Learning Objectives

- Examine the challenges facing the North American pipeline rehabilitation market
- Discuss advancements in Cured-In-Place Pipe (CIPP) and reinstatement of service connections
- Review a recent pilot project

North American Pipeline Rehabilitation Market

Potable Water Infrastructure Condition

According to Bluefield Research:

- The estimated average **age** of water pipelines across the nation has climbed **from 25 years** in 1970 **to 45 years** in 2020 — largely because of underinvestment.

- U.S. utilities lose nearly **two trillion gallons** of water — **15%** of the total drinking water treated nationwide — to leaks each year.

- Municipal non-revenue water losses — real losses, apparent losses, unbilled consumption — run **as high as 43%** in major U.S. cities **and exceed 85%** in some smaller rural communities.

According to the American Society of Civil Engineering (ASCE) 2021 Report Card for America's Infrastructure:

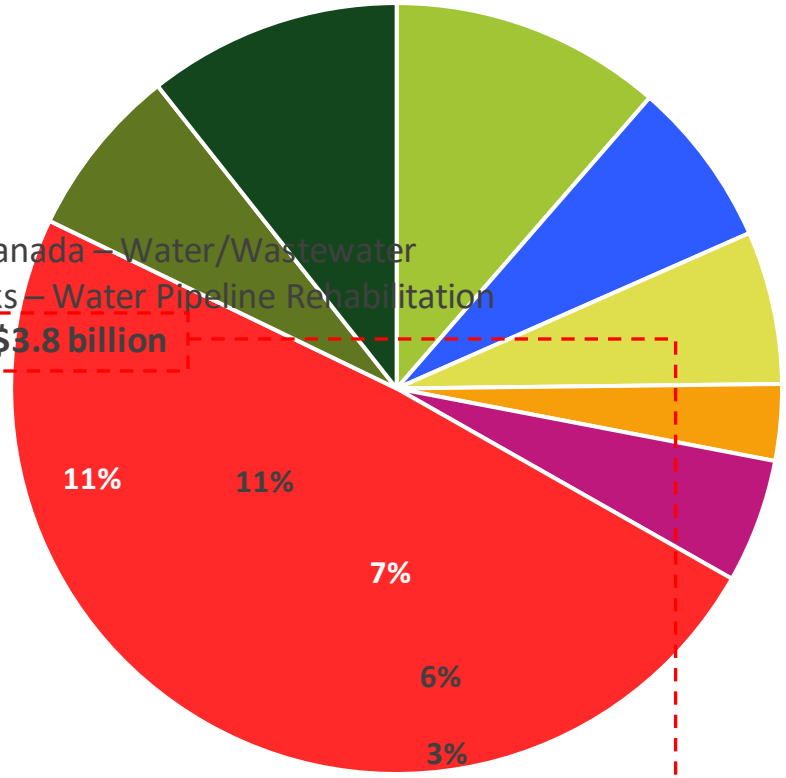
- Our nation's drinking water infrastructure system received **a "C-" grade**.

- A recent survey found that **47%** of the maintenance work undertaken by utilities is **reactive and done as systems fail**.

- Our nation's drinking water infrastructure is composed of **2.2 million miles** of pipe. By 2019, utilities were replacing **between 1% and 4.8%** of their pipelines per year on average.

on Market

- U.S. & Canada – Water/Wastewater Networks – Water Pipeline Rehabilitation Spend: **$3.8 billion**



Pipe Burst
Cured-in-place Pipe
Slipline
Epoxy Lining
Cement mortar lining
Dig and Replace
Horizontal Directional Drilling
Other

($ in MM)

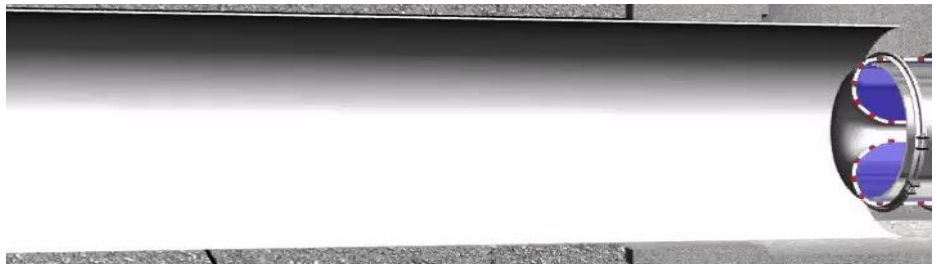
Water Pipeline Rehab - Sub-Categories	% Spend Allocation	
Pipe Burst	*11%*	$432
Cured-in-place Pipe	*7%*	265
Slipline	*6%*	243
Epoxy Lining	*3%*	121
Cement Mortar Lining	*5%*	197
Dig and Replace	*49%*	1,855
HDD	*7%*	273
Other	*11%*	403
		$3,791

Pressure pipeline agencies are less inclined to use trenchless technology compared to gravity pipeline agencies, primarily due to additional access requirements and unfamiliarity

Cured-in-Place Pipe (CIPP)

What is Cured-in-Place Pipe (CIPP)?

- **Developed in 1971, Cured-in-Place Pipe (CIPP) is a trenchless technology:**
  - Initially used in sewers (~30,000 miles)
  - Full length, jointless, “pipe-within-a-pipe”
  - Minimally disruptive installation methods
- **Market needs later led to development of a pressure-capable CIPP product:**
  - Uses reinforcing materials and advanced resins to meet environmental and physical properties demanded by pressurized systems
  - Certified to NSF/ANSI 61 standards
  - 50+ year engineered design
  - Utilizes multiple curing methodologies
    - Steam, hot water, UV light



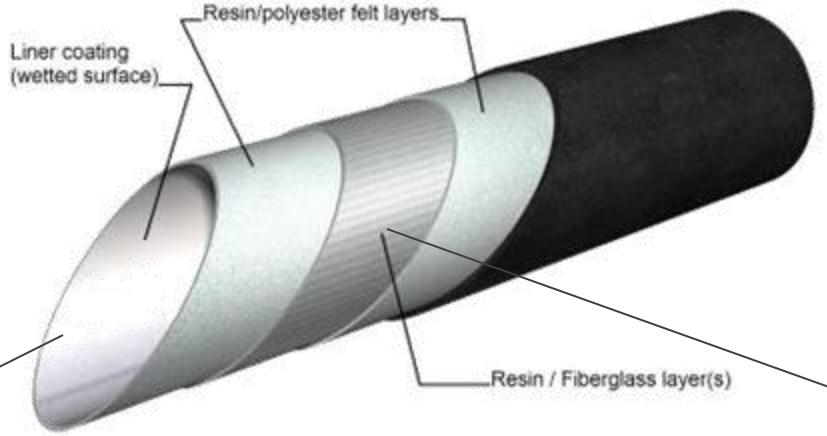
Pressure CIPP Glass Composite Structure

Epoxy/polyester felt structure

- Provides for external load capacity
- Layer thickness can be varied depending on loading conditions
- Utilizes epoxy resin system instead of polyester resin (drinking water safe)

Hazen-Williams Coefficient

- C=140



PP/TPU coating

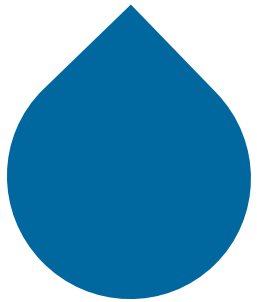
- Water contact surface
- Coating also provides water barrier for installation processes & handling

Epoxy/fiberglass structure

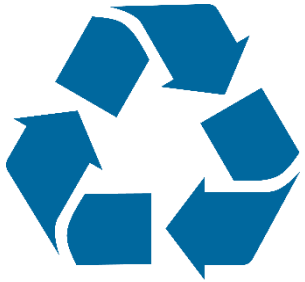
- Provides high tensile/hoop strength
- Number of layers varies depending on diameter and internal pressure

Pressure CIPP Technical Envelope

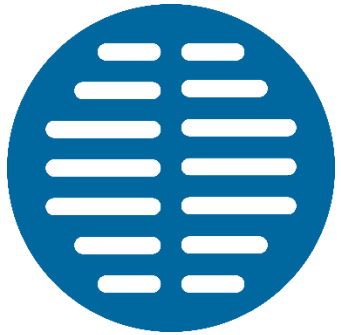
Potable water



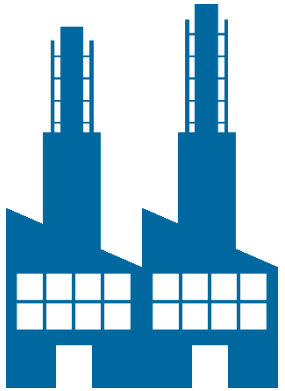
Raw water



Reclaimed water



Sanitary water



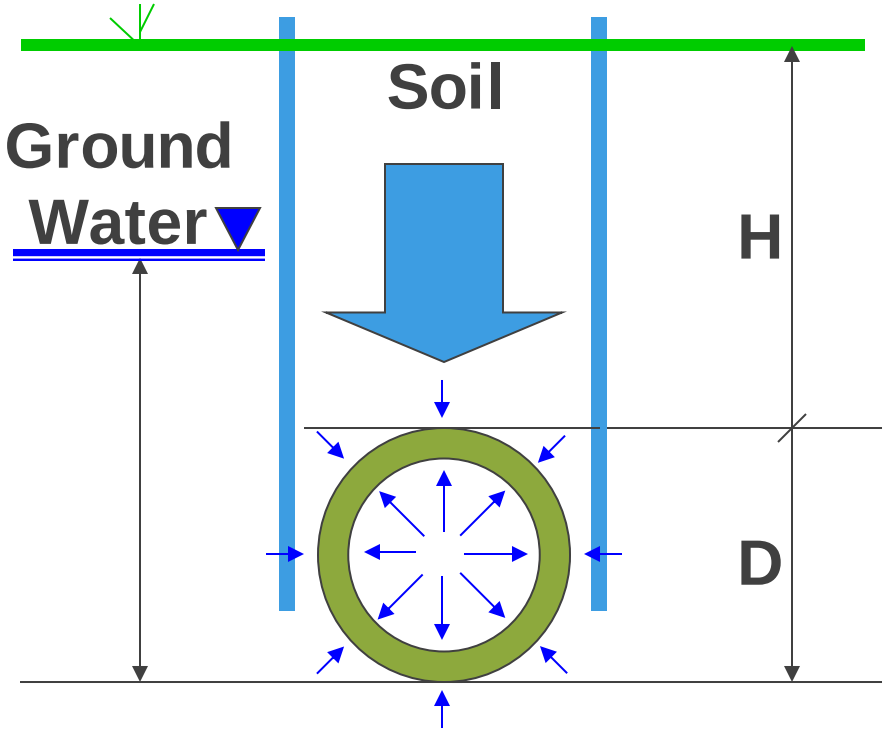
Industrial
(Fire & Process Water)

Technical Envelope

- Diameter = 6” to 96”
- Max. Operating Pressure = 250 psi
- Bends = up to 45°
- Access Pits Required for Installation
- Internal Reinstatement of Service Connections

Pressure CIPP Installation

CIPP Design Parameters



Gravity CIPP

- Meet the design intent of:
  - ASTM F1216 / AWWA M28
- External design:
  - Soil, groundwater, traffic, and other live loads

Pressure CIPP

- Internal design:
  - Operating, transient and vacuum pressures
- Other factors:
  - End fittings, bends and services

AEGION

Pressure CIPP Watertight Seal Requirements

Potential Leak Locations:

- End terminations
  - Vary by product and installer
  - Adhesion, mechanical or combination
- Service connections
  - Excavated, adhesion or mechanical

Mechanical Reinstatement of Service Connections

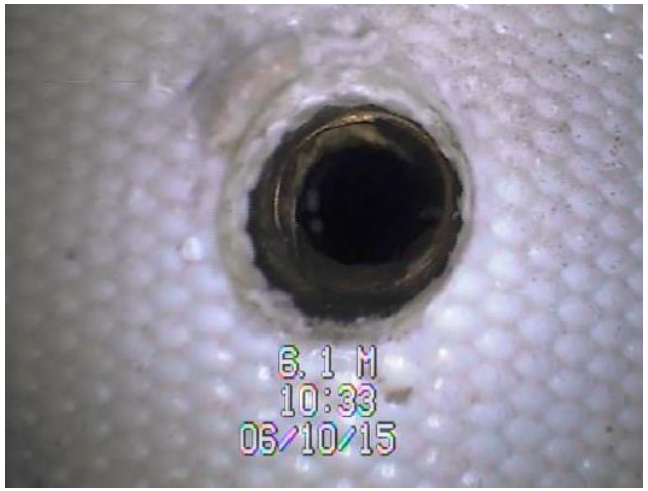
Historical Service Reinstatement Options

Excavated Mechanical Reconnections:

- Involves open-cut excavation installation of new mechanical connections at each service

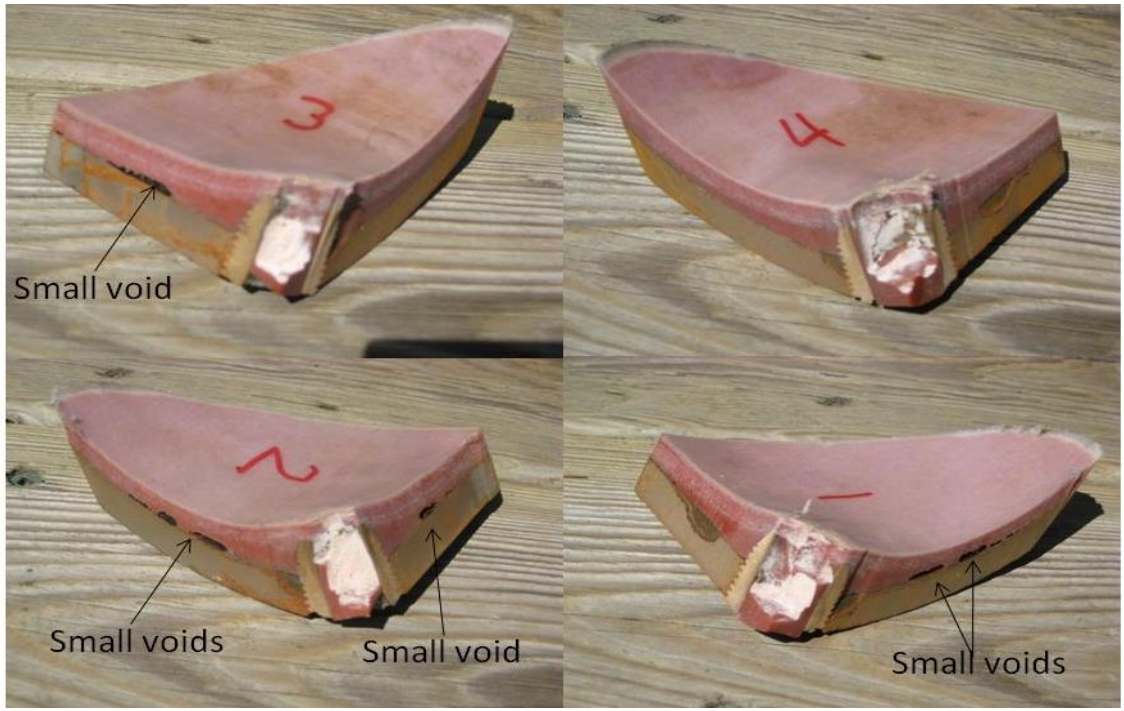
Adhesive Reconnections:

- “Plug and drill” method whereby liner adheres to host pipe and service corporation valve



Adhesion or Bond Reliance Summary

- Commercially implemented and cost effective
- Key to bond strength is surface preparation
  - Testing has proved that suitable bond can be achieved
  - Achieving bond is not a localized process
  - Different levels of effort provide varying results
- Long term effectiveness currently not characterized
- No governing standard for bond requirement
- Difficult to measure effectiveness



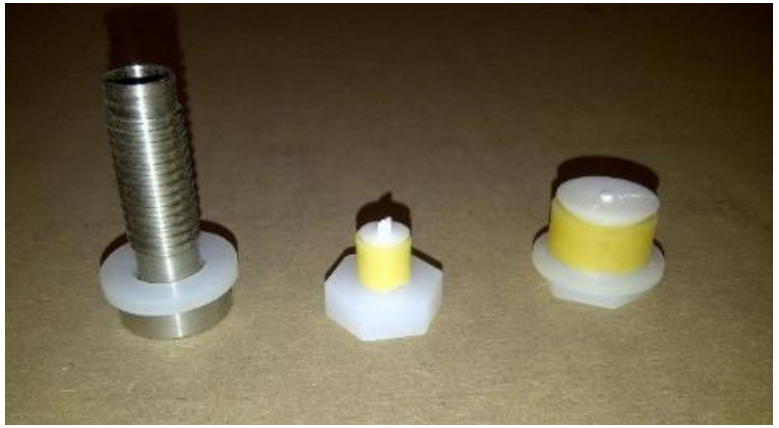
Traditional Internal Reinstatement

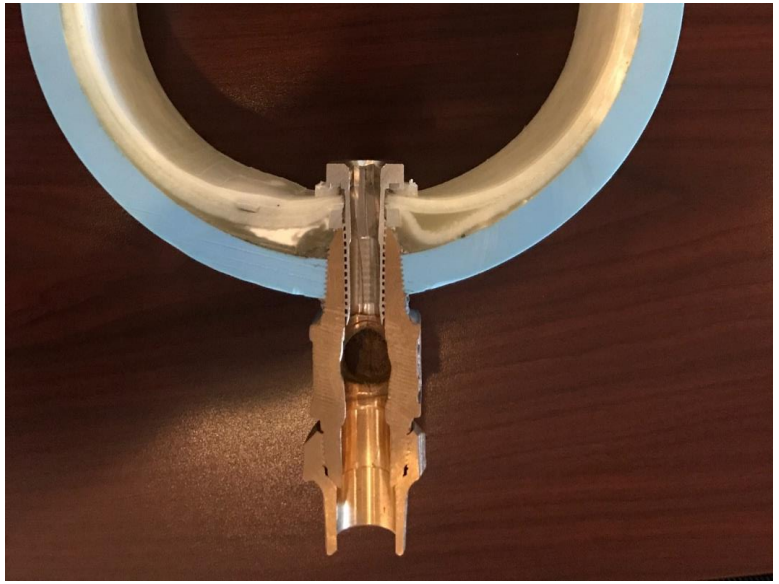
All reinstatement systems have common requirements/processes – bond reliant to date

1. Prepare internal surface
   - No specification, installer's requirements
2. Plug existing corporation valves – system specific
   - Direct tapped
   - Saddle tapped – no protruding corporation valve threads
3. Install CIPP pressure pipe liner
4. Terminate/cut liner at ends of lined pipe
   - Processes and effectiveness to provide a leak tight seal at terminations vary
5. Locate service under liner
6. Open service by drilling out plug

Mechanical Service Reinstatement

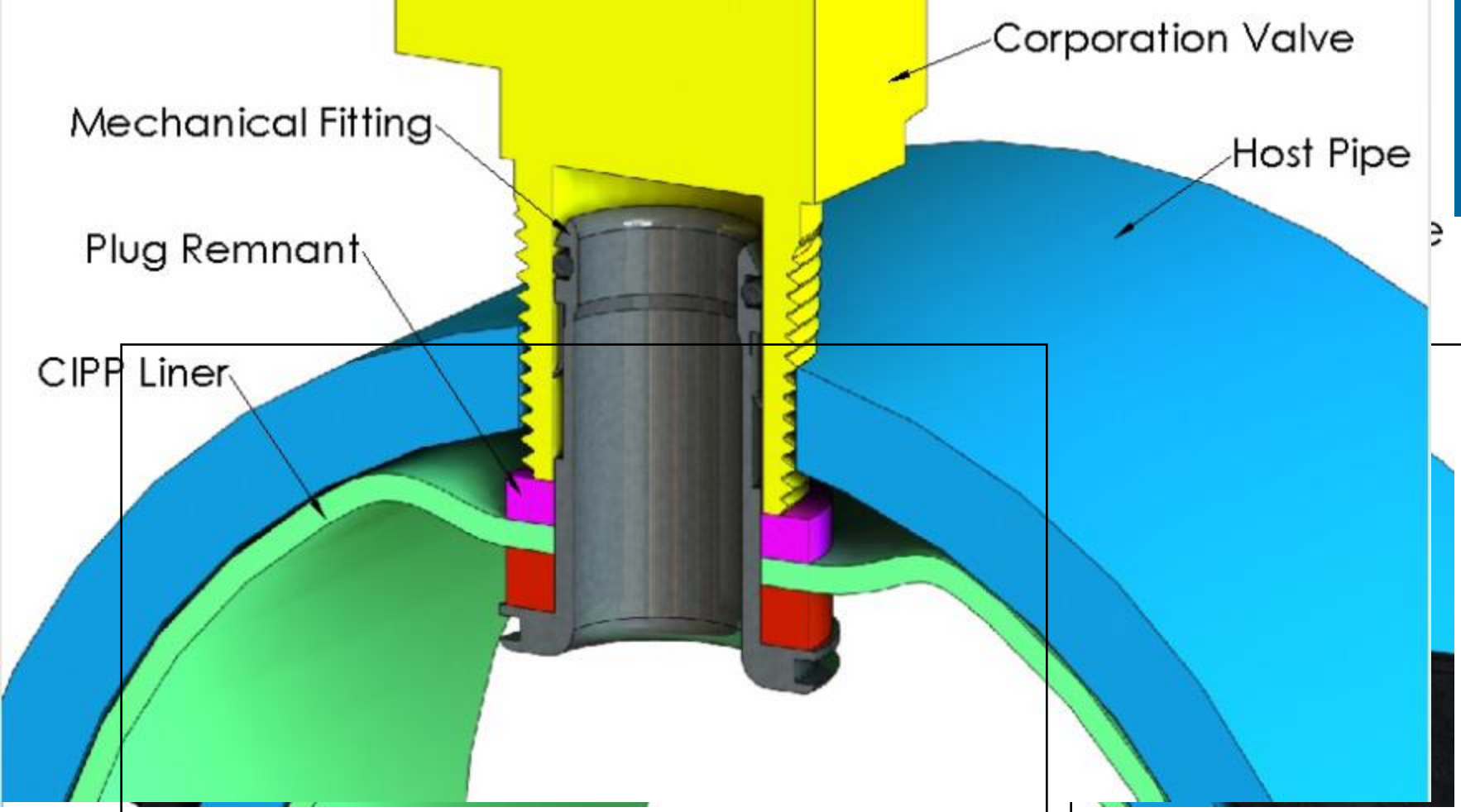
- First-generation mechanical service reinstatement system introduced in 2009
  - Plastic expandable plug
  - Hollow T-nut inserted and screwed in
- Technically successful but not cost-effective
  - Single process installation per pipe entry (plug and T-nut)
- <u>No reliance on bond or integrity of the host pipe</u>





Mechanical Service Reinstatement

- Current-generation mechanical service reinstatement system recently introduced
- Cork plug with magnetic studs
- Hollow stainless-steel fitting
- Push in installation process
- ½-inch, ⅝-inch, ¾-inch and 1-inch sizes



Direct Tap Service

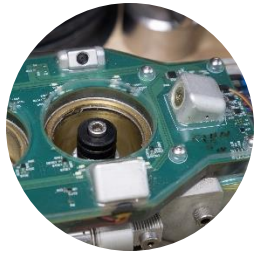
Saddled Tap Service

Mechanical Fitting System Components

Measurement probe
Consists of laser sensors and inspection camera

Mechanical fittings
Utilizes a patented push-in-place "Corpbite" system that maximizes pull-out force

Self-locating plug
Installed prior to lining to prevent resin migration



Cartridge loading system
Holds up to 8 plugs/mechanical fittings to maximize production

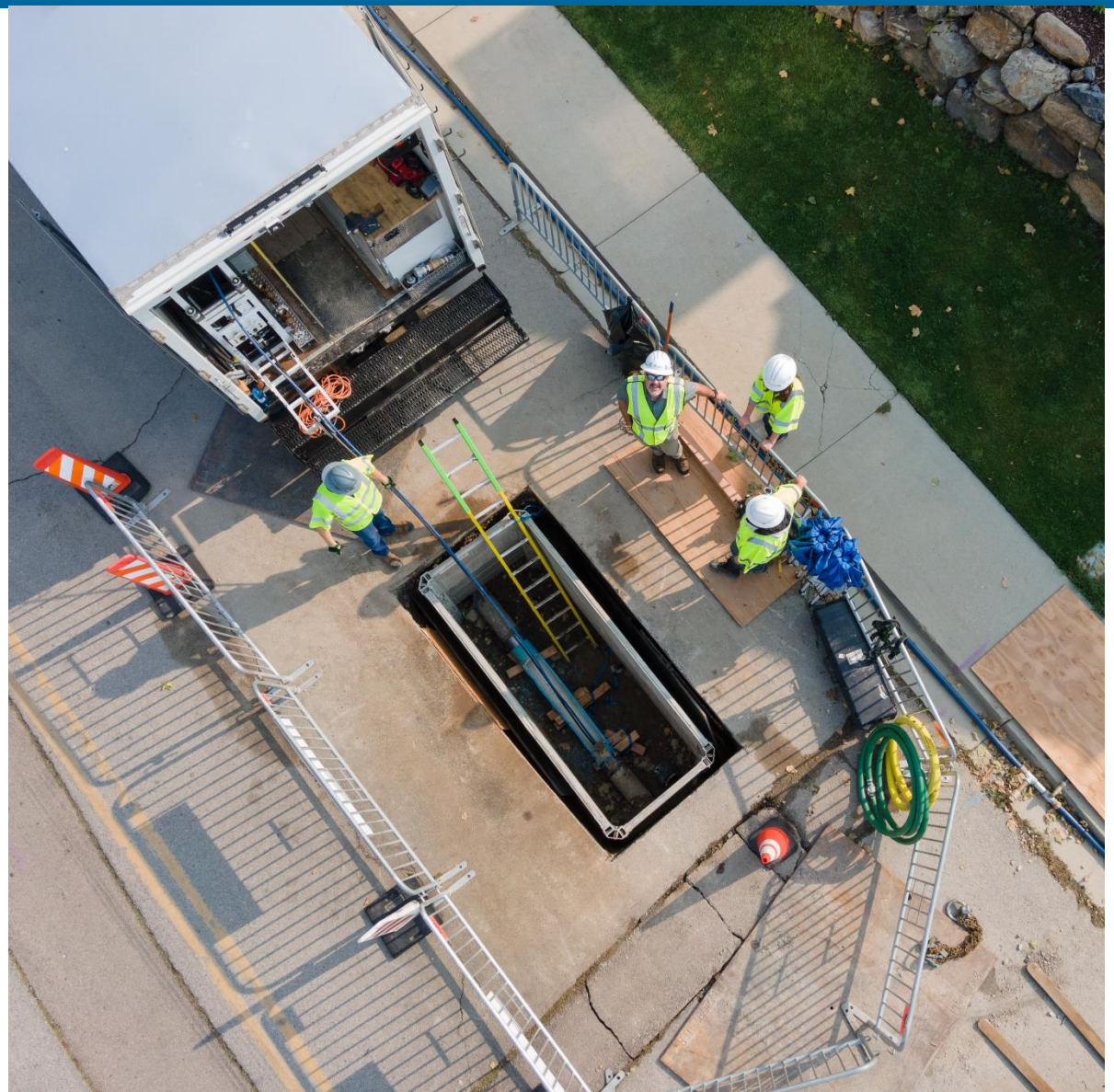
Drilling tool
Detects exact location of plug prior to drilling

Interface software
Provides operator with easy-to-use interface for reinstating connections

Mechanical Fitting System Review

Mechanical Reinstatement Pilot Project
Pleasant Grove, UT

Mechanical Reinstatement Pilot Project – Pleasant Grove, UT

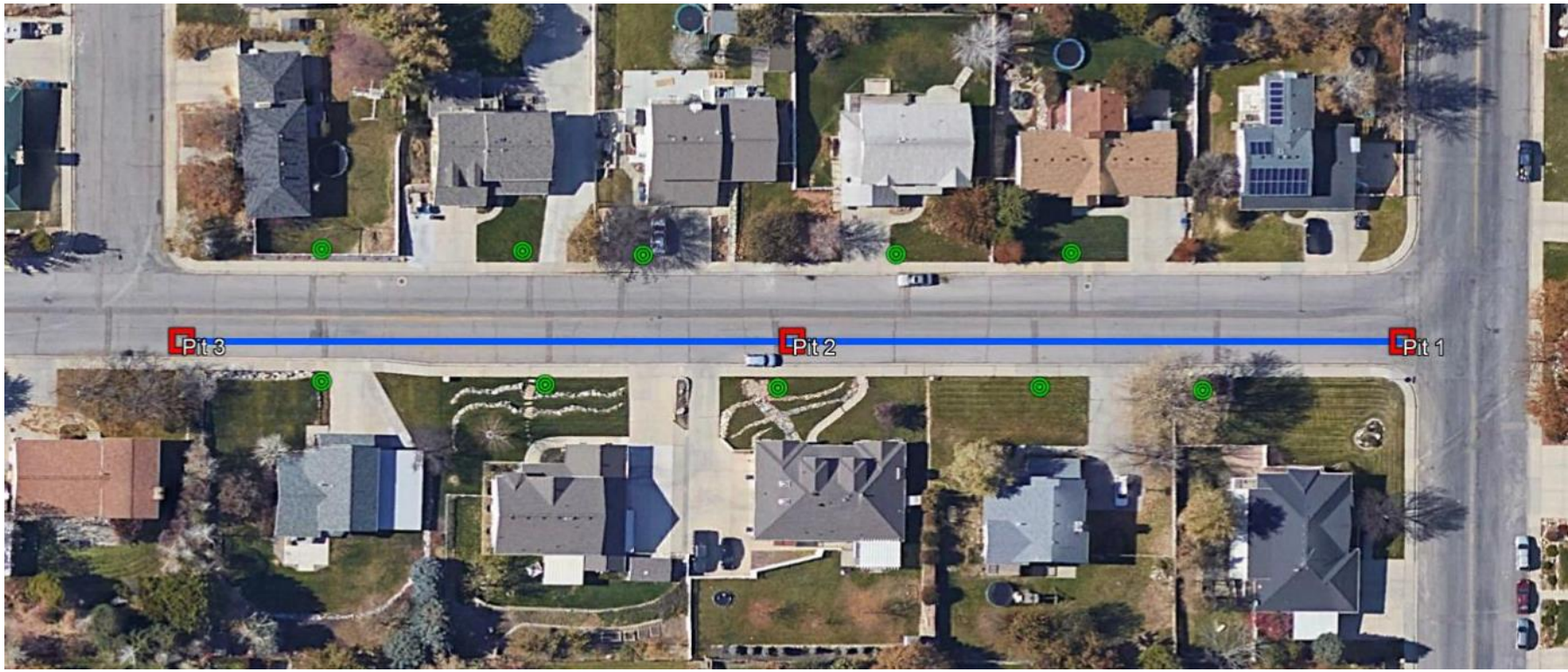


Project Description – Pleasant Grove, UT

Project Description

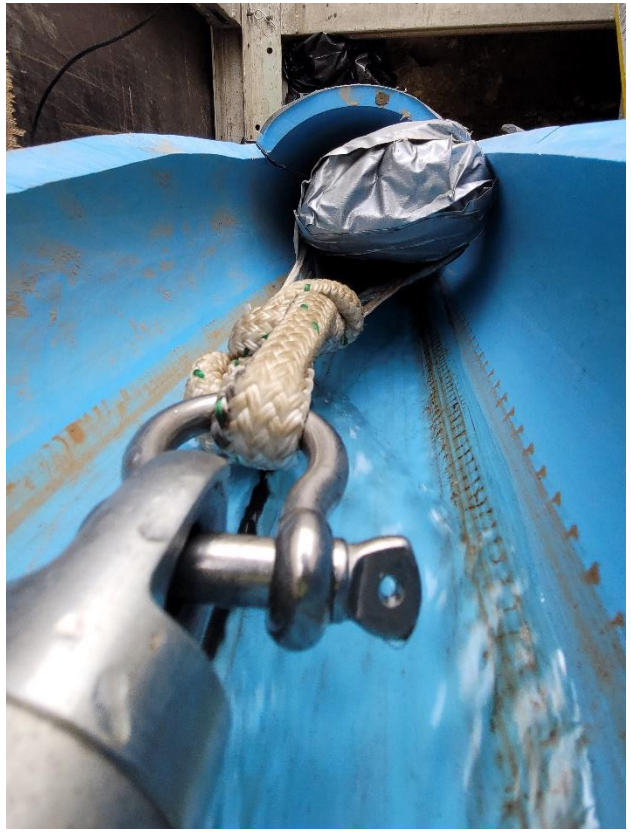
- Owner: Pleasant Grove City, UT
- Pipe Material: Ductile Iron
- Diameter: 8-inch (measured ID varied from 8-⅛ to 8-⅜ inch)
- Length: 540 LF
- Pressure: 120 psi
- Type: Potable water
- Services: Ten one-inch service connections
- Problem Statement: Historical breaks and leaks
- Other: Pipe sloped downhill to from Pit 1 to Pit 3

Pleasant Grove
Utah's City of Trees

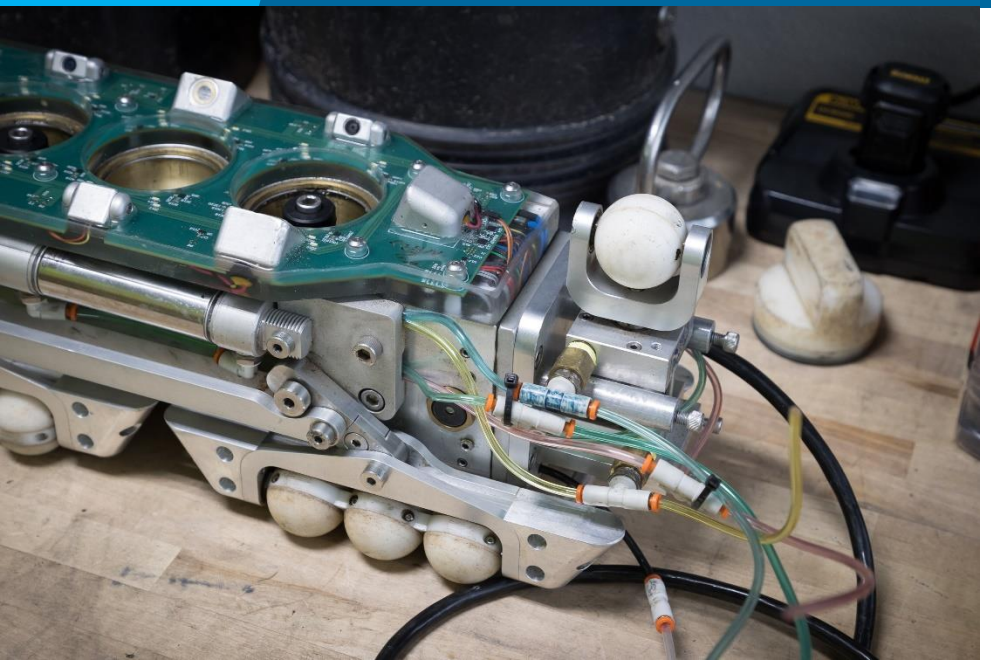


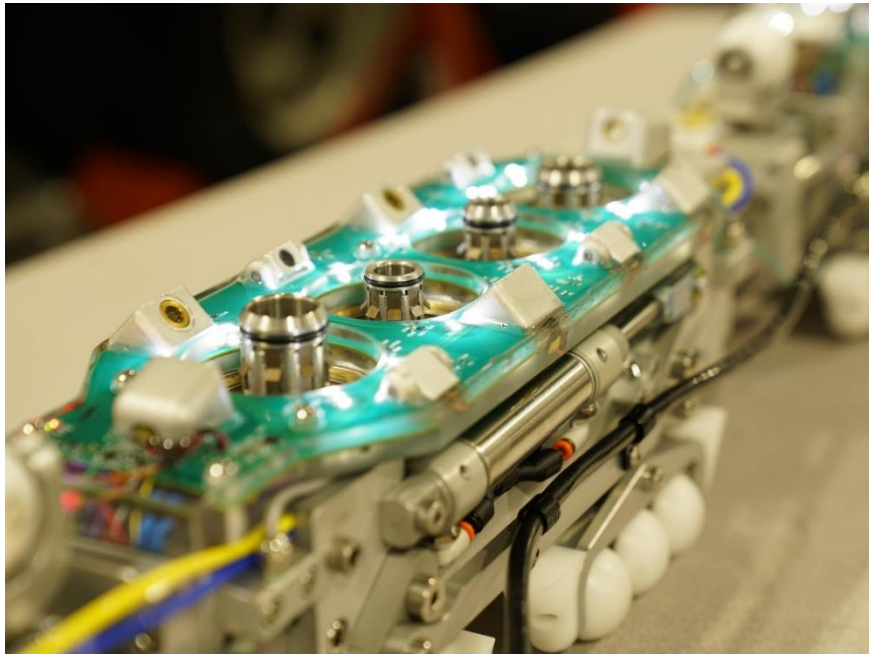
Potable Water Bypass

CIPP Liner Installation

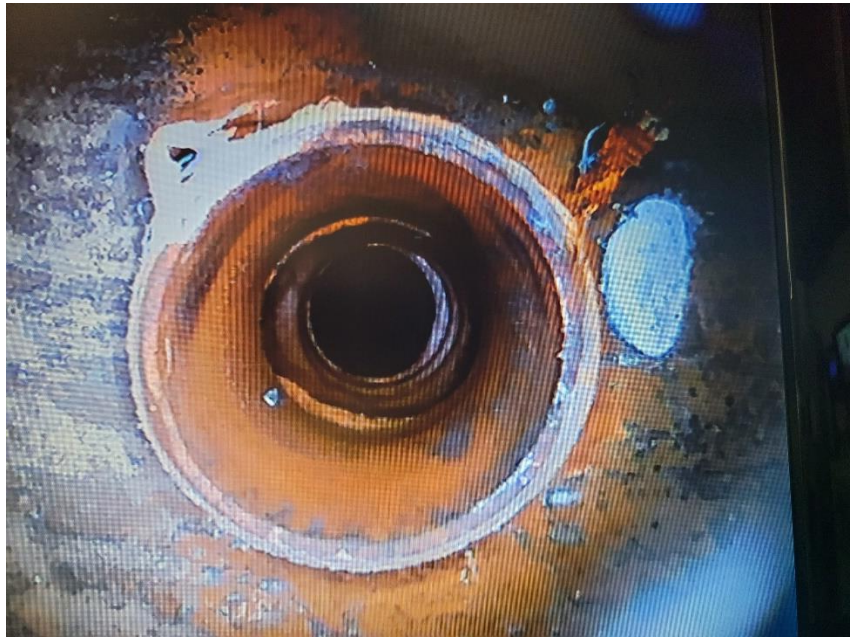


Plug/Fitting Installation Unit

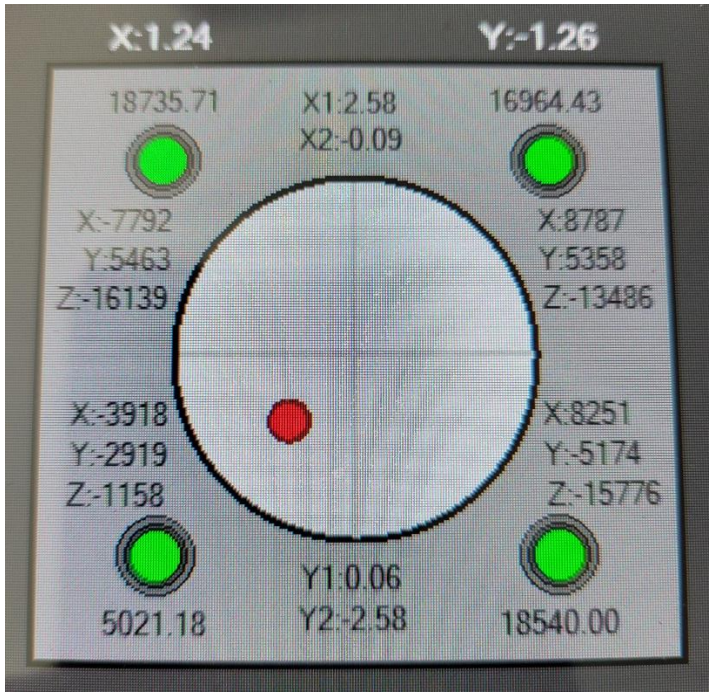


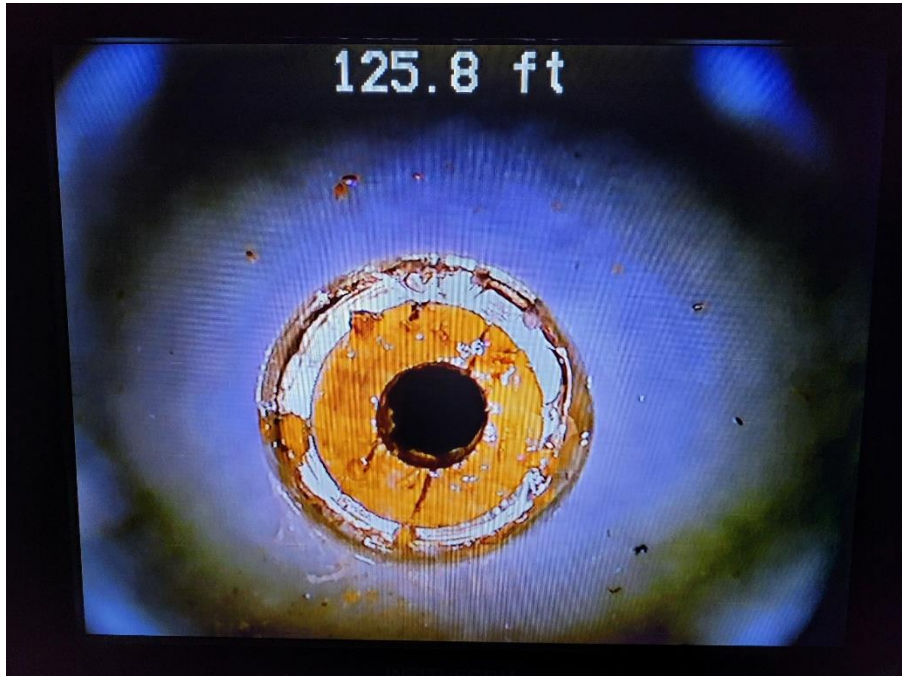


Milling of Direct Tap Corporation Valves

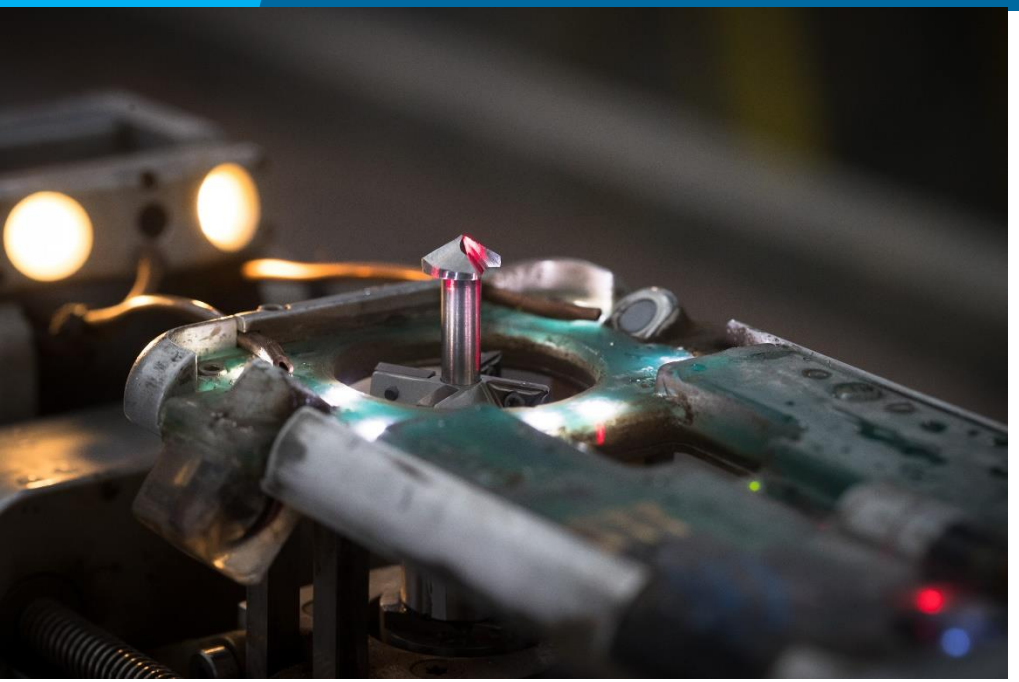


Service Plug Location and Removal

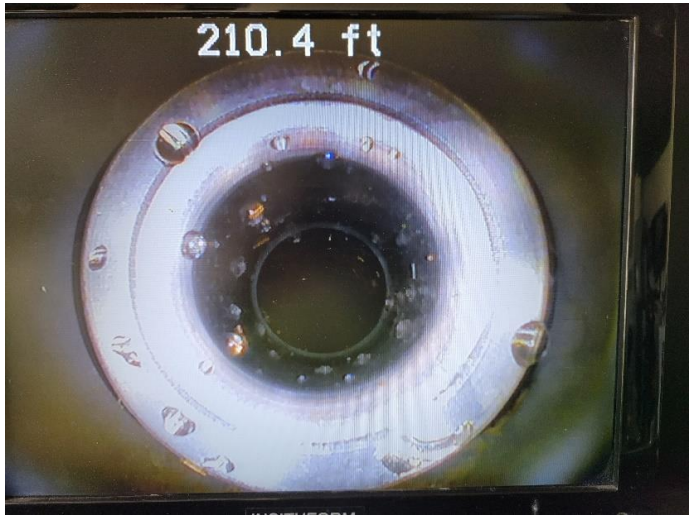




Drilling/Grinding Tool



Mechanical Fitting Installation



Thank You for Joining Me Today!

Feel free to reach out with any questions:

Brad Conder, P.E.

bconder@aegion.com

801-472-8472

www.Aegion.com

AEGION®

Stronger. Safer. Infrastructure.®