Pressure Pipe Rehabilitation with CIPP using methods cited in ASTM F 1216 & F 1743

Building and restoring sustainable infrastructure to support the needs of our communities

Presented by
Fred Tingberg Jr.

Value of this Engineered Solution

- Time Required to Deliver Project
- Minimal Disruption
- Improved Hydraulics
- Reduced Environmental Impact
- Maintain well established Hydraulic Grade Lines & Soil Envelopes
- Joint less System requiring reduced Maintenance over the Project Lifespan

Utility Relocation Avoidance

Lining Candidates offer expedient options to otherwise Difficult Choices

Slip line Design Criteria

- Design Life
- HS 20 Load Stand Alone Structural
- Equivalent or Improved Hydraulics

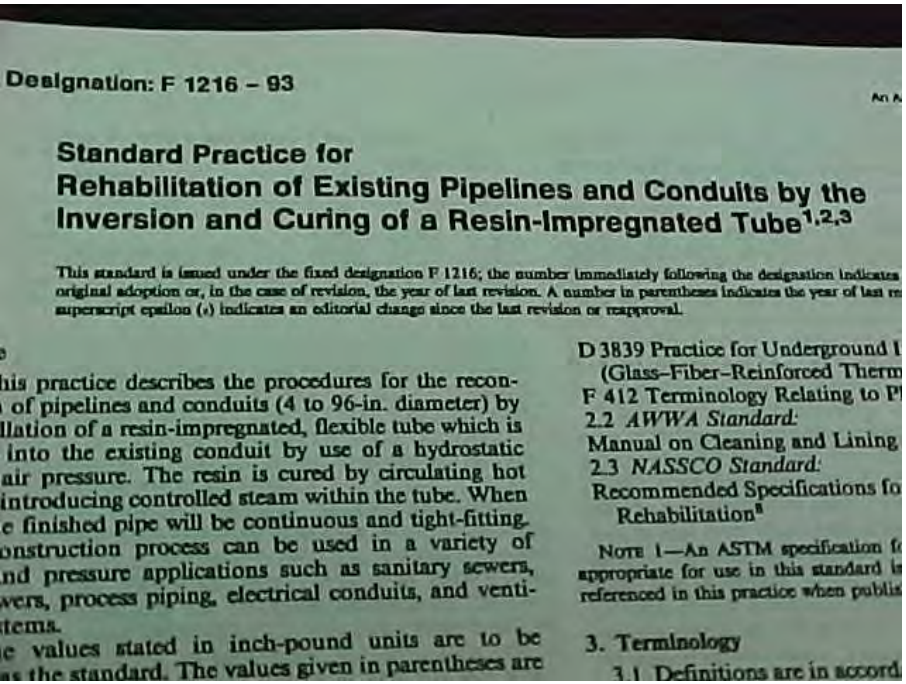
Slip line Installation Criteria

- Ability to Dewater
- Access & Space
- Time Sensitivity
- Flow profiles and hours of operation
- Ability to insulate the environment
- Tolerable Size Reduction
- Grout “ability” if HDPE “Discrete” Hard pipe Slip line

CIPP Benefits

- Ability to insulate the environment
- Maximum Storage Potential
- Increased Flow Capacity
- Take the shape of its container
- Not reliant on grout
- Optimum access requirements
- Ability to negotiate diameter and/or directional changes
- Utilization of established flow line and soil envelope
- Timely Completion / Minimized Disruption

Direct Inversion F 1216 vs. Pull & Invert F 1743



Designation: F 1216 – 93

Standard Practice for
Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube[1,2,3]

This standard is issued under the fixed designation F 1216; the number immediately following the designation indicates the original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last re superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

his practice describes the procedures for the recon- of pipelines and conduits (4 to 96-in. diameter) by llation of a resin-impregnated, flexible tube which is into the existing conduit by use of a hydrostatic air pressure. The resin is cured by circulating hot introducing controlled steam within the tube. When e finished pipe will be continuous and tight-fitting. onstruction process can be used in a variety of nd pressure applications such as sanitary sewers, wers, process piping, electrical conduits, and venti- tems.

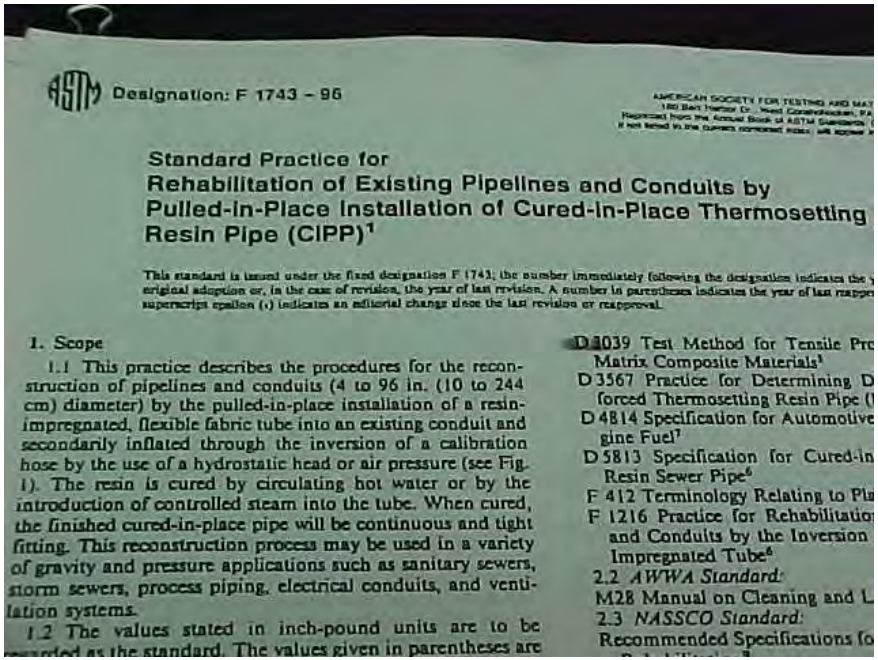
e values stated in inch-pound units are to be s the standard. The values given in parentheses are

D 3839 Practice for Underground I (Glass-Fiber-Reinforced Therm
F 412 Terminology Relating to P
2.2 *AWWA Standard:*
Manual on Cleaning and Lining
2.3 *NASSCO Standard:*
Recommended Specifications fo Rehabilitation[8]

NOTE 1—An ASTM specification f appropriate for use in this standard i referenced in this practice when publis

3. Terminology

3.1 Definitions are in accord



Designation: F 1743 – 96

AMERICAN SOCIETY FOR TESTING AND MAT

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 F 1743; the number immediately following the designation indicates the original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapp 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 (4 to 96 in. (10 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 or by the introduction of controlled steam into the tube. 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.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are

D 3039 Test Method for Tensile Pro Matrix Composite Materials[5]
D 3567 Practice for Determining D forced Thermosetting Resin Pipe (
D 4814 Specification for Automotive gine Fuel[7]
D 5813 Specification for Cured-in Resin Sewer Pipe[6]
F 412 Terminology Relating to Pla
F 1216 Practice for Rehabilitatio and Conduits by the Inversion Impregnated Tube[6]
2.2 *AWWA Standard:*
M28 Manual on Cleaning and L
2.3 *NASSCO Standard:*
Recommended Specifications fo

LANZO COMPANIES

Building and restoring sustainable infrastructure to support the needs of our communities

Practical Maximum CIPP Lengths

	NSF 61 Water main	Sewage Force Main
8”	600 lf	2000 lf
12”	600 lf	2000 lf
16”	600 lf	2000 lf
30”	400 lf	2000 lf
72”	n/a	1100 lf

Innovation: Cured in Place Water main Rehab

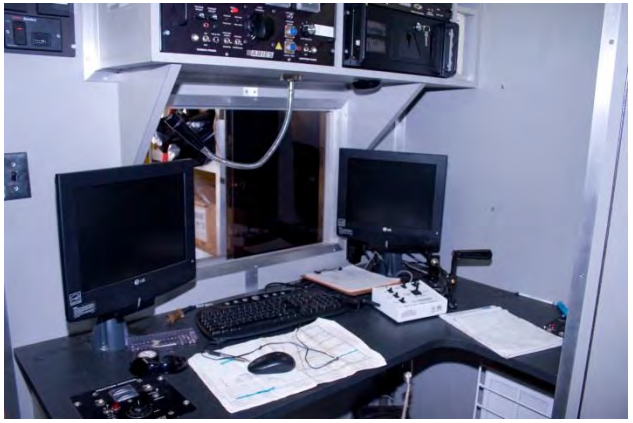
- Minimum disruption
- NSF 61 listed
- Over 1,000,000 lf of CIPP potable water main installed
- Ability to preempt line breaks
- ASTM F 1743 Pull in Place Method
- 100 psi working pressure
- fifty (50) year design life

Certified to NSF/ANSI 61

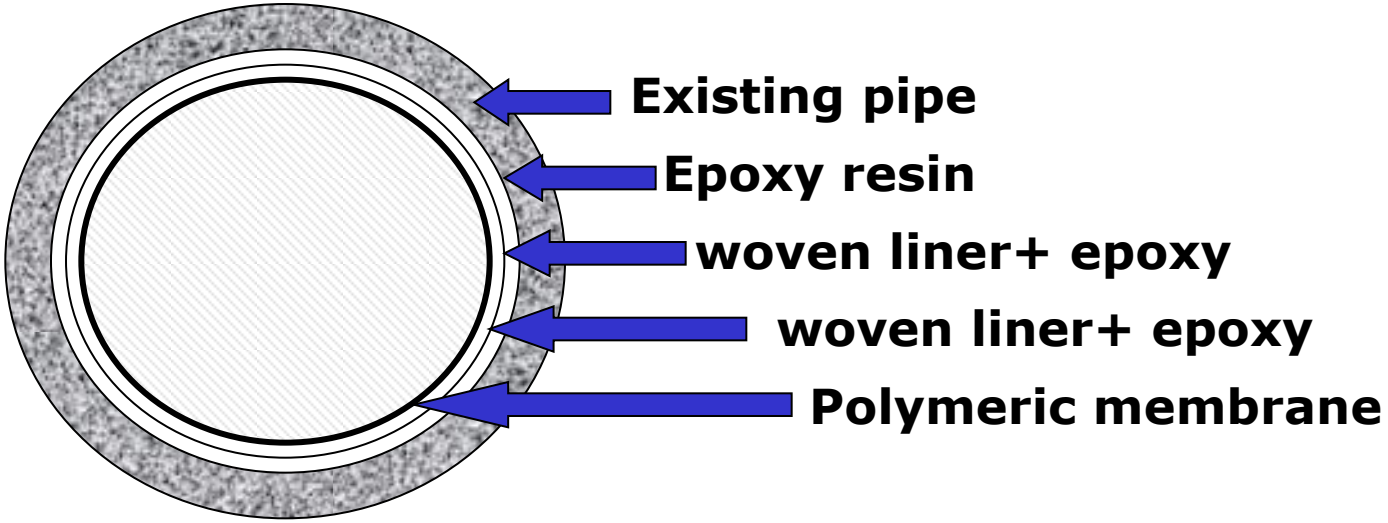
Pit construction / Bypass

- Pits at minimum intervals
- Tees, 90's, dead ends, hydrants define pits
- Bypass assembled, pressurized, chlorinated, tested then connected
- Lift Station or Residential tie ins
- Main isolated then accessed

DE tuberculate, rinse, televise



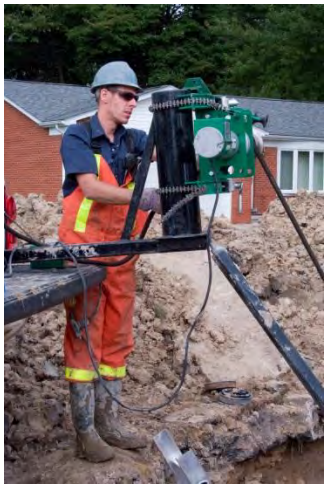
Water Main Renewal

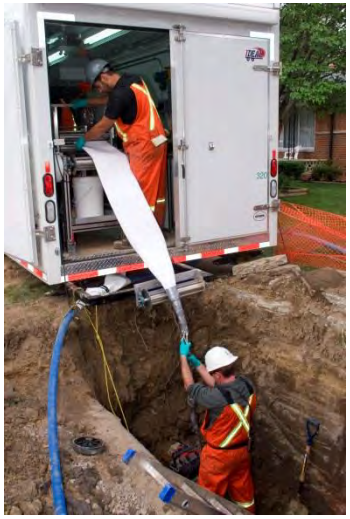


Note: not to scale

Installed diameters	6 - 42 in
Installed lengths	600 ft
Hazen Williams Coefficient	>120

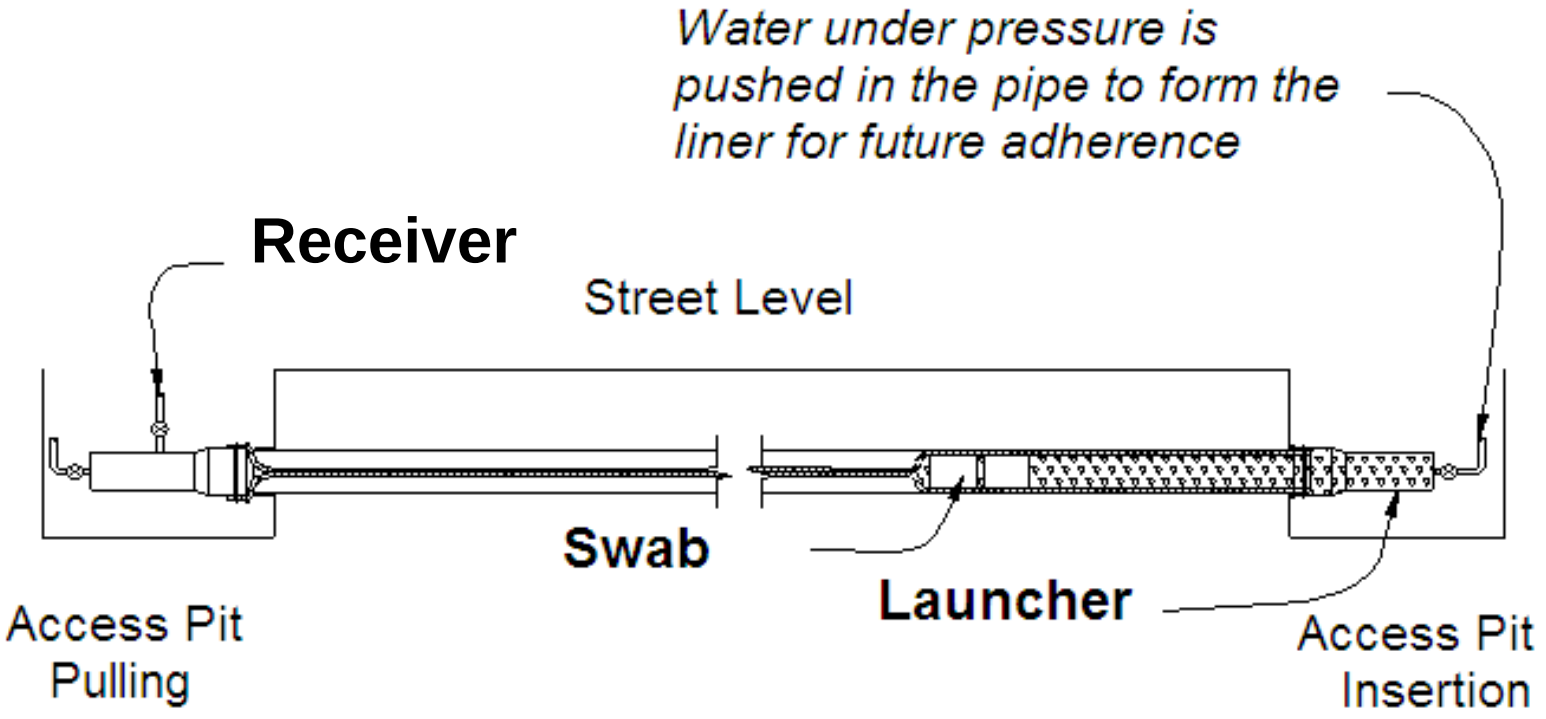
Winching the liner tube in place



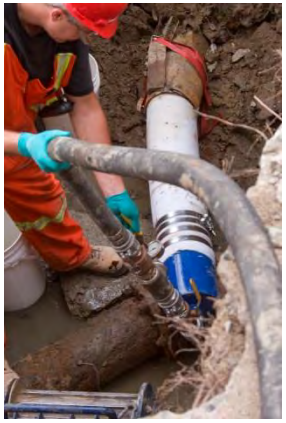


Water Main Renewal

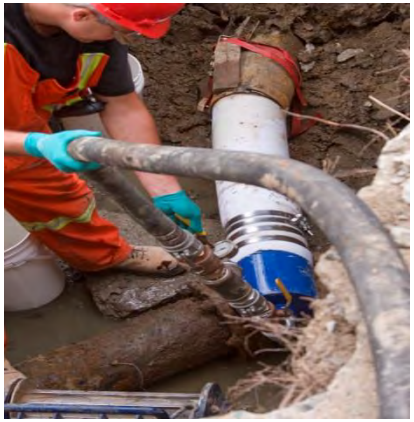
Liner installation



Proofing and pressurizing the line



Liner curing, pressure testing & service reinstatement



- 8 hour cure at temperature
- Pressure test liner
- Expose liner and post televise
- Robotically reinstate services


14.8 M.

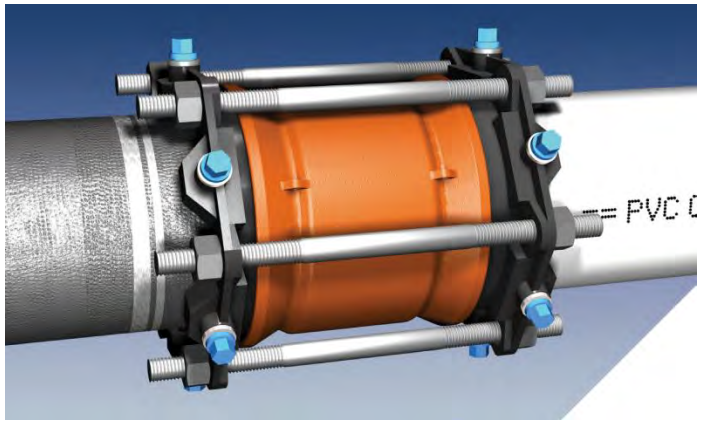
Innovation: Cured in Place Sewage Force Main Rehab

- Minimum disruption
- Over 500,000 lf of CIPP pressure pipe installed by Lanzo
- Ability to preempt line breaks
- ASTM F 1216 Direct Inversion Method
- 100 psi working pressure
- fifty (50) year design life

Design Parameters

- Length/Diameter/ Diameter Equivalent
- HS 20 or E 80 Traffic Loading
- Depth of Soil/Water
- Soil Modulus
- Flexural Modulus CIPP (Epoxy/ Vinyl Ester)
- Flexural Strength of CIPP
- Tensile Strength of CIPP
- Assigned Hazen Williams Value >120 for CIPP
- Safety Factor
- Hole Size
- Elongation

Closure Assemblies



- Restrained
- Similar Materials
- Spool at ends
- Internal End Seals
- New Fittings at Side Connections
- Bends, Terminations and Valves

Air vs Water Inversion

Also Limited by Transport Weight

Examples of Limits by Diameter

24” x 13.5mm	**3000 lf**
30” X 16.5mm	**2000 lf**
48” x 28.5mm	**800 lf**
84” x 52.5mm	**300 lf**
10’ x 10’ x 82.5mm	**100 lf**

Considerations

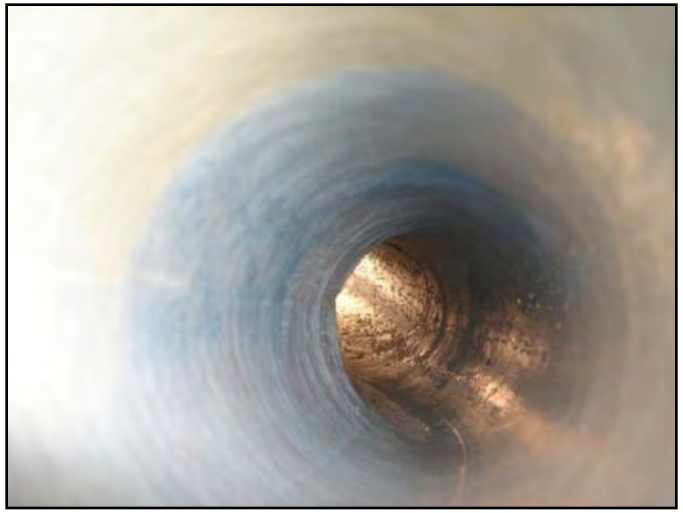
- **Staging Area**
- **Pot Life Limits**
- **Tent with Climate Controls**
- **Round the Clock Operation**

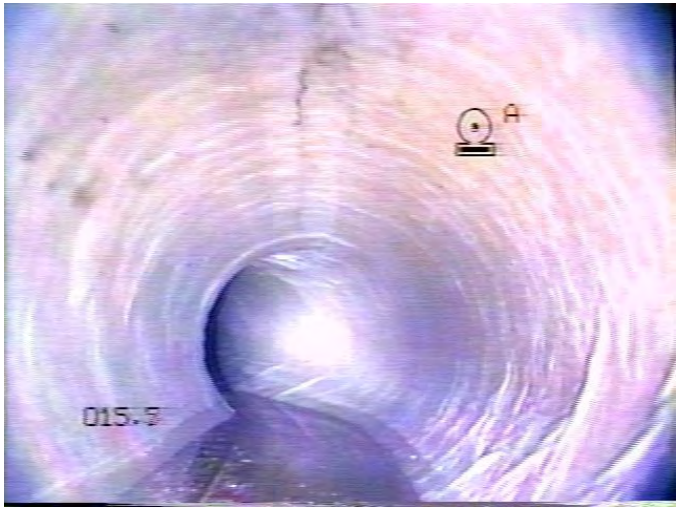
Remote Epoxy Impregnation Station

Remote Impregnation Station

- Entire process is controlled On-Site
- Takes the Pressure off the “Pot Life”
- Data from start to finish wet-out, installation and cure
- Engineered “Piece of Mind”
  - Computer controlled
  - Data logging
  - Quality assured resin content in tubes
- Production without sacrificing quality

Installation Observations





Pre Televised Inspection using PACP Criteria

Post Televised Inspection using PACP Criteria

Compare the two

Defects vs Anomalies

Lifts

Fins

Post Lining Inspection

Localized fins (CIPP)	Pipe size or material change, offset joint, bend or fitting	• None – cosmetic defects (if defect is minor, over a short distance and hydraulic capacity is not sacrificed) • Grind down or cut out defective area (remotely) and patch with epoxy or CIPP point repair (if necessary)
Localized lifts (CIPP)	Insufficient cure time or head pressure, or resin washout caused by groundwater infiltration or contributing flow at service	• Isolate and reprocess with controlled steam • Cut out defective area (remotely) and patch with epoxy or CIPP point repair • Open cut point repair (last resort)
Full-length wrinkling, fins, lifts (CIPP)	Liner oversized, not fully processed, or installed with insufficient head or pressure	• Plug and reprocess with controlled steam • Invert thin, unsaturated calibration tube and reprocess with water • Remove and replace (last resort)
	"Veining" in coating of CIPP	• None – cosmetic defect

System Testing (100 psi)

- Is Host adequately restrained?
- 2 x WP
- WP + 50 psi

(Whichever is less)

- Test at Inversion Pressure
- Column filled measure for leakage
- Burst the Liner offsite

Third Party Testing

- Proves the wet out phase
- Proves cure/cool cycle
- Resin verification
- Validates the Design Basis
- Verify Flexural Modulus
- Verify Flexural Strength
- Verify Tensile Strength
- Verify Wall Thickness
- Burst Testing for internal pressure rating

Contact Lanzo

LANZO TRENCHLESS TECHNOLOGIES SOUTH

Delivering innovative trenchless technology solutions to rehabilitate the world's diverse infrastructure

Fred Tingberg Jr.

954 931 4430

Fredt@lanzo.org