BEROLINA

ITS

PipeTech

Pipeline rehabilitation & construction

BEROLINA TECHNICAL GUIDE

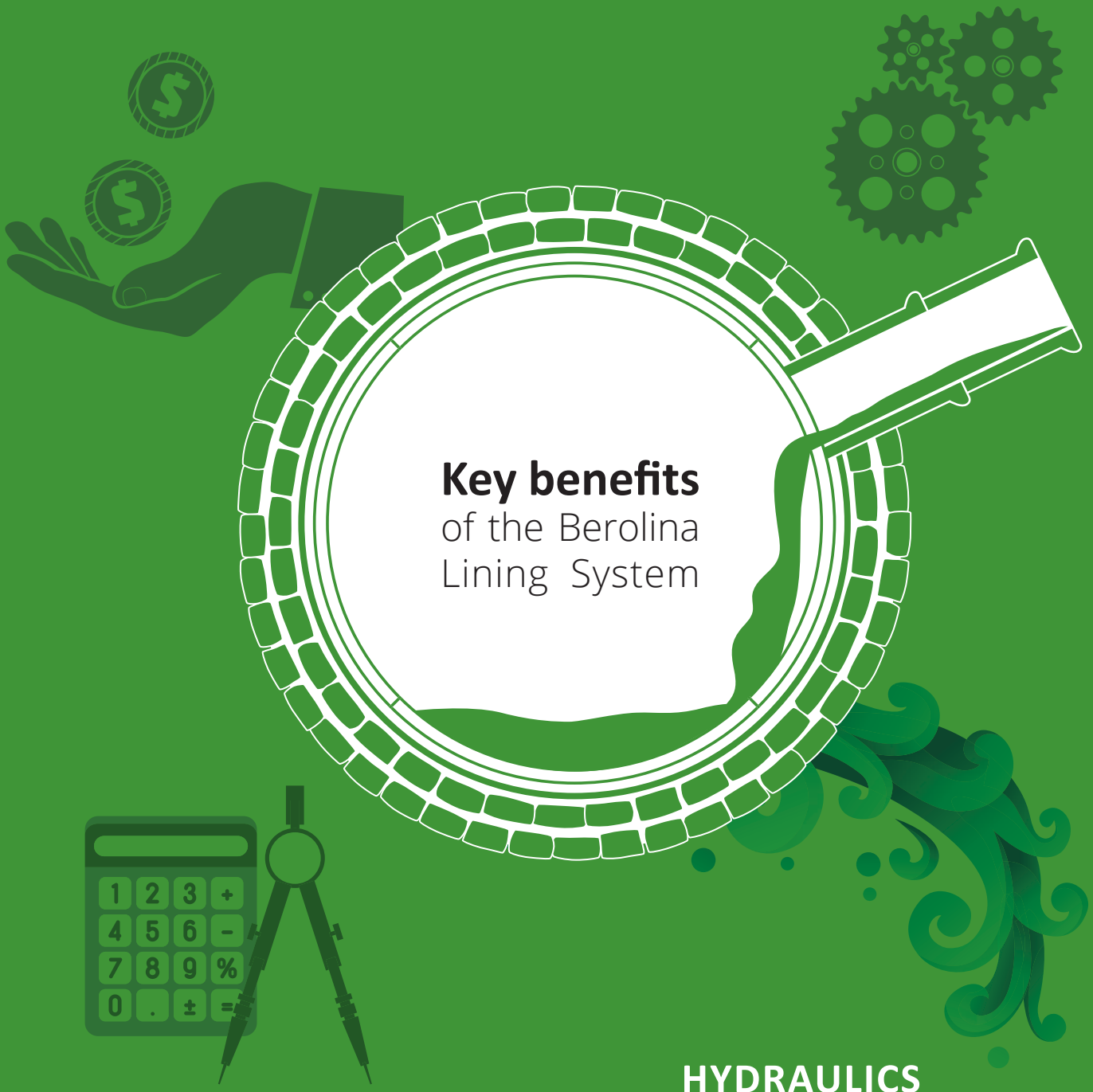
Contents

PROGRAM & COST

Quick efficient non man entry, no surface interaction with little impact on the existing operator.

STRUCTURAL

Standalone structural liner to AS 2566.1



Key benefits of the Berolina Lining System

DESIGN

Can be designed with a life up to 75 years depending on application.

HYDRAULICS

Minimal loss of cross sectional area, and a smooth internal bore provides superior flow rates compared to concrete, jointed pipe and spiral wound liners.

PROJECT REFERENCES

Berolina in Action

High profile projects that have been successfully completed across Australia.

Corrugated Stormwater Culvert
3 Cells x 50m @ 1200mmø

Location

Kiewa Valley Highway, Victoria

Application

Road Infrastructure

Corrugated Steel Culvert
3 cells x 50m @ 900mmø

Location

Pilbara, Western Australia

Application

Mining/Rail

Under CBD Roads and Trams
8 cells @ 300,375 & 450mmø

Location

Melbourne CBD

Application

Road Infrastructure

Pre cast concrete pipes
syphons @750 & 1200mmø

Location

Kununurra, Western Australia

Application

Water Infrastructure

4 Cell x 17m x 1200mmø
Including Head walls

Location

Moura, Queensland

Application

Rail Infrastructure

Berolina Overview / Applications

The Berolina lining system offers an expansive range of size and thicknesses that provides a close fit structural lining for almost all profile shapes. Berolina's ability to provide a bespoke and tailored solution ensures that asset owners receive best value outcomes for the maintenance of their systems and pipe networks.

The Berolina lining system is an effective thermo-setting structural rehabilitation relining process for pipes, conduits and culverts from 150mm - 1600mm in diameter. This lining system provides a tight fitting, standalone structural pipe inside any degrading, damaged or corroding host pipe. Berolina's structure meets all Australian Standards and provides an effective solution for a common infrastructure problem, without the need to undergo intrusive excavation and surface intervention of the asset. The Berolina liner can be manufactured to provide a design life of up to 75 years dependent on its application.

BKP Berolina GmbH of Germany is an industry leader in the manufacture and supply of cured in place pipe (CIPP) Berolina liners. The team at ITS have been working with Berolina since 1999 and has installed many kilometres of liner for councils, road and rail authorities and water utility managers across the country.

Berolina acts as a flexible liner in accordance with AS2566.1 and has the ability to expand as a tight fit liner inside the host pipe. As a result, Berolina is able to conform and interact with the existing host pipe for support and load distribution as a flexible liner is intended to.

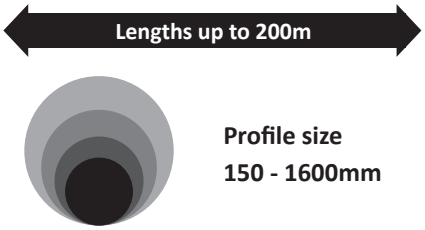
Product Description: The Berolina liner is a resin impregnated fibre-glass tube that is fed into the pipe via man holes, access chambers or head-walls.

The liner is cured in place once it is inflated inside the host via a UV light train thereby sealing the pipe against any leakage. In addition, the expansion of the liner during inflation provides a close, pressured fit inside the original pipe. This eliminates any potential for a void to be created between the liner and the host pipe, and as such, no grouting of any annular gap is required.

Installation Process: The installation and curing of the liner is a simple and fast process, with installation of up to 200m per day possible with only minimal disruption to the existing network. Sidelines and branch connections are cut out via robotic units once the lining has been installed and cured. Due to its tight-fit pressured installation, no secondary "top-hat" or junction seals are required to protect the integrity of the lining once complete.

The soft liner is cured using UV light which is a clean and efficient method, avoiding the production of unwanted styrene by-products that can otherwise be produced from steam and hot water curing methods.

The Berolina liner is noted for its markedly reduced CO2 emissions and low carbon foot print during the installation and curing process. The Berolina CIPP liner is complemented by installation equipment that has been specifically designed for purpose, and can be adjusted to differing compositions and liner thicknesses, dependent on the particular application, design or specific client requirements.



APPLICATIONS

Berolina can be installed to a range of host elements both in construction material as well as shape profile. **Up to 1500mm across profile.**

Circular **Oviform** **Elliptical** **Parabolic Ellipse**

Berolina can be installed in the following materials:

- **VC Pipe**
- **Steel Pipe**
- **Brick Sewer**
- **CSP Culvert**
- **RC Box Culvert**
- **AC Pipe**
- **Cast Iron Pipe**
- **DI Pipe**
- **HDPE Pipe**
- **Brick Culvert**
- **Mini Tunnels**
- **PVC Pipe**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Installation process

1 MOBILIZE & SET UP

The installation of a Berolina Liner is designed to occupy the least amount of on-site space as possible therefore liners are factory manufactured under full QA control and delivered to site ready to install. Liners can be winched from the packing crate directly into the pipe via existing manholes / man access points or from side access portals.

Excavation from the surface down onto the culvert / pipe is not required.

Small compounds (4.0x10.0m) can easily be erected then dismantled at the end of the day when the lining has been installed.

The plant required for installation is contained inside 1 Pantech truck.

2 DEALING WITH EXISTING FLOWS

As the system is a tight fit inside the existing host, the host has to be clear of flow. As such bypass pumping or flow diversion will be required.

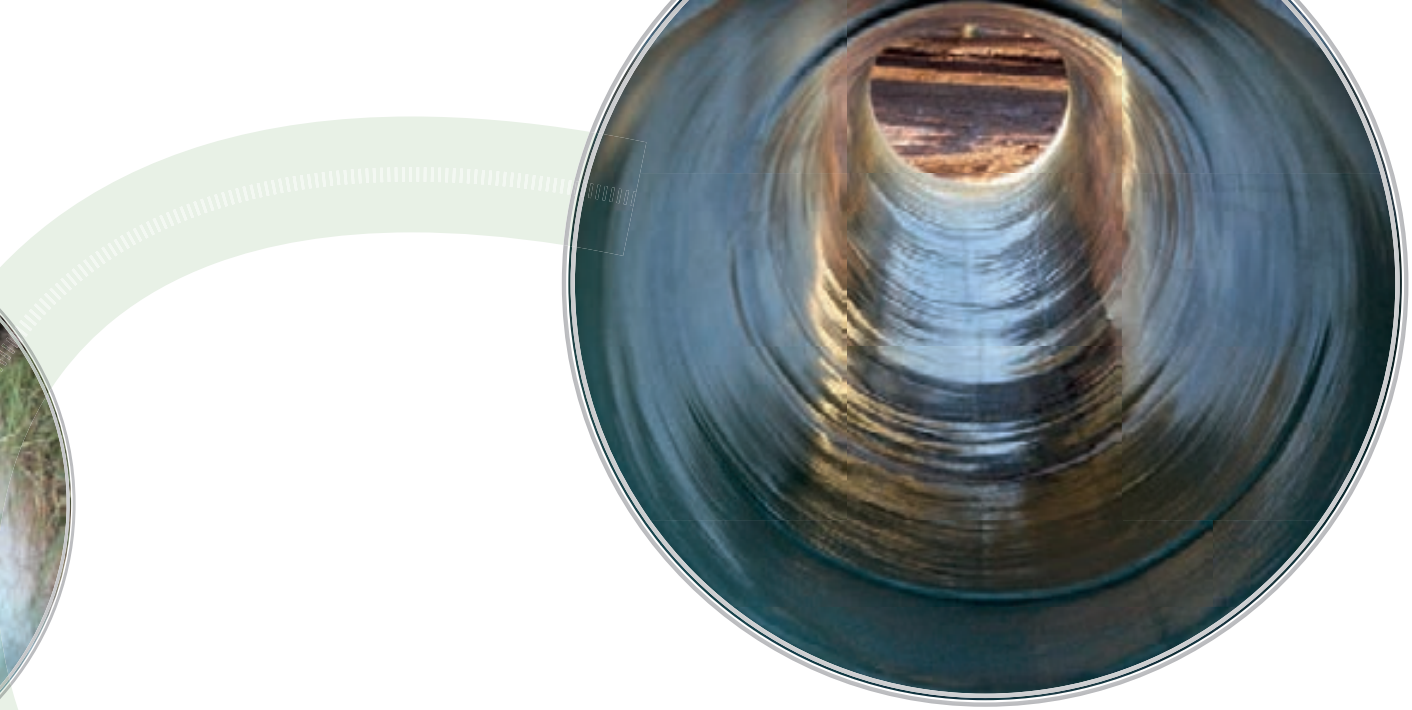
Existing laterals and branch connections can be stopped at the first available inspection point until the liner has cured after which they are reopened with our robotic units to restore flow.

3 CLEANING OUT AN EXISTING PIPE

Once the pipe has been accessed the first operation is to survey the pipe and this is undertaken with a CCTV unit. This survey will define the extent of cleaning required. The pipe is then cleaned. In the event of any obstructions, high powered hydraulic robotic units can be used to remotely grind out and remove the obstructions before the liner is installed.

4 PRE LINER

Prior to installing the full liner a pre liner manufactured from PE sheet is pulled through the host pipe. This pre liner runs through the length to be relined and covers the pipe or culvert from the 3 to the 9 O'clock position. The pre liner ensures the liner is not damaged during the tow in process.



5 LINER PLACEMENT

The liner is pre-cut and wet out in the factory and is then crated for delivery to site.

A winch rope is fed from a manhole or access point at one end of the length that is to be relined and runs through to a pulling winch at the other end. The liner is towed into position from inside a standard manhole at a headwall. Once towed into position, the liner has packers installed to allow for inflation.

Following the installation process the expanded liner is surveyed with a CCTV camera to ensure that the expansion is completed along the entire length of the liner.

Once this is confirmed the UV light train is introduced into the pipe and winched to the far end before the lights are switched on and the train pulled back thereby curing the pipe.

The curing speed is predetermined by the manufacturer to ensure a complete hardening of the resin.

The light train is then removed and the CCTV is again introduced to confirm the installation. The final process is to remove the sacrificial ends to allow trimming of the ends of the liner.

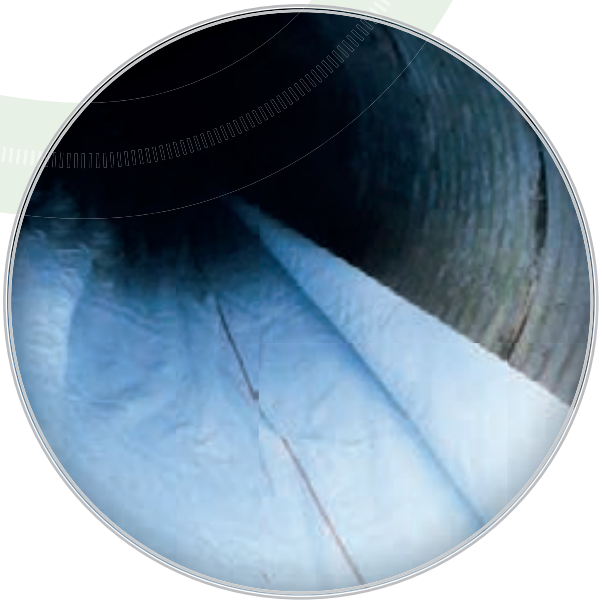
6 LATERALS AND CONNECTIONS

Any laterals and connections along the line will be sealed over as the liner is installed. CCTV will have plotted the accurate position of these in the initial survey.

After liner placement, robotic cutters will traverse the pipe, locate the laterals and these will be neatly reopened.

As there is no measurable annular gap, there is no requirement for any junction seals but if a seal is required, application of a tried and proven epoxy injection sealant can be provided using robotic technology.

Final check is done with CCTV to confirm that all is ok before returning the refurbished pipe to service.



CASE STUDY

Structural lining of twin 900mm corrugated steel culverts under the Princes Highway, Kiama NSW

Client: NSW Roads and Maritime Services
Project: Structural lining of twin 900mm corrugated steel culverts under the Princes Highway, Kiama NSW.

NSW RMS had identified that 2 x 60m long x 900mm corrugated steel culverts under the Princes highway at the Kiama needed to have their structural integrity reinstated back to an "as new" condition.

ITS undertook a survey and proposed the installations of a BKP Berolina thermosetting fibre glass liner to secure the culverts which was a first for this lining technology for the Australian market.

The site posed a number of issues and challenges due to access restrictions to the site and the extreme deformation in the host pipes. In addition to the obvious challenges, the client scope was for a fully structural standalone solution with a design life of 50 years whilst managing a Sm1600 loading and maintaining a maximum cross sectional area within the host structure. The location was equally sensitive from an environmental standpoint, so it was important not to contaminate the existing water course and limit any potential footprint damage to the local landscape.

The fully structural Berolina liner sets new standards in pipe rehabilitation due to its high strength, long service life, cost effectiveness and installation methodology with the added advantage of a minimal site footprint.

To meet today's demanding standards, the Berolina liner is extremely corrosion resistant and also fire resistant. From the ensuing CCTV footage, the clearly defined corrugations and quality of finish was proof that ITS had achieved an outstanding outcome.

It also demonstrated the suitability of this technology for the renewal of corrugated steel culvert and pipelines up to 1.6 metre in diameter and sets a new benchmark for culvert lining solutions in Australia.

In summary, RMS now has a very smooth, tight fitting, abrasion and chemically resistant structural liner which will provide for a minimum 50 year service life.

Specific advantages and key benefits include :

- Strong wear and fine resistant lining
- Improved hydraulic performance
- No residual process contaminated curing water
- Fast one pass installation
- Minimal site footprint
- No road closures
- Fire Resistant

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Frequently asked questions

Q: WHAT IS THE BEROLINA LINER SYSTEM?

A: It is a cured in place resin impregnated fiberglass tube which expands to form a tight fit against the host pipe. It is cured via a UV light train.

Q: WHAT CAN IT BE USED IN AND WHAT ARE ITS LIMITATIONS?

A: Berolina liners are manufactured to fit circular, elliptical, oviform and parabolic elliptical culverts and conduits with a profile range from 150mm to 1600mm. Berolina can also accomodate for pipeline bends.

Q: HOW ARE SEAL LINER ENDS AND CUT OUTS SEALED?

A: Due to the tight-fit nature, there is no annular gap at sidelines or junctions, so sealing using Top-Hat systems is not required. As the liner is manufactured and installed ~5% below nominal diameter of the host pipe a degree of expansion occurs when inflating the liner.

Q: WHAT IS THE CAPACITY FOR CHANGES IN GRADE; STEPPED JOINTS?

A: Berolina can accommodate step transitions of up to 5% of the liner diameter, steps greater than this will need pre grinding to reduce the step using robotics in advance of any installation.

Q: WHAT FORMS OF ACCESS IS REQUIRED?

A: Access requirements to manholes; minimum working space required inside manhole and conduit (in man-entry) is nominally 600mm minimum however on liners greater than 600mm a space of diameter plus 100mm would be required to fit the end packers necessary to seal the liners for inflation.

Q: WHAT LENGTHS CAN BE LINED WITHOUT BREAKS?

A: Maximum length of lining is 200 lineal meters in a single run. Longer runs are possible but must be reviewed on a case by case basis.

MATERIAL AND DESIGN PROPERTIES	
Short term tensile strength	150 N/mm²
Short term flexural strength	200 N/mm²
Short term flexural modulus	18,000 N/mm²
Long term flexural modulus (MPa)	6,800 N/mm²
Maximum allowable long term strain (%)	~ 0,5 %
Poisons ratio	u » 1/3
Hardness	Min. 40 (barcol impressor)
Coefficient of thermal expansion	~ 30 · 10-6 1/K
Radial shrinkage (%)	< 1 %
Longitudinal shrinkage (%)	<< 1 % hardening of material starting on one end and continuing with the light source to the other end (longitudinal shrinkage during hardening of material is compensated).

THE FINE PRINT

Design considerations

Berolina is designed as a fully standalone structural lining to comply with our client specified loadings and standards. It can also be designed as a composite member taking some of the inherited strength from the host structure. A typical design would incorporate the following considerations:

- Undertake a needs analysis
- Survey inspection of the existing asset with remote CCTV
- Identify any installation constraints
- Confirm access arrangements and design if required
- Confirm loading requirements
- Identify hydraulic requirements
- Establish design criteria
- Undertake hydraulic velocity and discharge review
- Undertake design development
- Undertake design risk assessment and review
- Develop inspection hold points
- Provision of 3rd party inspection/ verification

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

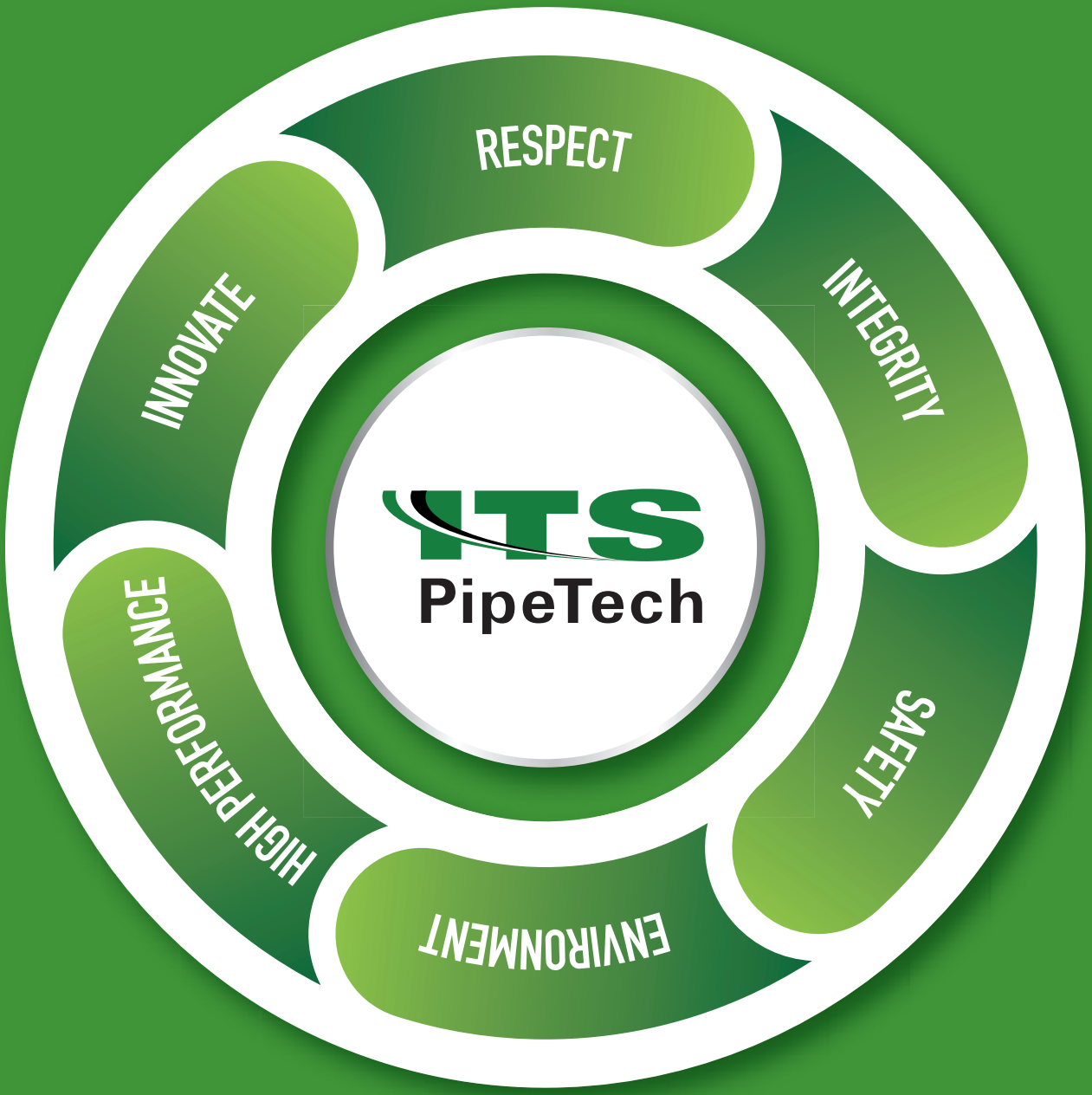
Upon project completion, ITS PipeTech compiles a copy of our QA documentation for client records. The documentation may include the following:

- Completed and endorsed inspection and test plans
- Design drawings
- Hold point notifications
- Inspection reports
- Project photos
- As-built drawings
- Construction certificate

Licensing

Developed in Germany and used extensively throughout the world, Berolina is exclusively represented in Australia by ITS. Berolina is licensed to ITS PipeTech who continue to work along side BKP Berolina GMBH in the development of the system throughout the continent.

COMPANY VALUES



RISE HI

Respect • Integrity • Safety • Environment • High Performance • Innovate

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...

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.

Pressureline

Pressureline 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' Pressureline 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.

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.

Berolina CIPP Lining

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 glass fibre materials together with a matrix of UV light initiated 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, Point-lining and 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.

Our 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

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