



**Lanes  
Group plc** Best Practice Series

**Relining**





## Relining: Introduction

### Best Practice for Pipe Relining

What should you expect from your drainage specialist when it comes to drainage pipe and culvert repair? What rehabilitation methods are available, and how is the appropriate technique selected? We asked **Lanes' Reline Manager, Simon Bull**, to put together a best practice guide. This is his advice:

Where drain repair used to involve excavation and pipe replacement, best practice today, wherever feasible, is to use 'no dig' or 'trenchless technology'.

This is also known as relining or CIPP (Cured In Place Pipe), during which a damaged pipe is relined with a special liner. The liner is then cured (hardened), creating a new pipe inside the old one.

This repair method means there is no need to dig up the whole pipe and replace it. The work is carried out underground, from access manhole to access manhole, leaving the land in between untouched.

Relining is generally best practice for all concerned parties. It's less disruptive to the local area, whether that's public streets, private property, businesses or domestic properties. It's usually cheaper too, since it's quicker, requires less reinstatement work and is less damaging to the environment. Of course no-dig isn't suitable for every situation: in some cases, excavation may be the only solution.

But before deciding on a repair method, there are physical factors to consider. Firstly, I'll take you through those. And, since they may dictate which no-dig technique is possible, I've added an overview of each method, along with its pros and cons. The FAQ section is based on questions I often get asked. And, finally, I've listed best practices that your contractor should work to when planning and carrying out a reline repair.



## Relining: Factors to consider

### Geography

The physical layout and features of the land involved, including buildings, roads, and so on, which need to be accommodated. Overhead lines may limit the use of cranes or scaffold platforms.

### Site of Special Scientific Interest (SSSI)

Is it an area of special Interest, for instance, which may mean that the surrounding area can't be disturbed for wildlife, heritage or scientific reasons?

### Impact

Who is likely to be affected by any disruption: workers, traffic, businesses, the public, transport, children and wildlife?

### Residential

Is the planned repair safe for homeowners and their families? Will it prevent them from living normally? Are there safety issues?

### What can go wrong?

#### Access

Can plant and machinery reach the access points to the drain? If the site is in a rural area, special all-terrain vehicles may be required or temporary roads be built to accommodate site traffic.

#### Pipe characteristics

The extent and seriousness of any damage, the pipe's construction and material, any severe angles or changes in shape, along with the diameter and length of drain to be repaired.

#### Environmental

Weather conditions, such as heavy rainfall, snow and changes in temperature, can influence the lining process and alter chemical reactions when mixing resins.

### Ecological issues

These may limit the options. Surface water drains may lead directly to a watercourse, so there may be a risk of contamination. The presence of protected wildlife, such as newts, would affect the way work is carried out.

### Cost

Clients may range from water and sewerage companies or large civil engineering enterprises, to private individuals, small businesses or insurance companies. The work may be urgent, or not. Lengthy projects may result in lost business. All factors have to be taken into consideration.



### Industrial

Will the project interfere with production? Will a business need to stop operating for the duration? Are there contamination issues?

### Rail

Does the work require track possession, and will it be completed during the designated time?



## Relining: The options - hot cure

During hot cure relining, a liner impregnated with resin is inverted through the pipe from manhole to manhole, using water. The water is then heated up inside the pipe to a given temperature for a prescribed duration, via a boiler. The diameter and length of the pipe determines the size of boiler; for example a 3.5 million BTU model will cure a liner from a 225-1500mm diameter pipe up to 500 metres long.

The diameter and length of the liner will also dictate the way it is inverted through the damaged pipe, and the type of scaffold system required.

### Hot Cure: Pros

- Good for longer lengths of drain due to the cure being controlled.
- Accommodates bends of up to 45°.
- Has a 50-year design life with a safety factor of 2, so 100 years in total.
- Is recognised by Water Industry Specifications WIS 4-34-04 or BS EN ISO 11296-1-2011.
- Epoxy resin or vinyl ester resin can also be used in this method of lining and offers good chemical resistance when used on process lines.

### Hot Cure: Cons

- Wastewater from curing is contaminated by styrene, a marine pollutant, which must be removed and disposed of at a treatment works.
- Requires a large site footprint, including a crane on >375mm diameter liners.
- Not suitable for surface water drains due to styrene.
- Requires boiler to heat water so is less energy efficient.



## Relining: The options - UV light

Using ultraviolet light to cure the liner inside the pipe is fast becoming the default technique. It's quicker, greener and generally requires less heavy plant and machinery.

The size of UV light rigs or train used will depend on the diameter of the pipe being repaired. There are also portable rigs for off-road sites.

### UV Light: Pros

- UV light cure results in a smaller site footprint (plant, personnel & time).
- Boundaries are being pushed all the time: 1800mm-diameter UV liners are now being manufactured and installed.
- No contaminated wastewater, so safer for surface water drains.
- Reduced carbon footprint as it is faster than hot cure (most liners cure within 4 hours).
- UV liners are thinner but stronger so there is less cross sectional loss.
- UV liners can be stored for up to 6 months.
- Data is sent back to installer and manufacturer in real time for analysis.

### UV Light: Cons

- Cannot be used if sewer bends more than 12.5°.
- The maximum length of a single liner is 300-metres due to cable length.
- Not suitable for badly fractured drains because the liner may become damaged whilst being pulled into place.
- UV liners are manufactured in Germany and have a two-week lead-time.





## Relining: The options - ambient cure

These liners will self-cure in given ambient temperatures. With a small site set up and minimal labour requirements, ambient cure is ideal for domestic properties on short runs of 100–150mm diameter pipes.

### Ambient Cure: Pros

- A smaller site set up and less labour intensive than hot cure.
- Suitable for shorter lengths of 75-375mm diameter pipes.
- Speedier cure (most jobs complete in a day).
- Can be used to line bends up to 90°.
- Prevents future root ingress.

### Ambient Cure: Cons

- Not a structural liner.
- Can shrink up to 6%.
- Its suitability is limited by the length and size of the liner, because it may begin to cure during installation.
- This method is not WRc-approved.



## Relining: The options - patch / point repair

Patch or 'point' repairs can be used to fix an isolated area of damage in a pipe. Sometimes several patches may be installed in sequence. The short liner or patch impregnated with resin is fitted round an inflatable packer, and placed in position inside the pipe. As the packer inflates, it pushes the patch against the pipe, where it cures against the damaged pipe. The packer is deflated and removed.

### Patches: Pros

- Suitable for 75-1500mm diameter pipes.
- Gives structural strength due to glass carrier.
- WRc-approved.
- Almost odourless.
- No shrinkage.
- Versatile: patches can be installed sequentially in the middle of pipeline.

### Patches: Cons

- Packers are rigid, so above 450mm diameter pipe, the manhole biscuit may need to be removed to allow packer access.
- Larger diameter patches also require considerable manual handling.
- Wet-out (ie impregnating the liner with resin) must be done under shelter to avoid rain or bright/hot sunlight.



**Q:** Can a pipe be too badly damaged to reline?

**A:** WRc guidelines advice is not to line a pipe with more than 15% deformity. Worse cases can be lined with a disclaimer. Your drainage expert will advise you.

**Q:** What is the expected loss of diameter/flow capacity after relining?

**A:** This depends on the design of the liner however the improvement in flow capacity (K factor) outweighs the loss in cross section.

**Q:** What diameter of pipe can be lined?

**A:** 75mm – 1800mm diameter.

**Q:** Can any shape of pipe be relined?

**A:** Unusual pipes, such as box- or egg-shaped, can be lined, but liners must be specially designed as they will behave differently under strain.

**Q:** What is the maximum length of liner that can be installed in one piece?

**A:** To date, our longest single liner was 515-metres, but hot cure will allow longer than that. 300-metres is the limit using UV light cure because of the cable on the light rig.

**Q:** Can any type of material be relined?

**A:** Yes, but with HDPE the liner/resin will not bond to it. A liner can still be installed but needs to be fixed in place with mechanical liner end seals.

**Q:** What is the liner made of?

**A:** Hot cure liner is usually needle felt impregnated with either polyester, vinyl ester or epoxy resin. The felt may be strengthened by the addition of glass strands during the needling. Ambient liner is a needle felt tube impregnated with polyester resin. UV light liner is primarily glass matting with some needle felt added as a wearing course, and UV-receptive polyester or vinyl ester to cure. Patch repairs are glass-fibre reinforced matting, impregnated with silicate resin.

**Q:** How long does a liner take to cure?

**A:** That depends on the method being used, and the size and length of the pipe. UV is the fastest currently, so for example a 3mm thick, 225mm diameter liner, would cure at around a metre per minute.

**Q:** How long does a liner last?

**A:** Installed to WIS (Water Industry Specification), liner life is 50 years, but incorporating a safety factor of two effectively gives a design life of 100 years.

**Q:** Can a pipe be lined if there is only one access point?

**A:** Yes by using an open-ended or 'blind' liner. This means installing a liner with no constraint and then inverting a secondary calibration hose through the initial liner.

**Q:** Are there any environmental risks involved in relining?

**A:** Yes, However, we minimise the risks by using the correct type of liner and curing method, and adhering to strict working practices.

**Q:** How much does lining cost?

**A:** This very much depends on the liner design, the complexity of the work and size of liner. Each case is assessed and scoped individually and priced as such.

**Q:** Can you repair damage in the middle of a drainage run?

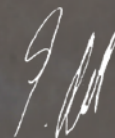
**A:** Yes. Your specialist will tell you whether it's most cost effective to line the full length of the drain, or to install several sequential patch repairs.



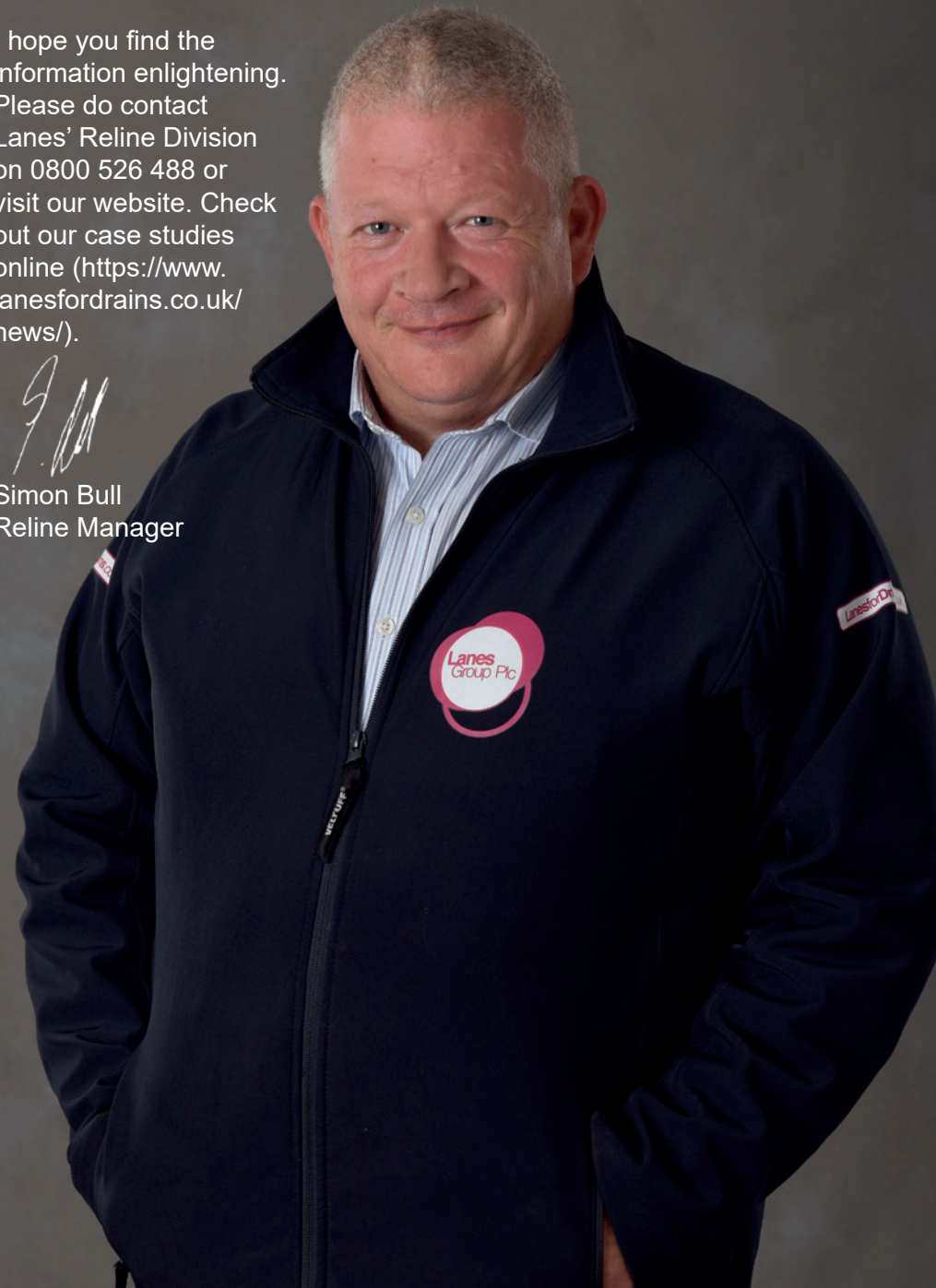
## Relining: Best practice for contractors

- Following a RAMS (Risk Assessment & Method Statement).
- Use WRc guidelines for liner design.
- Be aware that lining pipes with more than a 15% overall deformity is possible but will not conform to WRc standards.
- Carry out a CCTV survey to ensure that all measurements (lengths and diameters) are accurate: a 10% variance could be as much as 10-meters on a 100-meter pipe run.
- Start the CCTV survey outside the host pipe to avoid missing any laterals connections.
- Select the correct liner and resin for each installation: the best option is not always the newest technology. For example, larger diameter pipes with bends of more than 12.5° require hot cure. Using UV light cure gives a higher strength and thinner liner, but carries a greater risk for bends over 12.5°.
- Use a pre-liner where there is water ingress, or for worksites near domestic properties. This prevents resin wash out, acts as a styrene barrier and prevents the liner from rising.
- Measure the position of laterals by pre-surveying the drain with the robotic cutter which will be used during the reline. This should have a fibre tape attached to a fixed point on the cutter so that the measurement is taken from a fixed point. The measurements and clock references should be recorded on a lateral log sheet.
- Install liners to manufacturer's guidelines (eg recommended head of water for the hot cure and correct air pressure and pulling speed for UV light cure, etc).
- Pre-clean and CCTV survey in good time before installation, not the day before the repair.
- Leave visibly capped connections uncut and record them as such.
- Ensure over-pumping is adequate for both given flow rates and potential weather events.
- Check over-pumping before and during use: blockages can cause flooding or liner failure.
- Post-survey the drain prior to taking the over-pumping off.
- Take liner material samples for independent testing to build up a database.

I hope you find the information enlightening. Please do contact Lanes' Reline Division on 0800 526 488 or visit our website. Check out our case studies online (<https://www.lanesfordrains.co.uk/news/>).



Simon Bull  
Reline Manager



## Case Study: UV CIPP Culvert Rehabilitation

### Project challenge

AMCO commissioned Lanes Group plc to rehabilitate a culvert under the West Highland Line at one of the most remote rail locations in the UK by installing a glass reinforced plastic (GRP) liner. The concrete circular culvert, carrying surface water beneath the line, needed to be strengthened. Network Rail stipulated that the liner needed to have a design life of 100 years.

Using standard assessment tools that access the design and condition of the culvert and other factors, including volume and flow of water, depth of track bedding, and rail movements, AMCO and Network Rail calculated that the liner needed to be 16mm thick. This was relatively thick for a liner, adding significantly to its weight.

### Solution

The isolated location of the culvert meant that a lining solution needing a minimal amount of equipment would be the best option. For that reason, ultraviolet (UV) light cured in place pipe (CIPP) lining was selected. UV lining needs a minimal amount of equipment, can be carried out within relatively confined work sites, creates minimal hazardous waste, and is completed more

quickly than other CIPP methods, making it ideal for rehabilitating rail culverts. A resin-impregnated GRP liner is inserted into the pipe and inflated with compressed air against the pipe wall. A UV light train is then pulled along the pipe to trigger a curing process in the resin. A road-rail excavator was used to take equipment, material, and personnel 10km to the worksite on Rannoch Moor, one of the few remaining areas of wilderness in Western Europe. Lanes personnel were supported by AMCO colleagues. All lining operatives had experience of working in rail environments and held the required accreditations and permissions to work trackside.

### Implementation

When the joint team arrived on site, AMCO operatives set up lighting. The Lanes team then carried out a confined space entry to clear 0.25 tonnes of debris from the pipe by hand. A CCTV camera drainage survey was carried out to establish that the culvert was ready to be lined. The liner was pulled into the pipe using a Tirfor hand winch attached to the excavator's grab bucket. It was then inflated with a portable air compressor.

Because of the additional thickness of the liner, very careful control of the movement and speed of the light train was needed to make sure the curing process was thorough and successful. The outer ends of the liner were grouted to seal it against the culvert. Once a post-installation CCTV survey had shown the liner had been successfully installed, the Lanes and AMCO team returned to the Bridge of Orchy station within the track possession time.

### Results

- A liner with a design life of 100 years was successfully installed
- All work was completed within one night's track possession
- The project was completed safely with no reported incidents
- The method used – UV CIPP – was the most sustainable and cost-efficient available to rehabilitate this rail culvert





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