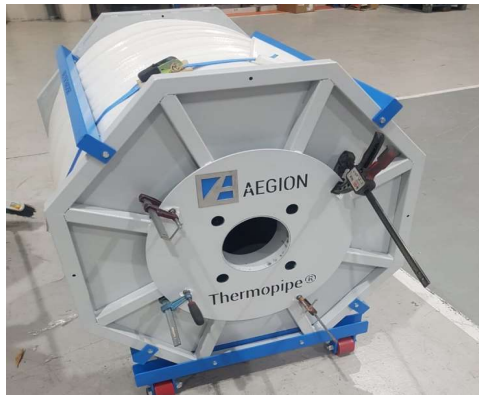
	Generation 1	Generation 2
Plastic Material	Polyethylene (PE)	Polyurethane (PU)
Reinforcing Fiber Material	Woven polyester	Woven polyester
Pressure Rating	Up to 200 psi	Up to 250 psi
Install Lengths	Up to 1000 ft	Over 2,000 ft
Diameter Range	4 to 12 inches	2 to 12 inches
NSF/ANSI Standard 61 Certified?	Yes	Yes (Q1 2020)
Tap into liner for new service line?	Yes, w/ special fittings	No
Close-fit to host pipe?	Yes	No- ½ in smaller diameter
Cure time?	Yes	No
Reel Condition	“C” folded section	“U” folded section
Install Pull Force	Low	High
ISO Certified?	Yes. 9001:2015	Yes. 9001:2015

The current material is a hose-style liner that is a static material containing no resins



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## Step 1

Set up Reel on site for unwinding.



## Step 2

Attach pull head, connect to cable and use winch for pull in.



## Step 3

Inflate Thermopipe® with compressed air to expand hose and break tape.



## Step 4

Simple mechanical end connections and reconnect with standard waterworks fittings.



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## Project Installation



**8" Hose-style Liner on Reel**



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## Project Installation



**Pull head on staged liner**



**Liner – pulled-in, uninflated**



**Fully completed installation with tie-ins**

- **Proprietary End Connections**
  - Epoxy coated steel
  - Plain end or flanged
- **Standard Waterworks Tie-Ins**
  - Owner preference for closure



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## Pressure Testing



### ASTM F1216-16



...recommended pressure and leakage test would be at twice the known working pressure or at the working pressure plus 50 psi, whichever is less.

~~ASTM = 140 psi test~~

Fire code = 165 psi test



## Challenges Encountered

- **CCTV Inspections**
  - Protruding Angle Iron
  - Exposed Rebar
- **Detrimental to Liner**
  - Pull-in / Snags
- **Owner/Engineer Review**
  - Point repairs to remediate



Protruding Angle Iron



Exposed Rebar



## Challenges Encountered

- **Site Readiness**

- Pipe access was challenging
- Lining portion was “easiest” portion of project.
- 8 days of lining under ideal conditions
- 6-week project duration (lining)





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## Project Summary



12 installations  
570 LF each



6,300 LF of Class III  
Pressure Lining



165 psi pressure  
tests – all passed



Job Duration:  
6 weeks (on time)



(Cleaning, Lining,  
Pressure Testing)



Massive  
savings over  
dig & replace  
costs / impact



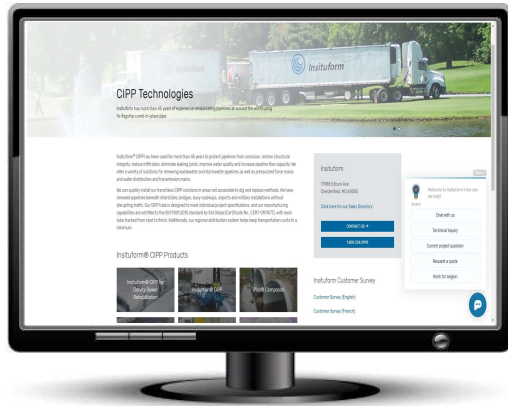
Completed safely  
and on budget  
(~\$1.2M)



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## Questions and Thanks!



[www.insituform.com](http://www.insituform.com)

- Pressure Pipe Lining Information
- Trenchless Applications
- Specifications
- Experience Requirements
- Budgetary Assistance
- Feasibility
- Engineering
- Pressure & Gravity
- Wetout/Manufacturing Tours

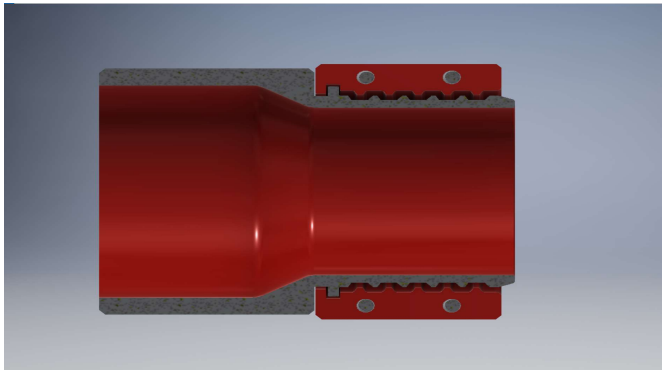
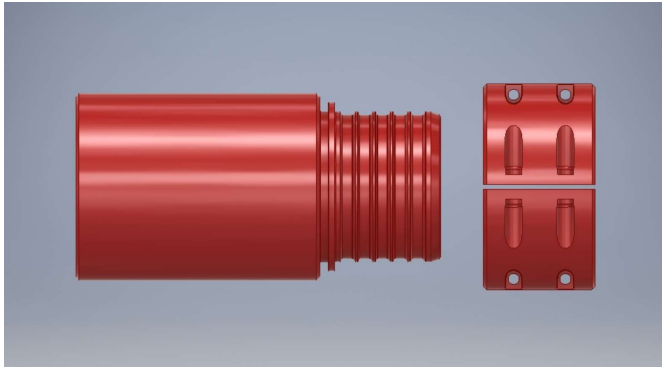
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- Epoxy Coated Steel
- Ease of Reconnection
- Plain End Connection