UNITED PIPELINE SYSTEMS

Thermoplastic lining systems for pipeline protection and rehabilitation

The Tite Liner® system can often rehabilitate pipelines at half the cost and time of dig-and-replace solutions.

The transportation of corrosive or abrasive materials in the oil & gas, mining, industrial and municipal markets can wreak havoc on your pipelines. Internal corrosion and abrasion can lead to leaks, pipeline failure, environmental damage and lost production.

Complete replacement of these pipelines is costly and time-consuming. Internal abrasion and corrosion can be avoided by utilizing the pipeline construction capabilities of United Pipeline Systems.

The Tite Liner® System

United developed the Tite Liner® system, a technology that enables a thermoplastic liner to fit tightly inside a host pipe.

The Tite Liner® system is manufactured with a larger outside diameter (OD) than inside diameter (ID) of the host pipe.

The Tite Liner® system temporarily reduces the thermoplastic liner's diameter for insertion. The liner then expands tight following installation. The tight-fitting liner acts as a continuous barrier between the host pipe and the corrosive or abrasive material.

The corrosion and abrasion resistance properties of thermoplastic allow the Tite Liner® system to protect pipelines from a variety of chemicals and abrasives through a broad range of temperatures and pressures. It is an efficient and cost-effective way to protect new or existing pipelines and its use can often extend the life of a pipeline far beyond the expected life of an asset. The Tite Liner® system comes in sizes from 50 mm to 1,300 mm (2 inches to 52 inches) in diameter, with larger diameters possible in certain situations.

The Tite Liner® system offers many benefits:

- **Long pull lengths:** Average pull lengths are approximately 600 meters to 800 meters (1,900 feet to 2,600 feet) and longer. Pull lengths of 2.5 km (8,000 feet) have been achieved (individual section length depends on the diameter, bends, terrain and condition of the host pipe).
- **Low cost and time:** The Tite Liner® system can often rehabilitate your pipelines for less than one-half the cost and time of dig-and-replace solutions.
- **No maintenance:** The Tite Liner® system is a "fit and forget" solution, unlike chemical injection alternatives that require ongoing maintenance and operating costs.
- **Temperature limitation:** The polyethylene pipe utilized in the Tite Liner® system exhibits superior mechanical properties in temperatures up to 82C (180ºF) for water service. For higher temperatures or more aggressive fluids, United can recommend alternative lining materials.
- **Chemical resistance:** Thermoplastic is very resistant to chemicals and other media such as acids, alkalis and salts which makes it suitable in almost every process application.
- **Field bends:** The lining system can easily negotiate field bends of 50D or greater. Bends as low as 20D have been achieved and tighter bends may be possible.
- **No pressure limitation:** The Tite Liner® system has no pressure limitation since the pressure is contained by the host pipe.
- **Leak-free connections:** Tite Liner® system flange fittings have been successfully used in projects with pressures up to 340 bar (5,000 psi). The connection has been tested and independently verified up to 500 bar (7,500 psi).
- **Increased operating efficiencies:** A Tite Liner®-protected pipeline often experiences increased operating efficiencies because the smooth thermoplastic liner improves hydraulic properties over and above a slight reduction of the inside diameter.

Tite Liner® System Installation Process

1 Before installation can begin, a new or existing host pipeline is sectioned to allow for the insertion of Tite Liner® pipe. Once on site, short individual thermoplastic pipe lengths are joined together by thermal fusion to form long, continuous lengths of liner pipe. A blow-down pig and sizing plate are then attached to a steel cable and sent through a section of the host pipeline. Once the steel cable reaches the other end of the section, it is attached to a pull-head on a corresponding length of liner pipe (Fig. 1).

2 A wireline unit pulls the liner pipe through United's roller reduction box positioned at the insertion end of the host pipe. The liner pipe is compressed radially as it passes through the roller reduction box (Fig. 2). This temporary reduction provides sufficient clearance between the OD of the liner pipe and the ID of the host pipe to allow for insertion. While the liner is pulled into the host pipeline, the liner remains under axial tension, and the reduced OD is maintained (Fig. 3).

3 When the tension is released, the liner pipe expands, creating a tight fit against the inner wall of the steel pipe (Fig. 4). Following relaxation of the liner pipe, custom manufactured polyethylene flange-fittings are attached at each end of the lined section. A steel spacer ring is placed around the raised face of the steel flange and the polyethylene flange-fitting to help ensure a leak-free connection. The two steel flanges are positioned together and the line is tested and bolted-up before placing in service.

Fig. 1: Steel Cable and Roller Reduction Box
The steel cable is pulled through a roller reduction box and attached to a pull-head on a fused section of liner.

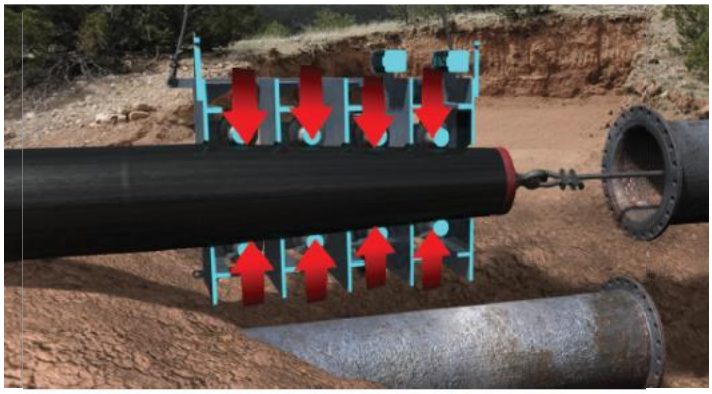


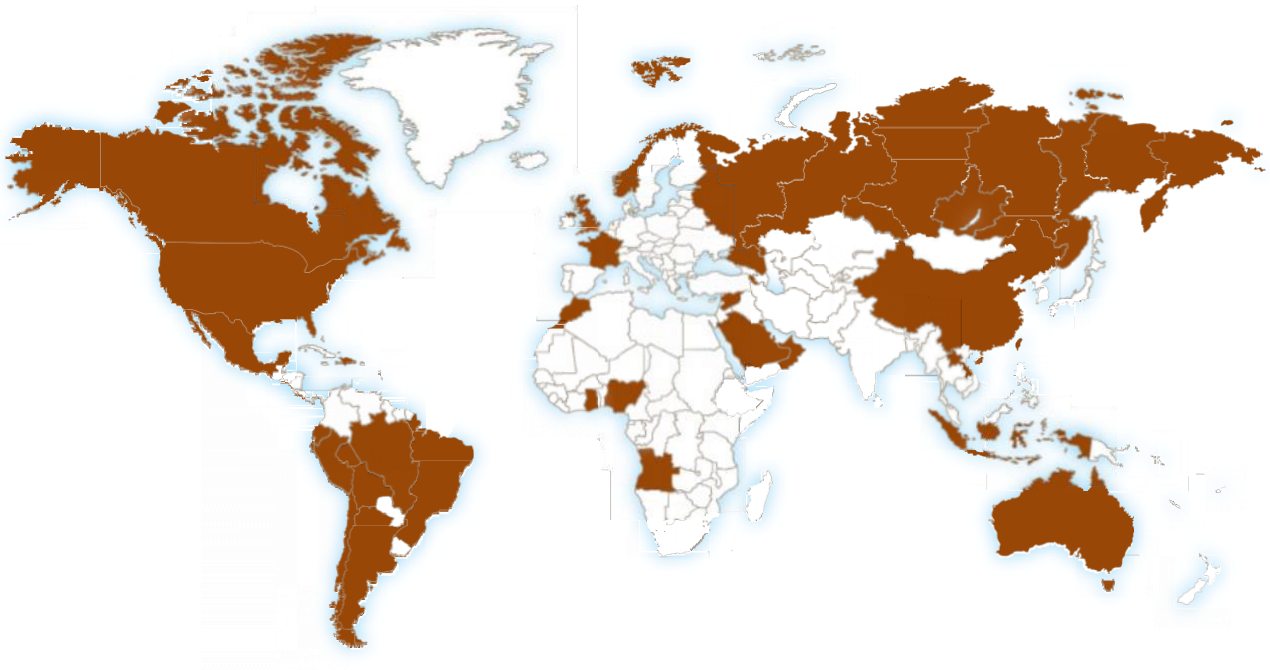
Fig. 2: Hydraulic Rollers
The liner is pulled through a series of hydraulic rollers, temporarily reducing the liner's diameter while it is installed inside the pipeline section.

Fig. 3: Liner Under Tension
The wireline unit keeps the liner under tension as it is pulled into the host pipe.

Fig. 4: Tight Fit Created
After the liner is pulled into the host pipe, the tension on the steel cable is released. The memory of the thermoplastic material allows the liner to revert back and form a tight seal against the host pipe wall.

Worldwide Experience

United has lined more than 32,000 kilometers (20,000 miles) of pipelines on six continents.



United Pipeline Systems

United Pipeline Systems is the global leader in providing thermoplastic lining systems for internal pipeline protection. United has constructed and internally lined more than 32,000 kilometers (20,000 miles) of pipelines on six continents since 1985.

With locations in the USA, Canada and Chile, United can respond quickly with the specialized personnel, equipment and material resources necessary to complete turnkey projects anywhere in the world.

Quality and Manufacturing

To respond quickly to customer needs and project requirements, United has established quality manufacturing and construction support facilities in multiple countries. United maintains a high standard of quality by designing and manufacturing all of its specialized material and proprietary installation equipment. Our manufacturing ability allows us to ensure materials are tailored for every job and delivered on time. United's in-house research, design, engineering and manufacturing capabilities provide complete control over quality, production scheduling and project coordination.

Safety

Our corporate safety policy and job training goal is to provide an accident-free work environment. We have maintained an excellent safety record and instill an attitude of safety awareness in everything that we do.

united

The Worldwide Thermoplastic Lining Leader

United has the trained manpower, specialized equipment, worldwide experience and expertise to safely tackle a wide variety of challenges in new or existing pipelines - on time and on budget.

For more information about United Pipeline Systems and its pipeline construction capabilities, or for a feasibility analysis and cost estimate for your next pipeline project, visit www.unitedpipeline.com or call 970.259.0354.

Typical Applications

Thousands of kilometers of the Tite Liner® system have been successfully installed around the world in a wide variety of industries.

Typical applications include:

Oil & Gas

- Crude oil and oil emulsion
- Sour and wet gas
- Water injection and disposal systems
- Offshore
- CO_2 production and injection

Mining

- Tailings
- Concentrate
- Acid lines
- PLS
- Water lines

Industrial

- Chemical slurries
- Sodium carbonate
- Corrosive effluents
- Caustics
- Brine

Municipal

- Force sewer mains
- Transmission lines

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