

THE FUTURE IS....TRENCHLESS TECHNOLOGY

TRENCHLESS LATERAL REPAIRS

All of A1 Advanced Drainage Technologies lateral rehabilitation systems can be launched through cleanouts. These patented techniques keep digging to a minimum which saves our clients money. These systems can also start and stop anywhere in the line which again can save our clients money.

Trenchless Technology services offered by A1 Advanced Drainage Technologies

- 💧 Lateral re-line without digging
- 💧 Lateral spot repair without digging
- 💧 Main line point repairs
- 💧 Remote robotic reinstatement cutting
- 💧 Complete sewer systems
- 💧 Change of diameter products
- 💧 Drainage CC.TV surveys and location
- 💧 Reline 90 degree bends, Junctions, Stop and start anywhere in the pipe
- 💧 Pipe lining 40mm and up to 1600mm
- 💧 Drain cleaning and repairs

A1 Advanced Drainage Technologies has a multitude of rehabilitation products. We can line 40mm pipe up to 1600mm. We can line complete sewer systems, most lining and reinstatement can be done without digging. We can also supply you with the technology to spot repair laterals as well as mainline sewers. A1 Advanced Drainage Technologies lining systems can be launched through cleanouts and allows you to fix problems anywhere in the line at any length. Give us a call today and we will fully explain your options.

With the growing concern over ground water contamination and our polluted waterways, shorelines and rivers, governments in Australia are spending millions of dollars to repair a crumbling infrastructure.

Poor materials in the ground, root intrusion, corrosive chemicals, ground shifting is damaging our drain systems. Their are estimates of 70% to 80% of the increased pollution come from the inflow and infiltration of the home lateral.

Trenchless Technology is the "new" solution for city officials and property owners.

This problem has become a high priority for city officials.







The Cured-In-Place Technology

Millions of linear metres of cured in place materials have been installed worldwide. They have withstood every corrosive environment plus the test of time. Billions of dollars have been saved because excavation was eliminated.

Cured in place materials mould to the host pipe. This seamless pipe prevents infiltration and exfiltration, restores structural integrity, eliminates joints that can weaken and allow root intrusion. Cured in place pipe actually increases flow capacity because the relined pipe is much smoother than old clay and concrete pipe. Above ground there are no piles of excavated dirt...no traffic tie-ups...no subcontractors and a happy customer.

A1 ADVANCED DRAINAGE TECHNOLOGIES STOPS LEAKS, INCREASES FLOW, AND RENEWS ORIGINAL PIPE WITHOUT EXPENSIVE DIGGING OR DISRUPTION

A1 Advanced Drainage Technologies has the experience and technical knowledge to specify the right thickness and right resins to meet your specific needs regardless how deep the pipe or how corrosive the environment.

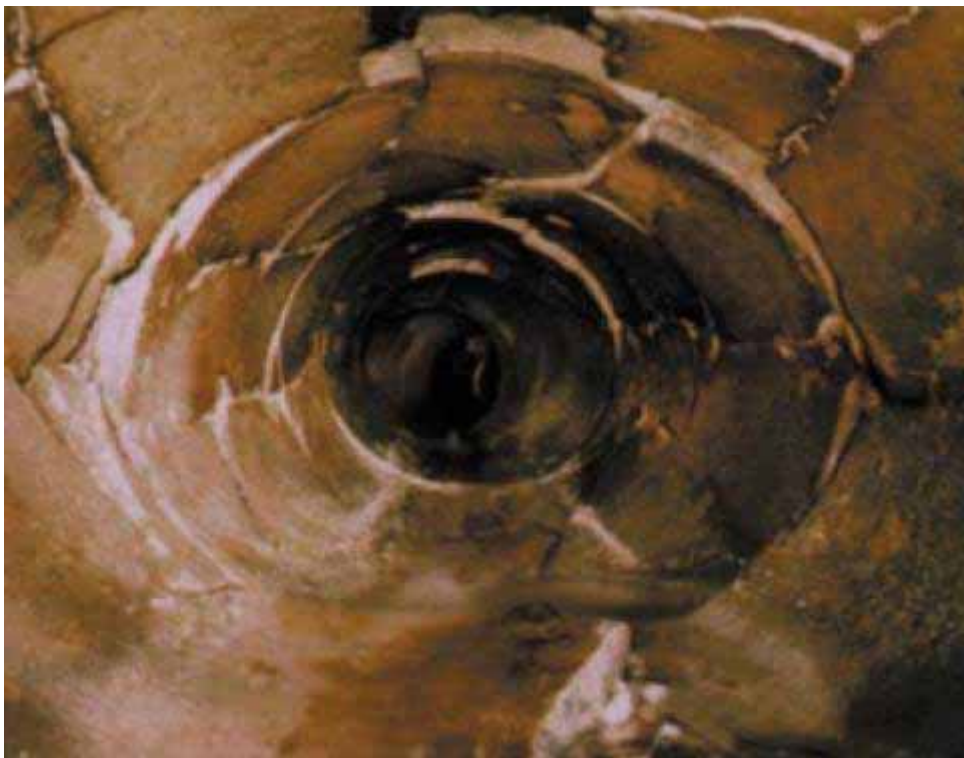
-  A1 Advanced Drainage Technologies is truly a "no dig" business saving you thousands of dollars in labour and restoration.
-  Seamless installation eliminates joints...increases flow
-  Lining conforms to non-standard pipe shape and size 40mm – 1600mm
-  Moulds to host pipe...stops leaks and root intrusion and can span "void" pipe sections
-  Can install under slab concrete, drives, floors, landscaping, etc.
-  Laterals accurately reinstated with CCTV camera...no digging to upset homeowners and local businesses

OVERVIEW

The main alternative to traditional sewer replacement involving trenching is cured-in-place lining, sometimes referred to as 'soft lining' or 'cured-in-place-pipe' (CIPP), which has dominated the non-man-entry sewer renovation market in many countries for over twenty years. For brevity, these Guidelines refer to all cured-in-place lining techniques as CIPP systems, although it should be noted that not all providers of such systems use this term.

Although several competitive systems are now available, the common feature is the use of a fabric tube impregnated with polyester or epoxy resin. The tube is inserted into the existing pipeline and inflated against the pipe wall, then cured either at ambient temperature or by re-circulating hot water or steam. Some variations use ultra-violet light to cure the resin.

CIPP systems create a close-fit 'pipe-within-a-pipe' which has quantifiable structural strength and can be designed to suit various loading conditions. The ring-stiffness of the liner is enhanced by the restraint provided by the host pipe and the surrounding ground, but systems designed for gravity pipelines do not rely on a bond between the liner and the substrate. Systems which rely on the host pipe for some measure of structural support are sometimes known as 'interactive lining' techniques.



Multiple fractures in a clay ware pipe – this is representative of the most severe damage that can be renovated using cured-in-place lining techniques

As well as minimizing bore reduction, an inherent advantage of cured-in-place liners is their ability to conform to almost any shape of pipe, making them suitable for relining non-circular cross-sections. Provided that the liner perimeter has been

correctly measured and that the material does not shrink significantly during cure, a close-fit liner should result. Their main limitation is the wall thickness, and hence the quantity, weight and cost of material, which may be required for larger sizes or for severe loading conditions, particularly in non-circular pipes.

Laterals can be re-opened remotely after lining, but care must be taken during installation to ensure that surplus resin does not enter branches. CIPP systems are also available for lining laterals from within the main pipe.

The major disadvantage of CIPP lining systems is the need to take the host pipe out of service during installation and cure. In gravity pipes, where flows are very low, it may be possible to plug any incoming pipes and to rely on the storage within the system. In other cases flow diversion or over-pumping will generally be required.

One way to overcome service intervention is with flow through plugs.

APPLICATIONS

Sewers	
Gas pipelines	(see note A)
Potable water pipelines	(see note B)
Chemical / industrial pipelines	(see note C)
Straight pipelines	
Pipelines with bends	(see note D)
Circular pipes	
Non-circular pipes	
Pipelines with varying cross-section	(see note E)
Pipelines with lateral connections	
Pipelines with deformation	(see note F)
On-line replacement (upsizing or size-for-size)	
Pressure pipelines	(see note G)
Man-entry pipelines	(see note H)

- a. Certain types of CIPP system have been designed specifically for use in gas pipelines rather than gravity sewers.
- b. Approval of the relevant regulatory body is needed for all materials in contact with potable water. Most CIPP systems are not intended for the renovation of potable water mains, but there are some which have been designed or adapted and approved for this purpose. A1 Advanced Technologies system is approved for potable water and meets with Australian / New Zealand Standard 4020 approval**
- c. The correct resin formulation must be chosen to resist unusually aggressive effluents and/or high temperatures.
- d. Wrinkling of the fabric may occur on the inner face of the bend, depending on the bend radius, the type of fabric used and the liner thickness. Nu Flex lining systems eliminate wrinkling.
- e. Some CIPP systems allow the fabric tube to be tailor-made to match changes in the circumference or perimeter of the pipeline within a manhole-to-

manhole section. Other systems use a fabric which can stretch to accommodate small variations in cross-section. It should be noted that, since CIPP liners are flexible prior to cure and can conform to almost any shape of host pipe; the critical measurement is that of the pipe's circumference or perimeter.

f. A widely accepted rule is that sewers with less than 10% deformation can be lined without any prior re-rounding. Ovality reduces the ability of the liner to withstand external loading such as hydrostatic pressure, and should be taken into account in the design.

g. Most CIPP systems were originally intended for gravity pipelines, but certain proprietary techniques are available for pressure pipes. See also notes A and B above.

h. Although used mainly in non-man-entry pipelines, some systems are also suitable for the renovation of large diameter sewers and culverts. The liner wall-thickness, weight and cost are the main limitations.

DESIGN & SPECIFICATION

Because liner specifications and design procedures vary from country to country and are subject to periodic amendment, it is outside the scope of these Guidelines to include reference to all national standards.

In countries where established local criteria do not exist, a widely-used standard is the Specification for Renovation of Gravity Sewers by Lining with Cured-in-Place Pipes contained in WIS 4-34-04, March 1995: Issue 2, published by WRc in the UK. Design procedures for determining the required wall thickness of circular and non-circular sections under different loading conditions are given in the WRc Sewerage Rehabilitation Manual.

Specifications for pressure (gas and water) applications are laid down by the relevant utility companies and approvals bodies. Most countries have strict requirements and accreditation procedures for all materials likely to come into contact with potable water.

INSTALLATION – GENERAL

As with all renovation systems, thorough cleaning and preparation are essential prerequisites. In non-man-entry sewers and other pipelines, inspection should be carried out by CCTV immediately prior to relining – old surveys can be misleading. Man-entry sewers may be surveyed by CCTV or manually.

All silt and debris must be removed completely, and a further inspection is recommended after cleaning to verify this. Care should be taken to avoid excessive pressures when using jetting equipment in damaged sewers, since this can exacerbate the defects. Intruding connections, encrustation and other hard deposits should be removed by mechanical or high-pressure water cutting equipment, followed by cleaning to remove the debris that this generates.

It is important to remove any loose fragments of pipe which may fall in as the liner is being inserted. This is particularly critical with 'pulled in place' liners where a broken

piece of pipe may fall onto the liner as it is being winched in, and then be trapped between the liner and the pipe wall when the liner is inflated.

Most CIPP systems require flow diversion during installation and cure. This period may be from a few hours to over a day, depending on the system and the characteristics of the pipeline. Lateral connections will be blocked by the liner until reopened, and provision should be made for removing surcharged effluent if there is insufficient capacity in the branch system. The build-up of effluent in a blocked lateral creates an external pressure on the liner, which may be significant if the sewer is deep. Measures may be required to limit the surcharge head.

Although CIPP systems are trenchless and designed to minimize disruption, vehicles and plant are needed on the surface throughout the installation procedure, especially at the entry manhole. Traffic regulation may therefore be required.

There may be short-term environmental implications with CIPP systems based on polyester resins, since the styrene solvent present in the uncured resin gives off a heavy vapour with a strong odour. However, although the vapour can be a health risk in high concentrations, such levels are not typically found around CIPP installations. Indeed, styrene vapour is detectable to humans at concentrations of less than one part per million and the odour becomes unbearably strong at levels below those at which it represents a hazard. However, to avoid any nuisance, adequate ventilation around the work site is essential. This problem applies only until the resin has cured.

Polyester resins may be adversely affected by water until they have cured which may be of relevance in a pipeline with infiltration or backed-up connections. In some cases, the use of a 'pre-liner' (see below) can overcome problems of contamination.

Epoxy resins do not have any environmental implication, are designed to stick to damp surfaces and it gives a relined pipe far greater strength, this is the resin used by A1 Advanced Drainage Technologies.

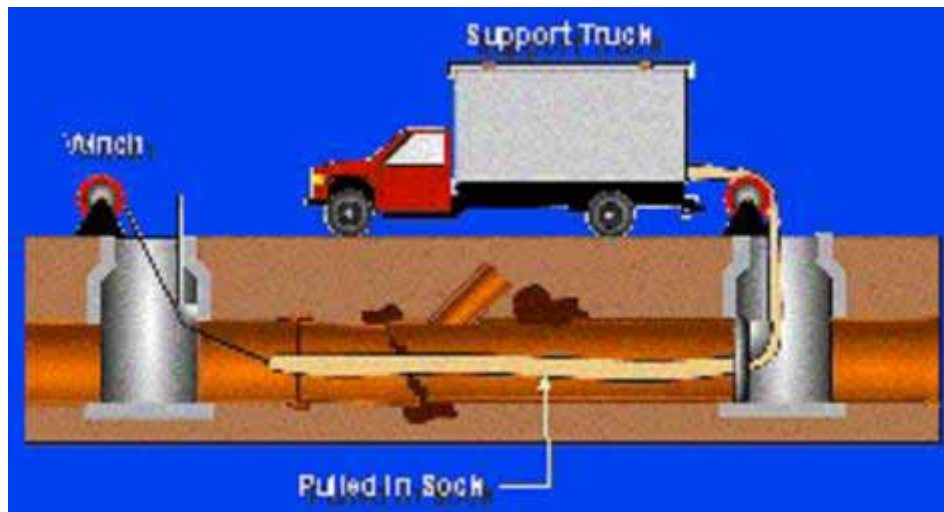
INSTALLATION IN SEWERS – THERMAL CURE

The following describes a typical process for installing thermal-cured CIPP liners in sewers. Each proprietary system has its own methodology, and the description below is intended as a guide rather than as a statement of best practice.

The majority of thermal-cure liners for gravity pipelines comprise a non-woven fabric – usually polyester needle-felt – impregnated with resin. Some systems use a composite material such as felt and glass-fibre. The formulation of the resin can be adapted to suit different cure regimes and effluent characteristics.

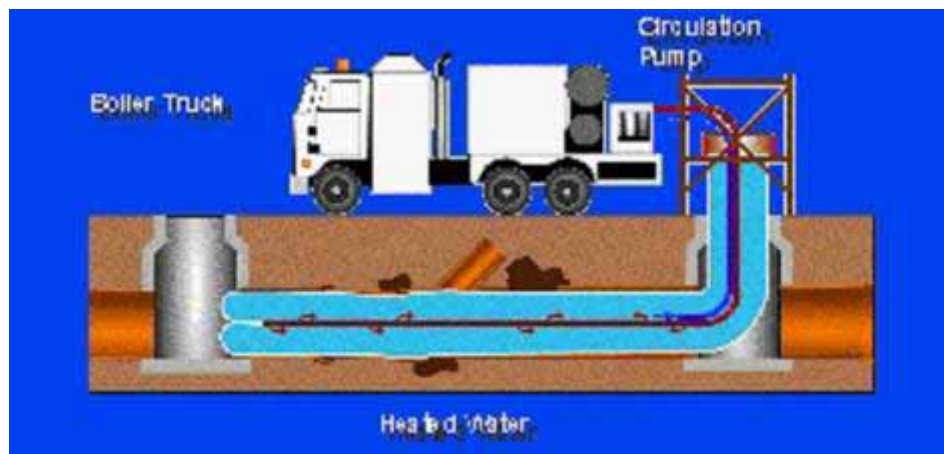
The liner fabric is usually coated on the outer face of the tube – which becomes part of the surface of a liner – with a membrane of polyester, polyethylene, surlyn or polyurethane, depending on the application. The membrane serves several functions – it retains the resin during impregnation and transportation, it retains the air during inflation, and it provides a low-friction, hydraulically efficient inner surface to the finished liner. Some systems use a separate membrane rather than an applied coating, and this may be removed after installation.

Impregnation is carried out in the factory or onsite using rollers to ensure the uniform distribution of resin. This is known as the wetting-out process. Depending on the characteristics of the resin, the liner may be delivered to site in a refrigerated vehicle, to prevent the curing reaction from starting prematurely.



Insertion into the existing sewer is usually carried out either by winching into place or by an inversion process. The following procedure is typical:

- a. When insertion is complete, the steam inside the liner is circulated through a boiler unit, using the hose attached to the trailing end to ensure that steam passes through the whole length of the liner. The rate of heat input is controlled according to the required cure regime of the resin.



- b. Temperatures at various points on the surface of the liner are monitored with thermocouples.
- c. Once cure has been achieved, the steam is gradually cooled down before being released.
- d. The ends of the liner are trimmed. Sometimes a few centimetres of liner may be left protruding from the manhole wall, which provides a better seal.

- e. If necessary, lateral connections are reopened with a robotic cutter or reinstated from the backside.

Some systems use a pre-liner which is installed within the host pipe before inverting the impregnated liner tube. The pre-liner is intended to stop surplus resin from entering lateral connections, and it also prevents contamination of the uncured resin by water infiltrating into the sewer or from surcharged connections.

Some systems involve winching in the liner rather than using an inversion technique. Inversion may be difficult in certain locations because of the need to create an adequate head of water, and towing in the liner avoids the need for scaffold towers and overhead working. However, there are limitations to the size and weight of liner which can be winched in.

INSTALLATION IN SEWERS – AMBIENT CURE

Ambient-cure lining systems are used mainly for the renovation of small diameter sewers, drains and other pipe work, including vertical rainwater and soil pipes. They use similar fabrics to thermal-cure systems – normally a coated felt – and most use resins which are formulated to cure without the application of heat.

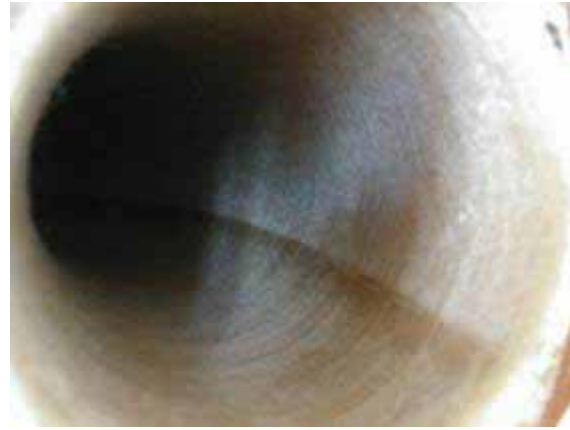
Ambient-cure systems avoid the need for boilers or other heat sources, and therefore tend to be less expensive than their thermal-cure counterparts.

The installation procedure is generally as follows:

- a. Unlike thermal-cure systems, mixing of the resin and impregnation of the liner are often carried out on site. A measured quantity of the resin is mixed, with different amounts of catalyst and accelerator being added according to the temperature and the speed of reaction required.
- b. The liner, with the coating on the outside of the tube, is laid out along the road or on firm ground, and the resin is poured in at one end. The resin is worked along the tube using a heavy roller, until the whole liner is saturated. It is essential to ensure complete impregnation of the fabric and the removal of all air pockets.
- c. The impregnated tube is pulled or winched into the host pipe, and a temporary inner sleeve is inside. This sleeve will contain the air used for inflation.



Before



After

- d. Compressed air is introduced into the temporary sleeve, which pressurizes the liner against the existing pipe wall.
- e. When sufficient time is judged to have elapsed for the resin to cure, the pressure is removed and the temporary sleeve is withdrawn.

CURED-IN-PLACE LINERS FOR WATER AND GAS MAIN RENOVATION

The structural characteristics required of a pressure pipe liner are quite different from those required of sewer liners. The primary loading on sewer pipes is external, and the most important structural parameters are elastic modulus and wall thickness which together provide the ring stiffness to resist buckling.

Pressure pipes, except in small diameters, fail less frequently through external loading. The most significant forces on the pipe are generally caused by the internal pressure which creates tensile stresses in the pipe or liner, and the most common pipe defects are corrosion and leakage from joints. Pressure pipe liners do not generally require as much ring stiffness as sewer liners, but they do need to withstand the bursting forces generated by internal pressure.

For this reason, the fabric used for CIPP pressure pipe liners tends to have a higher tensile strength than that for sewer liners, and, because flexural stresses are not so critical, the wall thickness of the liner is usually much less. Glass-fibre or a glass-fibre composite is commonly used, except in woven hose linings which generally use polyester fibres.

The fabric of woven hose linings is normally impregnated with epoxy resin, rather than polyester, which may produce an adhesive bond with the substrate and eliminates water-paths which could allow internal corrosion to continue. Epoxies may also be more acceptable in contact with potable water. Most of the techniques aimed at pressure-pipe renovation were initially developed for the gas market, mainly in Japan, but several CIPP systems are now available to renovate potable water mains.

The installation process is similar in concept to the inversion method used for gravity pipe liners. However, because pressure pipe liners are less bulky, it is possible to contain the impregnated liner within a pressure vessel and to invert the liner through the host pipe with compressed air. Curing is achieved by introducing steam into the liner.

In addition to the thin-walled liners described above, there are also CIPP techniques using epoxy resins which do not rely on a bond to the existing pipe wall. These systems develop their strength from the composite action of the resin and fibres rather than a woven jacket, and are designed to resist both internal pressure and external loading. As an alternative to epoxy resin, vinyl ester resins are used for some industrial applications.

- 💧 Most cured-in-place lining systems are intended for the renovation of gravity pipelines, though pressure pipe systems are also available.
- 💧 They are versatile, being able to accommodate non-circular sections, bends, and changes of cross section, all pipe materials and various loading conditions.
- 💧 They produce a close-fit liner with a smooth internal surface, and the low hydraulic roughness often compensates for the reduction in bore.
- 💧 The liners generally used are resistant to all chemicals normally found in sewers. Special resin formulations are available for particularly aggressive effluents.
- 💧 Pipes from less than 100 mm to over 2500 mm diameter can be relined, although the economics may become less favourable in the largest sizes as the weight and cost of materials increases.
- 💧 Lateral connections can be opened remotely from within the main pipeline.
- 💧 Lateral relining systems are available for installation either from within the main or from the upstream end of the lateral. These can provide an integral, sealed lining system for gravity sewers.
- 💧 The host pipe is blocked during insertion and cure of the CIPP liner, and flow diversion will often be required unless there is adequate storage in the upstream pipes. In some cases a flow through plug may be used.
- 💧 Cured-in-place techniques have a track record going back over 25 years, and their durability is well established.