Case Studies: UV CIPP Point Repairs for Rapid Response to Defect Correction

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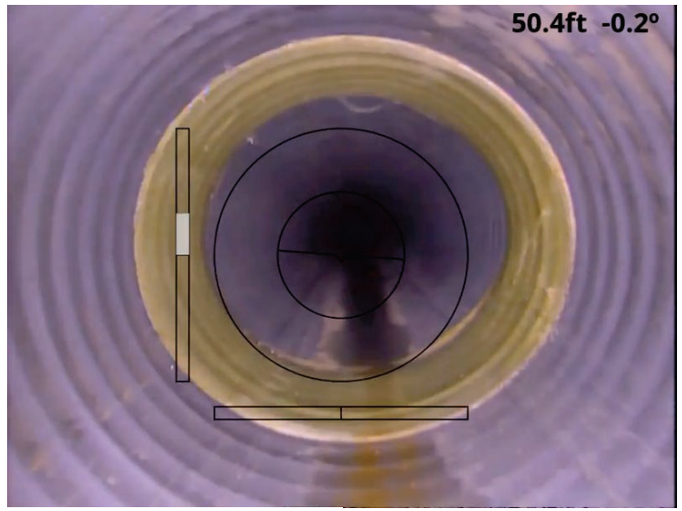
Brief Overview of Presentation

- **Background on Market Need**
- **Consensus Standards & System Design**
- **Good Practice in Product & Contractor Qualification**
- **Case Study Examples:**

  Rapid Response Capabilities

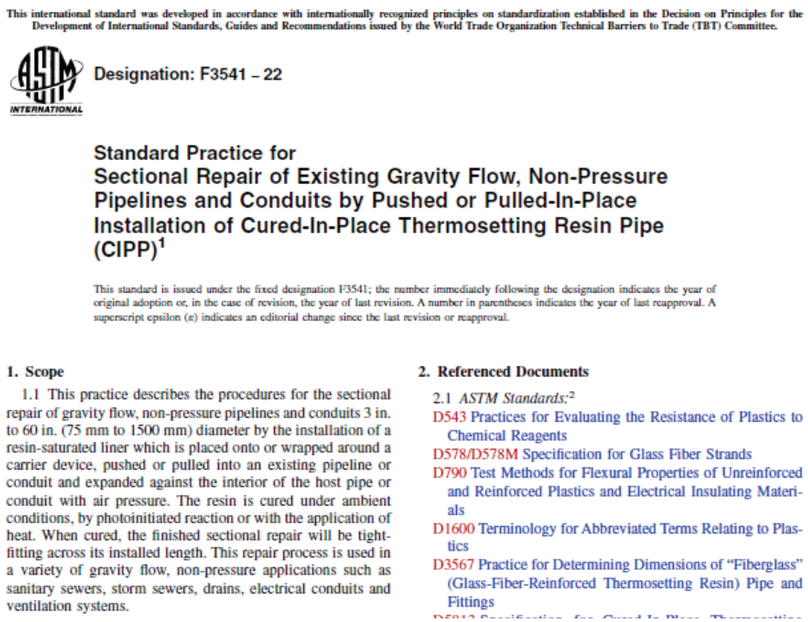


Market Need

- **Segmental lining for repairs has been a significant market for decades.**
  - **Failed Joints (with infiltration or root intrusion) or Failed Welds**
  - **Cross-bore repairs**
  - **Localized structural failures**
  - **Correction of CIPP installation imperfections**
- **Most CIPP point repair products must balance working time against curing time**
  - **Polyester or Viny ester**
  - **Epoxies**
  - **Silicates**
  - **UV gives the longest working time and the shortest curing time**

Consensus Installation Practice Standards

- **New ASTM standard: ASTM F3541 Precision PIP (Pull-in-Place)**
- **Meets or exceeds ASTM F1743 / ASTM F1216 requirements**
- **Can cure CIPP that meets ASTM F2019 requirements**



This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: F3541 – 22

Standard Practice for
Sectional Repair of Existing Gravity Flow, Non-Pressure Pipelines and Conduits by Pushed or Pulled-In-Place Installation of Cured-In-Place Thermosetting Resin Pipe (CIPP)[1]

This standard is issued under the fixed designation F3541; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice describes the procedures for the sectional repair of gravity flow, non-pressure pipelines and conduits 3 in. to 60 in. (75 mm to 1500 mm) diameter by the installation of a resin-saturated liner which is placed onto or wrapped around a carrier device, pushed or pulled into an existing pipeline or conduit and expanded against the interior of the host pipe or conduit with air pressure. The resin is cured under ambient conditions, by photoinitiated reaction or with the application of heat. When cured, the finished sectional repair will be tight-fitting across its installed length. This repair process is used in a variety of gravity flow, non-pressure applications such as sanitary sewers, storm sewers, drains, electrical conduits and ventilation systems.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

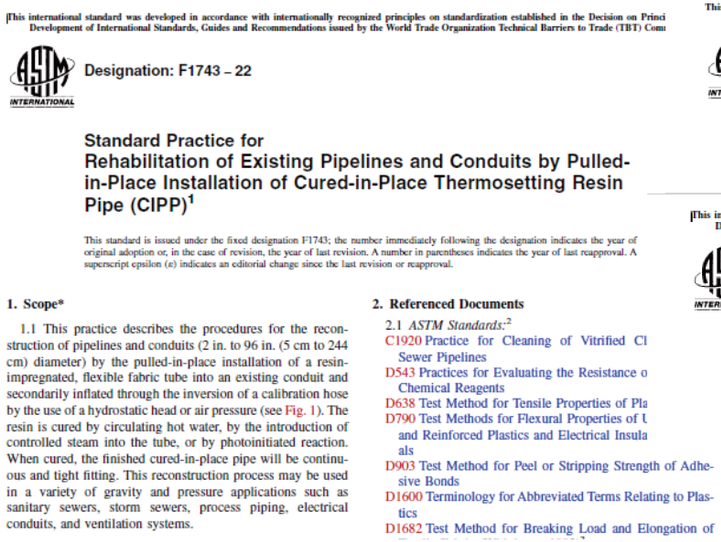
D543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents

D578/D578M Specification for Glass Fiber Strands

D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D1600 Terminology for Abbreviated Terms Relating to Plastics

D3567 Practice for Determining Dimensions of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings



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Designation: F1743 – 22

Standard Practice for
Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)[1]

This standard is issued under the fixed designation F1743; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This practice describes the procedures for the reconstruction of pipelines and conduits (2 in. to 96 in. (5 cm to 244 cm) diameter) by the pulled-in-place installation of a resin-impregnated, flexible fabric tube into an existing conduit and secondarily inflated through the inversion of a calibration hose by the use of a hydrostatic head or air pressure (see Fig. 1). The resin is cured by circulating hot water, by the introduction of controlled steam into the tube, or by photoinitiated reaction. When cured, the finished cured-in-place pipe will be continuous and tight fitting. This reconstruction process may be used in a variety of gravity and pressure applications such as sanitary sewers, storm sewers, process piping, electrical conduits, and ventilation systems.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C1920 Practice for Cleaning of Vitrified Cl Sewer Pipelines

D543 Practices for Evaluating the Resistance o Chemical Reagents

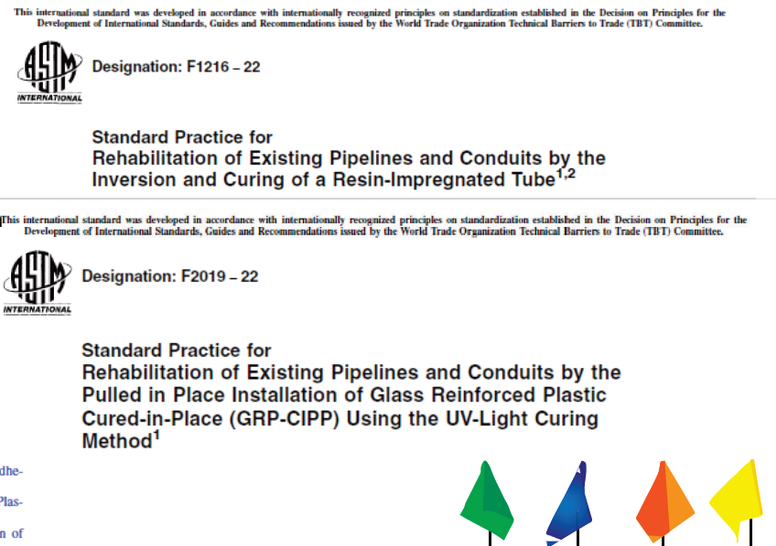
D638 Test Method for Tensile Properties of Pla

D790 Test Methods for Flexural Properties of U and Reinforced Plastics and Electrical Insula als

D903 Test Method for Peel or Stripping Strength of Adhesive Bonds

D1600 Terminology for Abbreviated Terms Relating to Plastics

D1682 Test Method for Breaking Load and Elongation of



This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: F1216 – 22

Standard Practice for
Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube[1,2]

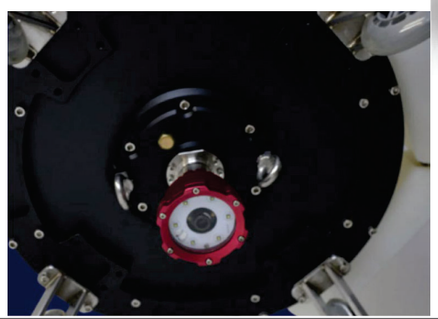
This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: F2019 – 22

Standard Practice for
Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic Cured-in-Place (GRP-CIPP) Using the UV-Light Curing Method[1]

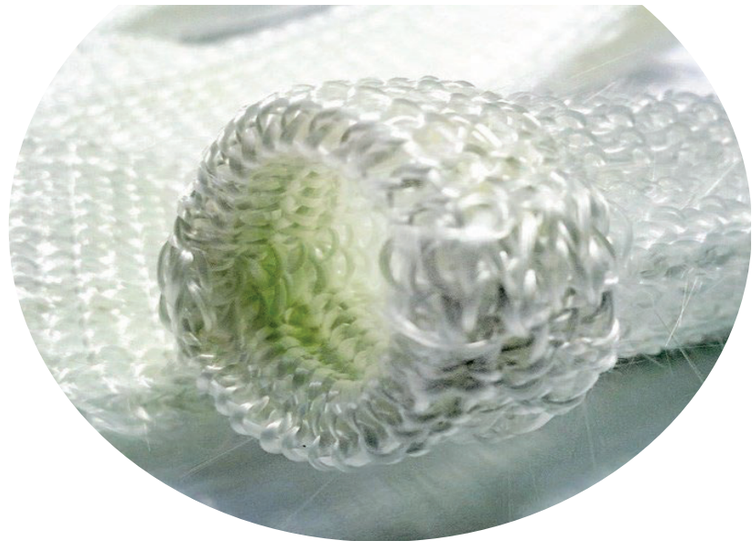
System Design

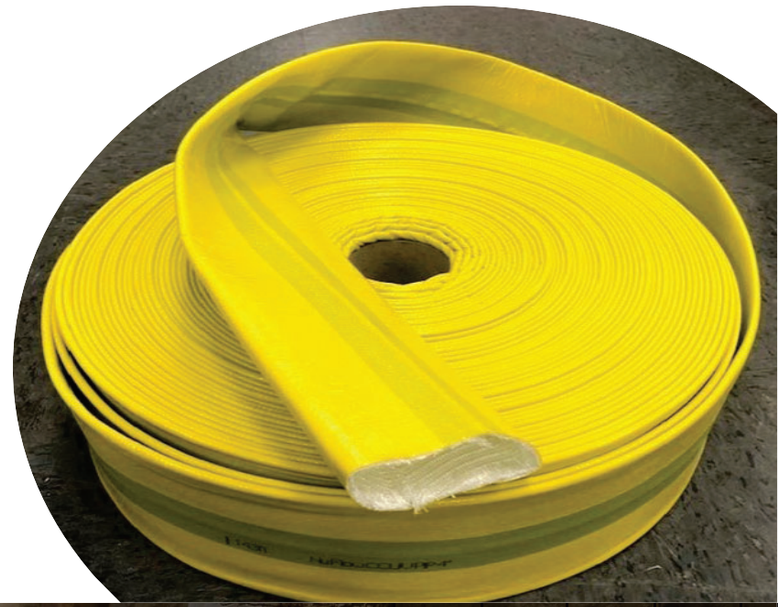
- **Cable Drum & Tablet Automated Controls**
- **4 Translucent Packer Bladders covering 8” to 24” / UV LED**
- **Transported on Wheels (pushrod, cable, or robotics)**
- **Built-in HD, wide view CCTV camera**



Tubes

- Proper **tube design** is critical for construction risk management & to achieve dense light curing; **translucence is key** to necessary light penetration.
- Seamless, **ECR glass** tubes
- Up to 7 mm thickness; can meet ASTM F2019
- **Resin Protection System**
  - An exterior **UV barrier** is critical during storage & handling
  - Liners can be combined with **outer barrier coatings** & **inner films (Precision PIP)** to encapsulate & protect the resin & the packer bladders.





Resin Systems

- **VOC-free resins**
- “Zero Shrinkage” resins achieve a reliable **frictional interface seal**
- **Calibrated initiators** are critical to CIPP system design
- **Translucence** is key to proper light transmittance
- Optimizing **viscosity** of the CIPP system
- **Fast light curing** limits the risks of resin loss or damage
- A low exotherm over a short duration results in **lower curing temperatures**

Wet-Out

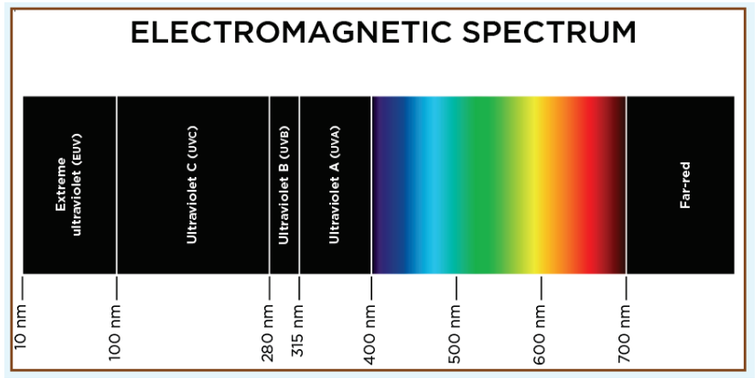
- ASTM F1743 requires **Calibrated Pinch Rollers**

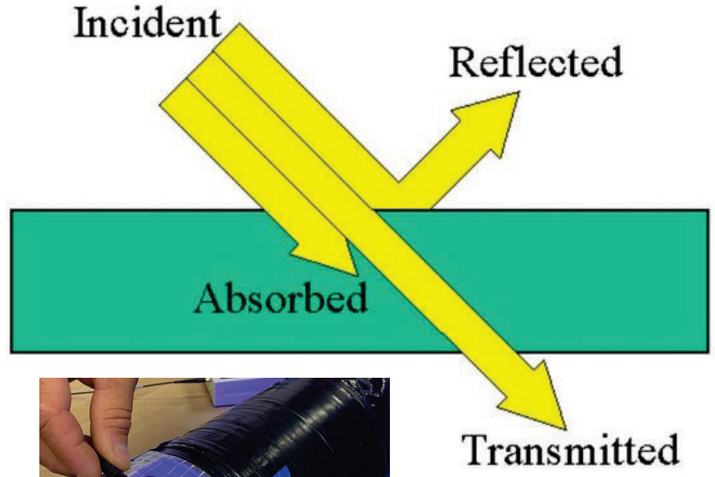
- ASTM F1216 requires **Vacuum Impregnation**

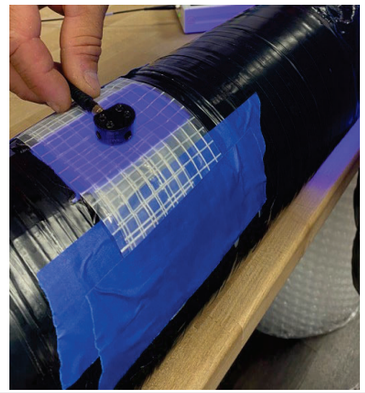
Good Practice requires doing BOTH!

Curing Calibration

- **Initiators are calibrated** to match the wavelength of the light
- **UVA** Spectrum (315-400) is used for UV CIPP curing; Other light curing methods use the **blue light** range (400-500 nm)
- When the correct wavelength strikes the initiators, they break apart into **free radicals** which drive the cure.
- The light source must be able to produce the **correct wavelength** at a high enough **intensity** to transmit through the CIPP thickness.
  - **intensity falls off exponentially over distance**.
  - Impeded by absorption & reflection;
  - **Specific curing equipment must be calibrated to specific liners**
  - Calibrate effective **transmittance** at the most **distal point** & at the **peak of operation**, as influenced by **temperatures & duration**.

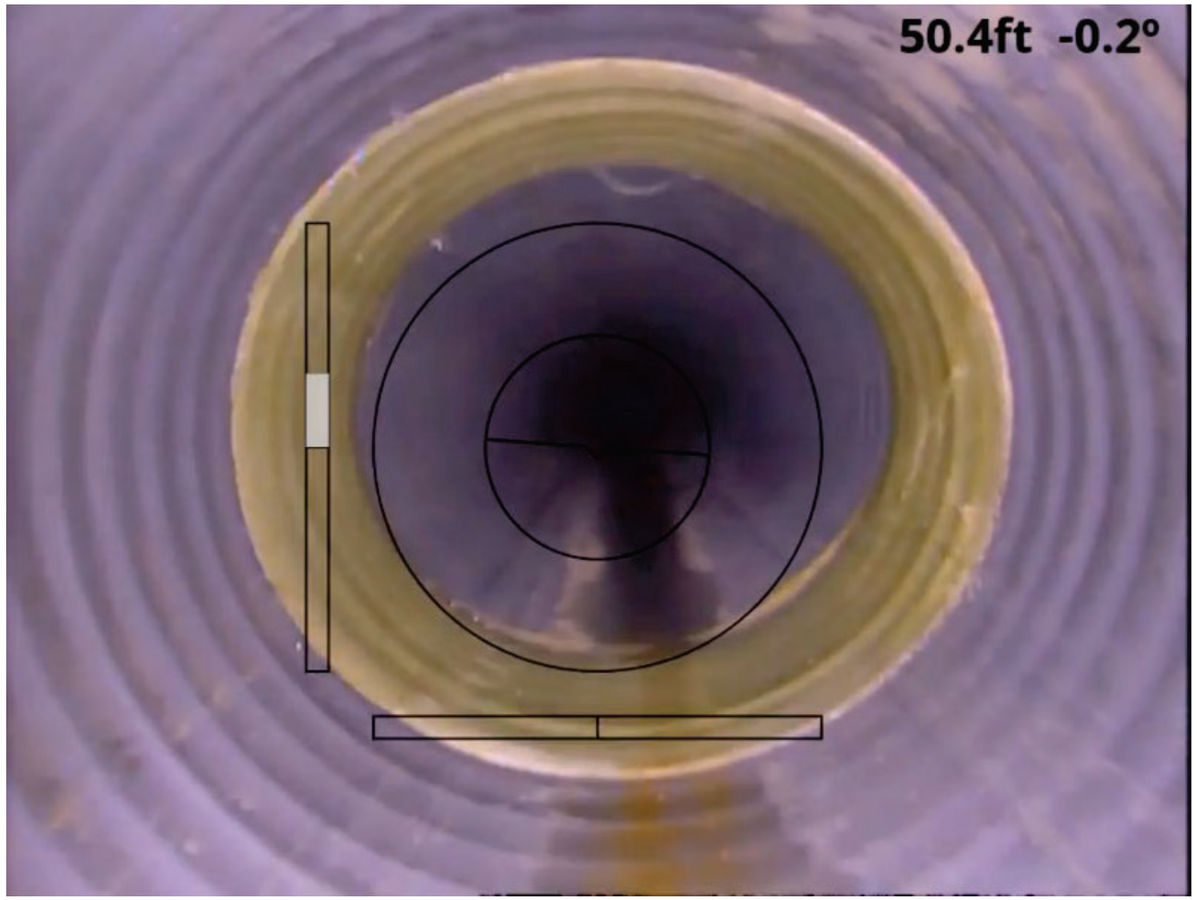






Performance: Tight Frictional Interface

Annular Leakage



Chile – Frictional Interface Strength Test

Contractor Qualifications

Qualifications should include:

1. Contractor Licensing & Bonding
2. Project References (comparable scale & scope)
3. Key Personnel Training & Certification
4. Availability of required equipment & back-up capabilities

Installation

- Local inventory of tubes & resin for immediate availability
- Long shelf-life, pre-wet-out sectional liners
- Rapid deployment
- Cures densely within minutes
- Packers in 4 sizes: 8″-10″, 12″-14″, 15″-18″, & 20″-24″
- Digital Control Tablet provides full installation process control and data capture

Construction Quality Verification

Supplier Contractor

Page 1 of 3

Cure Lining Report: - Buildin… **Date:** 01/25/2023

Project Address:	34 The Street	All Ok, liner installed in pipes to code	
Project Ref #:	ABC213		
Lead Technician:	Stuart Stevens	Has water been run at each fixture and verified with the camera?	✓
Supporting Tech's:	Steve Medley	*The liner/s have been installed and commissioned as per the Cure policy and installation procedure.:-* *01/25/2023 12:38*	

Liner #:	Location:	Liner Diameter:	Liner Batch #:	Total Length (ft):	Launcher Length:	# of 22° Bends:	# of 45° Bends:	# of 90° Bends:	# of Connections:	# of Gaps:	# of Transitions in Size:	Method of Install:	Resin Batch #:	Roller Calibration Set'g:	Time in Place: (hh:mm)	Bladder inflated to: (psi)	Bladder increased to: (psi)	Average Amps (A)	Average Volts (V)	Time taken out:(hh:mm)	Liner Spoilt and Scrap:
2	Laundry	4"	'83100013	26	33'	0	2	0	2	2	No 0	Pull	040822	5mm	No	11	16	15.8	24.5	09:40	No

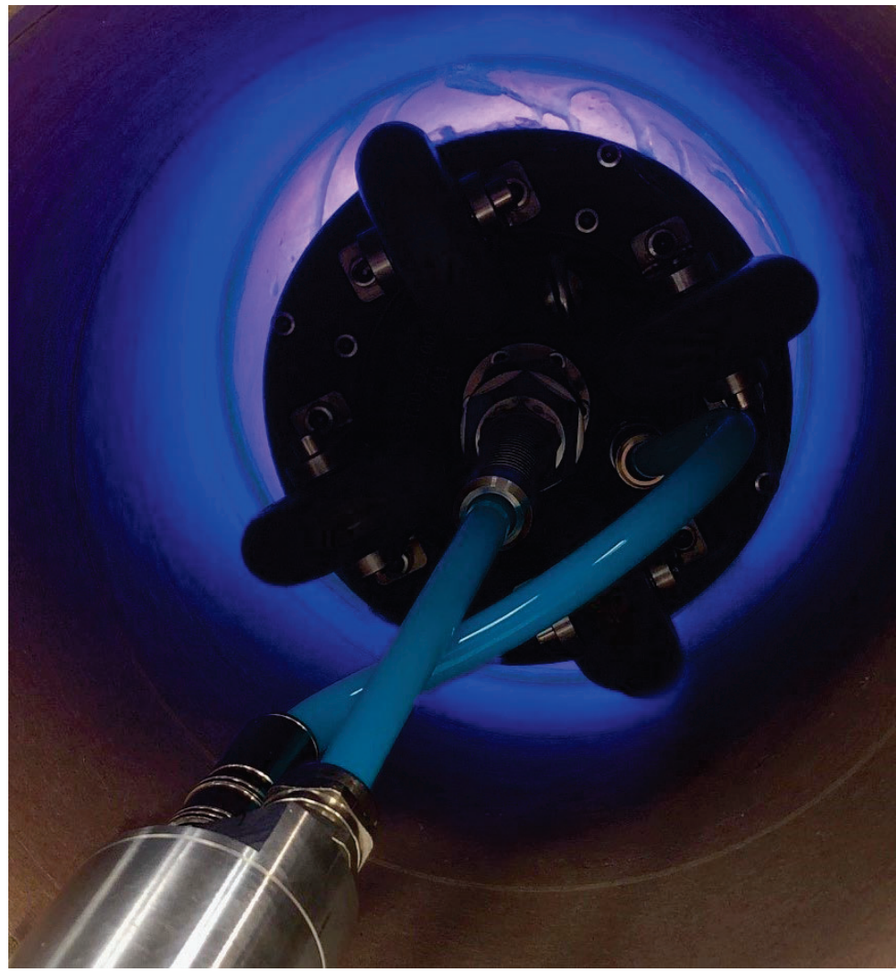
Pre-Lining Video Details:	VIDEO DETAILS TO BE ENTERED	**Post-Lining Video Details:**	VIDEO DETAILS TO BE ENTERED

- **Data Capture** of relevant project parameters
- **Cure Log Report** for Inspection
  - **Batch numbers** of raw materials (for traceability)
  - **Wet-out** control data
  - **Installation** control data
  - Before and after **video**
- Immediate output of comprehensive **As-Built Project Report** for the Owner's asset commissioning records.
- 3rd party, certified lab **testing of Field QC sample**, as appropriate

Installation Defect Repairs

Specification compliant corrective repair for rapid asset commissioning & project close-out

- CIPP miscut service reconnects & local imperfections
- Correction of joint or weld test failures with new construction
- Cross-bore repairs



Structural Repairs for “Find & Fix” Programs

QUESTIONS?

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