INNOVATIONS

INNOVATIVE SOLUTIONS IN PIPE RENEWAL

inliner™ technologies

The Pipe Renewal Problem

All across America, municipalities and industries are struggling to maintain an infrastructure suffering from the effects of age and deterioration. Crumbling stormwater and wastewater systems, worn-out process pipes, leaks, inflow, infiltration, overflows — these are just some of the serious problems created by worn-out pipes. Millions of feet of pipe are in need of repair or replacement. That's a lot of digging.

Or is it?

Inliner Technologies' No-Dig Solutions

Repairing or replacing underground pipe is a big job, fraught with problems and risks. Extended road closures or detoured traffic can be devastating to small businesses. Industrial plant downtime can cost thousands or even millions of dollars per hour. Trenching with heavy equipment creates noise and dust, and can add significant costs for repair of damaged landscaping.

With Inliner Technologies' no-dig Cured-in-Place Pipe (CIPP) technology, a crew with a modest amount of equipment can install a durable new pipe directly inside the existing worn or damaged pipe without breaking ground. In all but the most extreme cases of deterioration or collapse, Inliner® CIPP can fully restore pipelines up to 120 inches in diameter with a service life of 50 years or more.

Inliner's® superior solutions require limited or no excavation, helping to eliminate costly road closures and damage to sensitive areas. Greatly reduced disruption, far fewer complaints and headaches—these are the hallmark benefits of Inliner® trenchless solutions. And no digging means you'll save considerable time and money. Trenchless CIPP pipe renewal projects can be completed up to five times faster and at 40 to 50 percent less cost than traditional excavation and replacement methods.

With an ongoing commitment to research and development, Inliner Technologies has perfected this innovative, clean and economical solution for pipe renewal. Inliner® methods and materials have been field-proven in more than 8 million feet of rehabilitated pipe all across America.

- **Mainline and lateral piping**
- **No-dig (or limited excavation) solutions**
- **Cost-effective**
- **Minimizes disruption and surface damage**
- **Proven in more than 8 million feet of pipe**
- **Four to 120 inches in diameter**
- **Minimum 50-year service life**
- **Time-efficient**

THE PROCESS

How Inliner® CIPP Works

In the past, the only way to repair or replace damaged pipes was to break up the surface and excavate. Inliner® CIPP technology eliminates this disruptive and often complicated process and goes straight to the heart of the matter—the underground pipe.

A qualified and licensed Inliner® crew inserts a resin-impregnated felt tube into the old pipe. The tube is engineered and fabricated at an off-site plant to precise specifications, accommodating bends and even pipe diameter changes. The tube is then impregnated with the appropriate resin and catalyst system at a designated facility or at the job location. After that the tube is installed by the inversion method per ASTM F1216, or the pull-in-place installation method per ASTM F1743. The tube is then expanded to the existing pipe by filling it with water or pressurized steam. Cured-in-place pipe takes the shape of the host pipe, making it a viable solution for round pipe, as well as eccentric shapes and box culverts.

When the tube is correctly positioned, hot water or pressurized steam is introduced into the tube to activate the thermoset resin/catalyst mixture and begin the curing process.

THE SOLUTION

The fully cured resin now serves as a barrier between the damaged pipe and the flow, or as a new stand-alone pipe. Lateral connections are opened by remote cutters in smaller diameter pipes and by man-entry in larger diameter pipes. Although the new pipe is slightly smaller in diameter, the smooth finish of Inliner's cured resin improves hydraulic characteristics of the pipe—thus reducing flow resistance caused by drag and turbulence, often times even increasing the flow capacity of the pipe segment.

In addition to precision control of pipe thickness, Inliner® also will use high-quality resins to meet specific municipal and industrial standards for service pressure and resistance to corrosion and abrasion. Laboratory and field testing provides a basis for design of Inliner® CIPP to a service life of 50 years or more, depending on the application and environment.

- **High-quality resins**
- **Controlled installation process**
- **Municipal and industrial applications**

Technical Information

Wall Thickness Design

Generally accepted practice calls for the existing pipeline's condition to be classified based upon a visual and/or physical inspection of the pipeline. Inliner Technologies provides its licensees with a conservative recommended set of guidelines for the classification of the piping system. Once classified, the wall thickness is calculated using ASTM F1216 and any unique design criteria as defined by the client or owner.

Corrosion Resistance

Chemical resistance performance of the materials specified for CIPP is another long-term performance criteria important to the design life of the product. Our cured resin/fabric tube matrix has been evaluated in laminate form for long-term chemical exposure per ASTM D5813. The qualification samples were immersed in the solutions for a period of up to 1.14 years (10,000 hours).
See table below.

Depending upon the environment in the pipeline being renewed, the corrosion resistance needs for a particular application are tailored by the designing engineer by selecting between an isophthalic polyester, enhanced polyester, or epoxy resin system.

Performance Testing

Qualified installers of Inliner® CIPP are required to routinely sample their field processing of the liner to confirm the properties ensure a quality finished product. For typical gravity CIPP installations, flexural strength, flexural modulus, and wall thickness values are derived from the samples per the following testing protocols:

Flexural Strength ASTM D 790
Flexural Modulus ASTM D 790
Wall Thickness ASTM D 3567

Chemical Solution	Concentration, %
Nitric Acid	1
Sulfuric Acid	5
ASTM Fuel C	100
Vegetable Oil	100
Detergent	0.1

For applications involving internal pressure, samples also are tested for tensile modulus and tensile strength using the procedures defined in ASTM D638.

Typical property ranges for resin/felt composites consistent with CIPP construction are listed in the table.

Typical Tested Properties

	Isophthalic Polyester	Enhanced Polyester
Flexural Modulus, psi	250,000 – 380,000	400,000 – 450,000
Flexural Strength, psi	4,500 – 6,600	4,500 – 7,000
Maximum Strain, %	2 – 4	3 – 5
Tensile Modulus, psi	290,000 – 360,000	290,000 – 400,000
Tensile Strength, psi	3,000 – 6,000	3,000 – 5,000
Tensile Elongation, %	1 – 3	2 – 4

Inliner® Innovation

Digging isn't the only thing Inliner Technologies eliminates. With a network of qualified, licensed installation crews across the United States and generations of experience in public works contracting and engineering, Inliner® is equipped to eliminate your exposure to the risk associated with major projects. With innovative design-build solutions, Inliner® offers a progressive, highly beneficial alternative to traditional engineering and contracting relationships.

Inliner Technologies is able to offer this advanced level of service because of our extraordinary depth of engineering and construction experience, our field-proven methods and materials, and an ongoing commitment to constant product improvement through our research and development program.

Our significant and ongoing R&D investment provides Inliner® customers and licensees with superior quality and support for CIPP solutions.

There are several companies offering CIPP products, but only one clearly superior choice — Inliner Technologies. To discover the benefits unique to your specific applications, consult an Inliner® representative, and make Inliner Technologies the choice for your next pipe renewal project.

- **Design-build solutions reduce your risk**
- **Inliner® solutions are field-proven**
- **Ongoing R&D programs mean superior quality and support**

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