



Plastics Industry Pipe Association  
of Australia Limited

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## Pipeline Replacement using Relining

Mark Heathcote, March 2006

Relining of old pipeline systems is becoming an increasingly attractive option to asset owners and operators as an effective alternative to open trench replacement. Relining options rely predominantly on plastics pipe systems for their success. These trenchless options utilise the existing pipeline and as the name suggests minimise the excavation or trenching required.

Relining can take a variety of forms – slip lining, roll down or swage lining, pipe cracking, folded and formed are some of the popular options. The focus in the following document will be on those systems using pipe based liners. This range of options allows them to be tailored to provide the best outcome for specific applications. The major material options are Polyethylene (PE), Glass Reinforced Polyester (GRP) and Polyvinyl Chloride (PVC) with application to water, sewer and gas pipeline renovation in both pressure and non pressure systems. In some cases the lining utilises strength from the host pipe and in others the new pipeline is completely stand alone.

### Slip Lining

Slip lining is probably the simplest of the lining options. It involves slipping a new pipe inside another generally older poor performing pipeline. Whilst slip lining can be done using any pipe option it is PE that is the most commonly used pipe system for this process. GRP and PVC have also been used as slip liners.

Coiled or butt welded PE pipes are well suited to this technique as there is no additional loss of diameter due to socket and spigot joints. Coiled pipe is generally only available in smaller diameters (< DN180). In larger sizes the ability of PE to be welded into long lengths is a distinct advantage. Couple this to the inherent flexibility and abrasion resistance of PE and you have a system that allows the new pipeline to be readily towed into place – even around curves.



*Butt welded PE pipes ready to be used  
– photo courtesy of CLM Trenchless*

The pipe size and wall thickness can be tailored to the application. Pressure and non-pressure applications can be accommodated. In some non-pressure applications the annular space may

require grouting but grouting is usually not required in pressure applications. Grouting will increase the overall stiffness of the installation and prevent ingress and movement of ground water in the annular space around the liner pipe. If GRP is used the shape can also be tailored to accommodate cross sections such as ovoid pipes.



*Slip Lining with DN500 PE, Botany NSW  
(photo courtesy of CLM Trenchless)*

PVC liner pipes have been commonly supplied in three metre lengths with solvent weld joints. The joints may utilise either standard formed sockets or machined “in-wall” joints. As with PE and GRP, the smooth bore of PVC pipes, coupled with minimisation of infiltration, means that, despite reduced bore, flow capacity may not be reduced and may in fact increase.

However, because the diameter of the new pipe will be smaller than the host pipe there is usually a desire to maximise the ID of the new pipe. Techniques such as pipe cracking and close fit linings like swage lining or folded and formed offer better opportunities to maximise the ID of the new pipe when compared to slip lining. This reduction in bore is often the limiting factor in the selection of which technique to use.



*PE liner about to enter an old brick sewer  
(photo courtesy of Vinidex)*

## Roll Down and Swage Lining

This process temporarily reduces the diameter of the new pipe by passing it through a die or rollers just before it is pulled into the host pipe. The reduced diameter allows the new pipe to be easily towed through the host pipe. Typically this reduction is in the order of 10 – 15% of the diameter. Once in place the new pipe regains its original dimensions by natural reversion– in some cases this process is assisted by the application of pressure. Roll Down and Swage lining results in a close fit lining system that maximises the internal diameter by minimising or eliminating the annular space between the liner and host pipe.

PE is again the material of choice for this process. Advantage is taken of its flexibility and the fact it can be butt welded into long continuous lengths. The availability of a wide range of wall thicknesses and diameters again assist in optimising the new pipe properties for the particular application. The primary application for roll down and swage lining has been for pressure applications where the pipelines being lined generally have a consistent bore with few obstructions like displaced joints.

Roll Down and Swage lining has been used extensively in Europe in sizes up to 1100mm diameter. The liner can accommodate gradual bends but will not negotiate an angled fitting such as a 900 bend or a Tee.



*Swage lining DN500 showing reducing die and rollers, Hobart Tasmania  
(photo courtesy CLM Trenchless)*

## Folded and Formed Lining

In this process a liner pipe is first folded into a “U” or “C” shape before it is inserted into the pipe. In some cases the pipe is folded in the factory and then coiled while in other cases (normally larger pipe) the liner can be folded on site immediately before it is inserted. Products like Iplex’s PE “Compact Pipe” use this folding technique. The folding process effectively reduces the size of the pipe so it can be readily drawn through the host pipe. Once inside the host pipe the liner is restored to the shape of the host by the application of heat and pressure and/or the insertion of a rounding device.



*Coils of PE Folded and formed liner – “Compact Pipe”  
Courtesy of Iplex Pipelines*

The Vinidex “EX” liner system offers a variation on this theme where a flat PVC liner pipe is first conditioned with steam to soften the material prior to insertion. Once inside the host pipe the liner is pressurised to expand it and then cooled resulting in a tight fitting liner system. This system is intended for non-pressure applications.



*“Ex” Pipe PVC liner system entering a sewer access chamber  
– Courtesy of Vinidex.*

Both PVC and PE are used for this technique. Pressure and non-pressure applications can be accommodated. PVC tends to be restricted to gravity or non- pressure applications whilst PE is suitable for pressure and non-pressure applications. There are limitations on wall thickness and pipe size with this process. The liner is restricted to pipe options that can be coiled or at least deformed on site immediately prior to insertion - hence smaller diameter or thinner walled options can be accommodated but thick walled or large diameter pipe systems pose a physical limitation to this process.



*"Compact Pipe", insert showing cross-sectional shape  
- available from Iplex Pipelines*

### Pipe Cracking or Bursting

Renovation of old cast iron, clay and concrete pipelines often involves pipe cracking or pipe bursting techniques that allow the new pipe to be as large or larger than the original pipe. In this technique the original pipe is broken into pieces by a pneumatic or hydraulic ram that expands inside the old pipe. Behind the ram a new pipe, usually PE is towed in. It has application to pressure and non pressure systems.



*PE being drawn behind pipe burster on Pittwater Rd, Sydney  
- Photo courtesy of CLM Trenchless.*

Again PE is the pipe material of choice for this application offering the flexibility, toughness and long continuously welded lengths to achieve cost effective long life replacement options. PE provides a complete pipeline system including a range of mechanical and welded fittings to facilitate connections to properties or off-take pipelines.

Because of the bursting action any connections that need to be kept intact must be disconnected prior to bursting or they will be damaged during the process. Similarly care must be exercised with adjacent services and pavements as the localised soil movement can damage these installations.



*PE pipe bursting head breaking open cast iron pipe at an excavation  
– Photo courtesy of CLM Trenchless.*

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