TUNNELINE

ITS

PipeTech

Pipeline rehabilitation & construction

TUNNELINE TECHNICAL GUIDE

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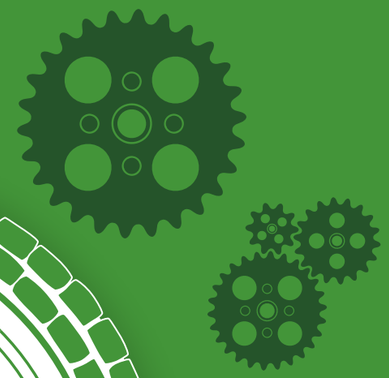
SUBSTANTIAL TIME AND COST SAVINGS over other conventional lining systems, with no impact on the infrastructure located above the asset.

STRUCTURAL
rehabilitation system that can be designed as a standalone element or as a composite structure.



Key benefits
of the Tunneline System

Can be designed with a life of up to
100 YEARS.

HYDRAULICS
flow rate (k factor) is equivalent or better than that of GRP or plastic smooth barrelled pipe.

PROJECT REFERENCES

Tunneline in action

High-profile projects that have successfully used Tunneline technology in Australia.

2300mm diameter Corrugated Steel Culvert

Location
Hume Highway, Broadford, VIC

Client
VicRoads

3700 x 2400mm Elliptical Corrugated Steel Culvert

Location
Burringbar, NSW

Client
Tweed Shire Council

2400 x 2100mm Concrete Box Culvert

Location
Colliery Access Road,
Kemira Valley, NSW

Client
BHP Billiton Coal Contract Services

1500mm diameter Twin Cell Corrugated Steel Culvert

Location
Wilton NSW

Client
Wollondilly Shire Council

1500mm diameter Quadruple Cell Culvert

Location
Cowra, WA

Client
BHP Billiton Iron Ore

Tunneline

The Tunneline System is a unique patented structural concrete lining system that can be applied to provide a full rehabilitation solution for man entry culverts and structures. The award-winning system is a simple, in situ reinforced concrete lining technique designed for difficult-to-access sites, and has a very low environmental impact.

The Tunneline System was introduced into Australia by ITS Pipetech, after we identified a need for a fully structural lining solution for man entry culverts and structures. There are numerous 'flexible' lining solutions (conforming to AS2566.1) that cannot meet the design standards required by many road and rail authorities for larger diameter structures.

The introduction of the Tunneline System into Australia has resulted in substantial time and cost savings over full replacement and conventional lining systems, with no impact to the operation of the infrastructure located above the asset. The Tunneline System utilises the tried, trusted and familiar construction techniques of reinforcement concrete providing a robust and durable rehabilitation solution with a design life of up to 100 years. The System is also fire resistant for up to 120 minutes, which is superior to its plastic and HDPE counterparts – particularly important in areas at risk of bush fire.

The Tunneline System has a flexible design approach that allows it to cater to a wide variety of rehabilitation situations and client requirements. The system can be designed under either AS3600 or AS5100 together with AS3725 to provide a standalone structural element, or can be designed as a composite structure and take in to account some of the host structure's residual strength to provide a further cost-saving solution.

The System can be used to line a host of existing structure profiles and will also accommodate vertical and horizontal bends, as well as size and shape transitions and service entries.

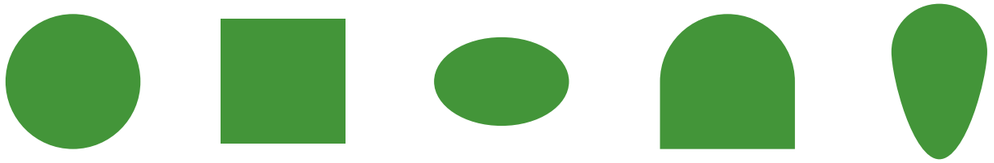
It can also be designed to accommodate internal pressures from large diameter sewer and water mains.

Lengths from 5m

Diameters from 1200mm to 9000mm

APPLICATIONS

Tunneline can be applied to a range of host structure materials and can accommodate many host structure shapes, including:



Circular | **Box-square or rectangular** | **Ellipse** | **Arch-vaulted and parabolic** | **Egg shape or oviform**

Installation process

1 MOBILISE & SET UP

The Tunneline Culvert Lining System is designed to be compact and all items are sized so that they can be man-handled into difficult access culvert locations without the need to adversely disturb the environment. The plant and equipment required to complete a Tunneline Culvert Lining Project takes up only a small compound footprint.

2 CONTROL OF EXISTING FLOWS

Any existing flows are generally bypassed through pumped diversions.

3 CLEANING OUT EXISTING HOST

Any remaining debris within the culvert is removed and disposed of prior to lining works.

4 FIXED REINFORCEMENT

The reinforcement cage is installed for the entire length of the culvert cell prior to any other works being undertaken. The Tunneline crew installs the reinforcement by hand and ties it into position forming a rigid cage. A rigid cage in some cases can be replaced with Dramix Fibers.

5 FIX SHUTTERS

The Tunneline steel formwork is set up by hand inside the culvert by the Tunneline crew. A sequenced process for installing the shutter sections is applied to ensure the structure is secure, both while the installation is in progress and once it is complete. Once the formwork is erected the ends are sealed off back to the host structure with a stopend ready to accept concrete.

6 CONCRETE PLACEMENT

Special class premix concrete is delivered from the concrete pump to the steel formwork via a sealed concrete delivery line.

7 STRIP FORMWORK

Once the formwork is completely filled with fresh concrete the concrete delivery line is disconnected. Formwork is left in place overnight and then removed the next day, revealing the new fully formed structural concrete lining. The formwork is then set-up in the adjacent section of culvert and the process is repeated until the entire culvert length is fully lined.

8 HEADWALL

As part of some culvert lining works there may be a requirement to construct concrete headwall and scour protection works at the inlet/outlet of the culverts. These works are generally completed using traditional wall form and concrete placement techniques.

An Australian first: concrete lining of large rail culvert, Broken Hill

Client: Transfield Services
Asset Owner: ARTC
Project: Rehabilitation of an existing 5600mm diameter Corrugated Steel Culvert under the Adelaide to Broken Hill line, Oodla Wirra in South Australia.

ITS PipeTech completed the structural reline of the largest culvert to date in Australia; a 5.6m diameter unit under the main Adelaide to Broken Hill line, SA. ITS was engaged by Transfield Services, the facilities manager for ARTC, to design and install a fully structural standalone solution to this under-track culvert that was showing advanced signs of decay, with large patches of rusted material and severe deformation on the shoulders where the structure had started to fail.

The Oodla Wirra contract involved the structural lining of a corrugated steel culvert that was originally a nominal bore of 5.6m – however it had distorted in places by 725mm as the strength in the host pipe began to deteriorate. Designed to accommodate the loadings of AS5100, a proposal was presented to install a twin cage reinforced concrete lining to provide a final diameter of 4.90m, thereby maximising the hydraulic flows but reverting the structure to a true circular bore.

Adaptation of the Tunneline shutter system to accommodate the distortion in the host-lining contract posed interesting challenges in maintaining a true line and level, however the construction team managed to overcome these, mainly due to the flexibility of the Tunneline system that can adapt to profile variations as it is installed.

Concrete lining of corrugated steel culvert under Hume Highway

The project involved the rehabilitation of a 100m long 2300mm corrugated steel plate culvert under the Hume Highway at Broadford in Victoria.

The existing culvert had severe invert erosion and its proximity to an adjacent access culvert was giving cause for concern.

ITS Pipetech deployed the unique Tunneline technology to install a fully structural in situ concrete lining inside the host pipe to deliver a final diameter of 2000mm.

The project scope included:
- Full structual design to Australian Codes and Standards
- Formwork design and manufacture
- Concrete mix design and testing
- Reinforcement scope and design
- Installation of the concrete lining
- Formation of inlet and outlet structures
- Handover and commissioning.

The project took 15 days in today, despite some severe flood disruption, and no advance repairs were required to the existing host structure.

Frequently asked questions

Q: HOW DOES THE TUNNELINE SYSTEM ENSURE ADEQUATE COMPACTION OF THE CONCRETE?

A: The flowability of the mix design (using super plasticisers and retardants) and the high slump of the concrete mix combine to minimise air entrapment of the pumped concrete. The positioning of the concrete inlet and air release valve also contribute to avoiding segregation of the concrete mixture. Comparative testing of concrete cylinders and representative core samples have demonstrated consistent and design-compliant concrete strengths.

Q: WHAT ARE THE BENEFITS OF THE TUNNELINE SYSTEM OVER OTHER CULVERT RELINING OPTIONS?

A: The Tunneline System was introduced into Australia following the identification of an industry need for a fully structural lining solution for man entry culverts and structures. There are numerous 'flexible' lining solutions on the market (conforming to AS2566.1) that cannot meet the design standards required by many road and rail authorities for larger diameter structures. Also, Tunneline can line non-round structures, which most other systems struggle with.

The Tunneline System offers a true structural solution with compliance to a number of structural codes and standards, depending on the client's needs. The Tunneline System is also fire resistant, which makes it the preferred option in remote and bushfire-prone areas, and can be fully installed with minimal interruption to traffic using the road or rail service above the project during the installation works.

Q: IS VEHICLE ACCESS REQUIRED TO THE CULVERT HEADWALL?

A: No – we are able to pump from long distances. It is only necessary that we are able to walk to the culvert wall.

Q: WHAT TYPES OF CONCRETE AND REINFORCEMENT IS USED IN THE TUNNELINE SYSTEM?

A: The Tunneline System uses a specially designed concrete of minimum 40MPa compressive strength to ensure that the structural design and durability requirements of the design are met.

Reinforcement is provided using either 500-grade steel reinforcing bar, steel fibres or a combination of the two. This is largely dependent on each individual client and the design approach taken.

Q: HOW DOES THE TUNNELINE SYSTEM CERTIFY ITS DESIGN?

A: The design process for each Tunneline project is undertaken by an experienced third party engineering firm. The design process consists of the production of an initial concept design for approval by ITS and the client (if required). Once approved, the final design is produced and submitted in the format of 'For Construction' drawings.

During the construction process and depending of the size of the Tunneline project, the third-party engineering firm will undertake at least one site inspection of the works, usually before the first concrete pour, to ensure that the design intent is being met during the construction phase.

At completion of the project, the third-party engineering firm will review the project quality assurance documentation and provide a certificate of compliance for the project stating that it has been constructed in accordance with the design intent.

Design considerations

Tunneline can be designed as standalone structures to comply with client-specified loadings and standards. It can also be designed as a composite structure taking some strength from the host unit. A typical design process incorporates the following considerations:

- Undertake a needs analysis
- Inspection of existing conduit
- Identify installation constraints
- Confirm load requirements
- Identify hydraulic constraints
- Establish design criteria
- Undertake design development
- Develop inspection hold points
- Provision of third party certification (post construction)

ITS PipeTech quality

QUALITY, ENVIRONMENT & SAFETY SYSTEMS

All our products and procedures are subject to thorough scrutiny, both internally and by third parties. This guarantees that what we offer delivers value consistent with client expectations in terms of serviceability and long-term performance, while ensuring the safety and welfare of our employees, the environment, the end user and the general public. ITS PipeTech has third-party certified safety, quality and environmental management systems in place.

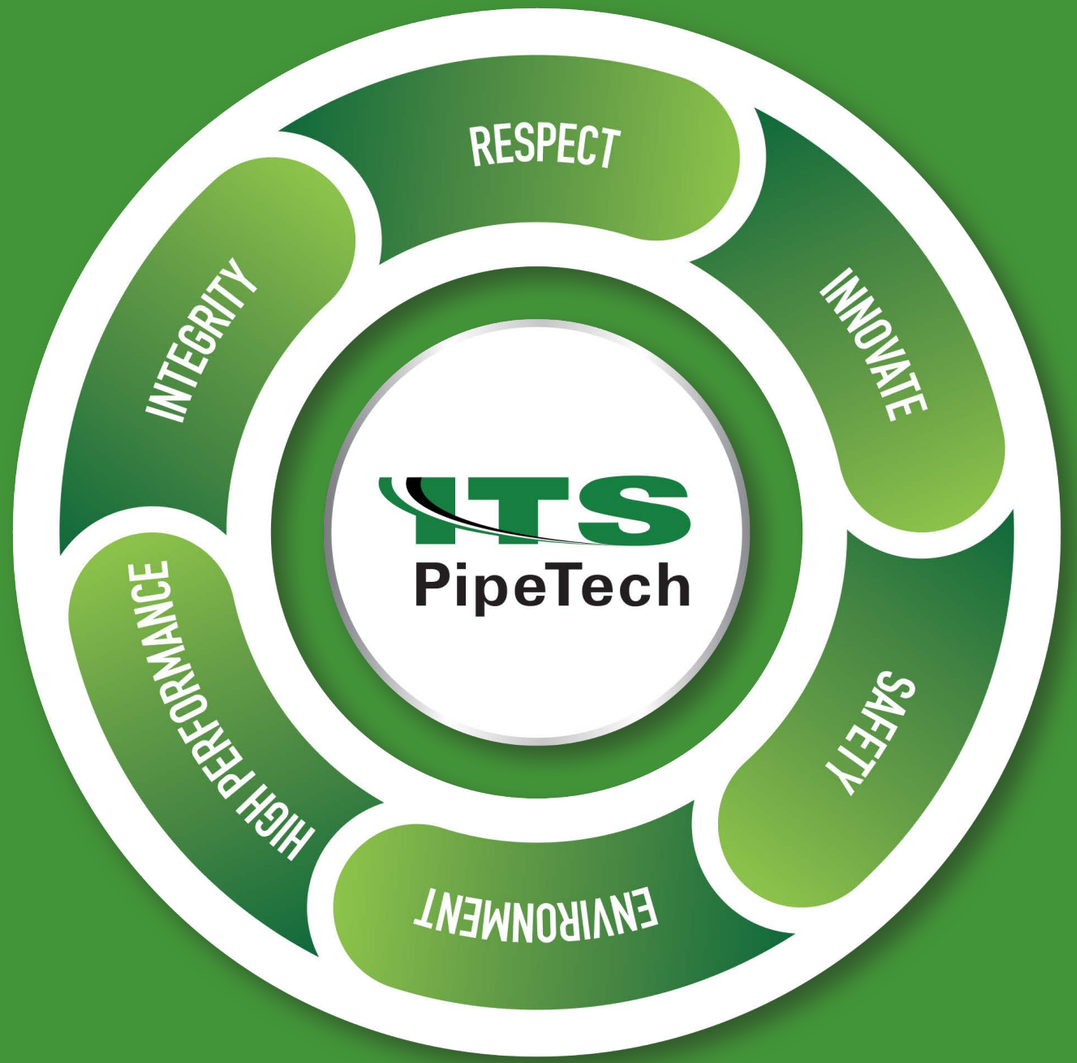
QA DOCUMENTATION

Upon project completion, ITS PipeTech compiles a copy of our QA documentation for client records. The documentation includes:

- Completed and endorsed inspection and test plans
- Design drawings
- Hold point notifications
- Concrete pour schedule and records
- Inspection reports
- Project photos
- As-built drawings
- Construction certificate
- Materials compliance certificates (concrete, reinforcement)

Licensing

Developed and widely used throughout the UK, the award-winning Tunneline system is a simple in situ concrete lining technique utilising lightweight manhole accessible bespoke formwork and high strength pressure injected concrete. ITS has an exclusive long-term relationship with the M3 Group (the technology owner) to provide the Tunneline system throughout Australia.



ITS products and solutions

Our services

Our diverse range of trenchless technologies are suited to pressure and non-pressure applications, including sewer, potable water, conduits and process pipelines, as well as stormwater culverts. Our environmentally-friendly and non-invasive capabilities include...

Swagelining

Swagelining is a process that was developed in the UK for the renewal of gas and water pipelines. The process involves butt-welding of a section of pipe that is originally longer than the main being replaced. Immediately prior to insertion, the pipe is temporarily reduced in diameter via a reduction dye, and then towed into the host pipe. The PE main then reverts to fit tightly to the host pipe. ITS' Swagelining solution is ideal for long length remediation with a minimal loss of pipe diameter or impact on the surrounding infrastructure and community.

Sliplining

Sliplining is a proven relining process undertaken by the installation of a new continuous pipeline that is smaller in diameter than the existing pipe. This is ideal for pipeline renewals where the capacity can be reduced. Installation is either by towing in a new pipe or (on occasions) pipe-jacking, depending on the project specifics. ITS is able to install a wide range of pipe products using this robust and proven remediation technique.

Tunneline

Tunneline is a unique patented structural concrete lining system that can be applied to provide a full rehabilitation solution for man entry culverts, pipelines and structures. The award-winning system is a simple, In situ reinforced concrete lining technique utilising a lightweight panel formwork system and high-strength concrete. Tunneline is ideal for culverts, tunnels and pipelines from 900mm to 5m-plus in diameter.

Pipebursting

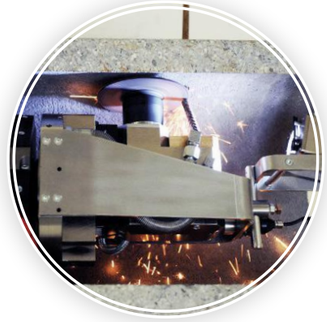
Pipebursting methodology involves the displacement of an existing host pipe, and the simultaneous installation of a structural replacement pipe of the same or greater diameter. This technique is suitable for the replacement of pipelines ranging from 75mm to 900mm in diameters.

CIPP (Localised and Full Length)

Cured in place Pipe, also referred to as Pipe Lining, is used for the structural repair of pipelines. ITS PipeTech has a working Partnership with German manufacturer BKP for the supply and installation of its full-length UV cured, Berolina glass fibre liner. The Berolina liner is tailor made for each pipeline rehabilitation application, with regard to length, diameter and wall thickness. The Berolina liner system utilises corrosion-resistant glad fibre materials together with a matrix of UV light initiated by polyester or vinylester resins to provide optimum reinforcement. This creates a high performing liner that is able to meet high design loads and withstand aggressive liquids or fluids.

Internal Joint Sealing

The Hydratech joint seal uses an EPDM rubber gasket (potable water approved), which bridges defective joints or cracks, and is then retained via stainless steel retaining bands that are locked in place. The seals are suitable for all pipe diameters from 700mm and greater, in round or other profile shapes. Once installed, the seals provide a long-term repair solution that is capable of withstanding both high internal and external operating pressures.



Pipeline Robotics & CCTV Inspection

Our KA-TE robotic pipeline repair equipment grinds materials, such as tree roots, deposits including grout, concrete and even steel, from within pipelines. It is also capable of clearing completely blocked pipelines. Epoxy injection is also possible with the robot system for repair of cracks and joints and sealing of junction connections. This repair technique provides for a 50- year sealing solution and is ideal for localised defect repair In pipelines. The robotic equipment is available for use in pipeline diameters from 150mm to 800mm. ITS also operates a fleet of new CCTV camera units for inspection, reporting and condition assessment of pipelines. Point-Lining is a localised repair method for singular defects, installed remotely using a combination of specialised resins and glass fabrics that are installed via inflatable packers to a nominated defective area. The packers are equipped with flow through passages, negating the need for by-pass of live flows. The point- Liner repair is suitable for use on defects in non-potable gravity pipelines. It is also possible to seal off dis-used junctions and connections.

Pipe & Water/Wastewater Related Structure Refurbishment

ITS PipeTech also provides pipe and structure refurbishment services including dig and repair and manhole rehabilitation to various water authorities, councils and industrial clients. From our perspective, having a complete suite of rehabilitation options has benefits in terms of being able to provide a tailored rehabilitation plan with the benefits flowing on to the client and the community.

COMPANY PROFILE

ITS PipeTech

About us

ITS PipeTech has offices in Sydney, Brisbane and Perth, providing innovative pipeline rehabilitation solutions to the water and wastewater industry, local government and industrial markets. Our more recent work has extended outside the eastern seaboard, with major projects now successfully delivered in South Australia and Western Australia.

We offer skilled staff, project experience and capability to deliver a wide variety of infrastructure solutions. ITS PipeTech is committed to keeping abreast of technology and market trends through a network of equipment and material supply partners, both locally and internationally.

Director's Message

ITS PipeTech deliver cost effective, high quality, low risk solutions for all pipeline and culvert rehabilitation, extending the life of existing assets and infrastructure utilising environmentally responsible processes and methodologies.

Better Smarter Outcomes

CONTACTS

NSW Office:
1/13 Stanton Road, Seven Hills NSW 2147
Postal Address:
PO Box 318 Seven Hills NSW 1730
Telephone: (02) 8603 2000
Fax: (02) 8603 2001
Email: enquiries@itspipetech.com.au

Queensland Office:
2/49 Links Ave, Eagle Farm, QLD 4009
Postal Address:
PO Box 173, Pinkenba, QLD 4008
Telephone: (07) 3630 2333
Fax: (07) 3630 2111
Email: enquiries@itspipetech.com.au

WA Office:
20 Baretta Road, Wangara WA 6065
Telephone: (08) 9408 1648
Fax: (08) 9408 0332
Email: enquiries@itspipetech.com.au