

## Micro-trench Reinstatement



### 1. Introduction

Fibre to the property (FTTP) or Fibre to the Home (FTTH) initiatives in many countries around the world have created the requirement to install extensive networks of optic fibres in order to make high speed broadband (up to 100MPs) widely available.

The technology has evolved rapidly with regard to the hardware from companies like Emtelle in the UK ([www.emtelle.com](http://www.emtelle.com)). However, in order to install such large networks in an economic and timely manner, and with minimal disruption to traffic and residents, the requirement for new techniques for laying ducts into highway infrastructure has emerged. The most popular alternative to traditional open trench excavation is the use of micro-trenching, because it is up to thirty times faster and only 20% of the cost of traditional trenching.

Whilst the formation of micro-trenches has developed alongside the technology of fibre networks, one crucial piece of the new technique has received little attention. That is the reinstatement of micro trenches to infill and repair the road surface.

Consent is normally required from the highway asset owner to install the fibre network, and an acceptable form of reinstatement must usually be agreed in advance of the works.

For clarity, the following terms will be used throughout this document but are defined below because the terminology varies in different countries around the world:

- **Road** – a surface, either flexible or non-flexible designed to carry vehicles. Typically also called the highway surface or pavement.
- **Footway** – a surface adjacent to the road designed for pedestrian traffic primarily. Typically also referred to as sidewalk (USA) and pavement (UK).
- **Micro-trench** – narrow trench or slot cut in the road or footway surface to accept the fibre duct.
- **Reinstatement** – Infilling and repairing the road or footway surface to its original level and condition.

This technical advice note sets out the requirements for reinstatement in flexible and non-flexible roads and footways and outlines how this can be achieved.

## 2. Cutting a Micro Trench

Micro-trenching requires the formation of a narrow slot of typically 10 – 30mm wide and around 150mm deep that may extend for many kilometres. This has resulted in various forms of cutting machines and techniques for asphalt and concrete. The selection of cutting machine can have a significant impact on the successful reinstatement of micro-trenches, after the fibre duct has been installed.

In general, dry or semi-dry cutting is more effective than wet cutting when a reinstatement material is required to bond to the cut edges on either side of the slot. Wet cutting, using water to cool and lubricate the cutting disk, creates waste in the form of a slurry or paste. This is fine particles from the cutting mixed with the water that is used on the blade. The result is a paste which tends to coat the internal surfaces of the micro trench. The paste creates a weak interface layer between any reinstatement product and the host road material that has been cut through. This results in the requirement for additional cleaning and drying of the slot prior to installation of a reinstatement material, which is both time consuming and an unnecessary additional process. Failure to remove the paste will result in a lack of adhesive bond, and possibly the lack of a good watertight seal, between the reinstatement material and the host road material. This is unacceptable as the road needs to be bonded back together and water excluded to avoid long term degradation of the road.



The most effective technique that Stirling Lloyd has experienced is the Ditch Witch cutting technique ([www.ditchwitch.co.uk](http://www.ditchwitch.co.uk)) for the following reasons:

- High cutting rates enabling large lengths to be cut, installed and reinstated each day
- The dry cut means that “paste” is not created and no water has to be dried from the slot cut, meaning fast output and greater lengths per day of completed installation.
- The slot cut is accurate, minimising over break and therefore reducing the volumes of reinstatement material required, as well as facilitating an even and regular repair to the road surface and minimising damage to the adjacent surface.
- Dry cutting typically leaves a better cut face to bond to because it has some texture to it created by the cutting process that aid mechanical interlock and bond of the reinstatement material to the host material.

## 3. Installing Fibre Ducts

Choice of cutting width for the slot should be selected to be slightly wider than the width of the fibre duct. Coiled materials like ducts when they are delivered can spring out of the slots during installation, so accurate matching of the cut width to the duct size makes retention of the previously coiled duct effective, and this simplifies and speeds up the installation of the reinstatement products.



If we are to achieve extensive fibre networks at viable cost, then installation speed is essential. For many applications, completing the installation and moving on quickly with minimum disruption to road users or to local communities (the future customers of the service) is essential.

Therefore reinstatement materials that can be easily applied, achieve full strength and become permanent very quickly, and are safe to use in close proximity to the public, are all requirements. The faster a road can be re-opened to traffic, the less disruption will be caused to the local community and road users.

#### 4. Road Types

Road surfacing can be sub-divided into 2 broad generic types – flexible and inflexible.

Flexible would include asphalt, bituminous macadam's, asphalt concrete, mastic asphalt, Guss asphalt and hot rolled asphalt.

Inflexible roads would generally be concrete.

Each road has particular requirements and if a slot is cut through it, how successful the reinstatement of that slot will be depends on the suitability of the reinstatement product chosen for that particular road type.

As the requirement for reinstating micro-trenches has evolved, various materials have been tried with varying degrees of success, including cement grouts, epoxy resins, hot asphalt mixes, hot applied bitumen, cold lay asphalt and pothole repair materials. Each of these has limitations depending on the circumstances. What is most important to assess when selecting a reinstatement product, is what the requirements of that reinstatement product are? What does it need to do (essential) and what attributes of a product would assist the process (desirable).

##### 4.1. Inflexible Road Surfaces

**Essential** requirements of the reinstatement of inflexible pavements are:

- Bond to the host concrete
- Seal the slot against water ingress
- Penetrate and completely fill the whole slot depth with no risk of secondary compaction
- Provide a dimensionally stable running surface
- Provide appropriate skid resistance for the road condition
- Rapid cure to enable same day road re-opening
- Resistant to being trafficked out of the micro-trench.

**Desirable** attributes in order to achieve high daily outputs for reinstatement include:

- Safe to use (no hot materials)
- Free flowing and self compacting into the slot
- Simple to use for multi-skilled installer teams

For inflexible concrete pavements, rigid materials like cement based grouts can also be used, although cure time (several days) may become an issue, requiring the trench to be protected throughout that time, and delaying the re-opening of the road. Rigid grouts can also crack into sections during curing shrinkage when applied into a long narrow trench, which will enable water ingress in the long term, and make the road susceptible to freeze thaw & hydraulic damage. Most clients require road closures to be limited to a single day in any one area – i.e. installation in one day and permanent reinstatement ready to open to traffic the same day, so rapid strength gain / full cure in about an hour is required.

#### 4.2. Flexible Road Surfaces

Flexible road surfaces are very common in certain countries, such as the UK, where bituminous based flexible materials like asphalt form the majority of road and footway surfaces.

The requirements for flexible roads are distinct and potentially more challenging than for inflexible roads. They can be reinstated successfully following micro-trenching but not by using rigid materials such as cement grouts and epoxy resins. This is because a flexible road will deform slightly under vehicle loading and rigid materials like cement and epoxy will not. This will lead to stress on the interface between the cut asphalt and the reinstatement product, and usually results in cracking. The resultant water ingress will lead to deterioration of the road through hydraulic and freeze thaw action, which will be unacceptable to both the owner of the road and to the operator of the installed network.

Therefore, requirements for reinstating flexible roads are:

##### **Essential:**

- Flexible to allow movement with the host material (i.e. asphalt)
- Bond to the host material
- Seal the slot against water ingress
- Penetrate and completely fill the whole slot depth
- Provide a dimensionally stable running surface (rut resistant)
- Provide appropriate skid resistance for the road condition
- Free flowing and self compacting into the slot (no additional compaction required)

**Desirable** attributes in order to achieve high daily outputs for reinstatement include:

- Safe to use (no hot materials)
- Rapid hardening to allow the road to be re-opened quickly
- Simple to use for multi-skilled installer teams

These requirements mean that whilst the host material will most likely be asphalt, reinstatement with asphalt or macadam is unlikely to be the best way to achieve a reinstatement. Principally, this is because asphalt type materials need to be compacted to be impermeable and achieve strength. Lack of compaction of asphalt will lead to water ingress and possibly secondary compaction and the reinstatement sinking. In addition, asphalt will have a very weak bond to the sawn asphalt face inside the micro trench.

Asphalt materials are normally installed hot in order to achieve optimum performance. With micro-trenches, the volumes of reinstatement products required are much smaller than with traditional open trench excavation, which means asphalt delivered by truck would have cooled to below its useable temperature before it could be used during reinstatement, so reinstatement of long stretches of micro-trench with hot materials is impractical. This becomes very important when considering that micro-trenching may be up to 30x faster than traditional trench excavation, so it is possible to cut and lay ducts into much longer stretches in a single day, compared to using traditional trenching methods.

## 5. The solution for reinstating micro-trenches

The solution for micro-trench reinstatement therefore, is a material that can be prepared on site for use, but has been factory batched beforehand in order to achieve quality consistency. A material that is mixed cold will enable multi-skilled installer teams to install the product with the minimum of plant and equipment and without CO<sub>2</sub> generation and the health and safety risks associated with hot materials. A free flowing material will allow full depth penetration into the slot without requiring additional compaction – this will ensure the trench is completely filled and will enable much faster reinstatement speeds than trying to pack and compact a stiffer material like asphalt into a slot. If the material is inherently waterproof, water will not be able to enter the road surface and foundation layers. The material must also have a degree of flexibility with a modulus similar to that of typical asphalt mixes, so that it can flex with the road surface rather than crack. It must be dimensionally stable, which means that the material should be thermoset. A thermoset material does not soften substantially as temperatures rise, which means it retains excellent rut resistance. In addition, skid resistance will only be maintained over the long term in a material that does not substantially soften.

Finally, some highway owners object to micro trenching on the basis that it damages their pavement and may reduce its life. The greatest risk of road deterioration is by water ingress, so a waterproof material stops this. But in addition, when a slot has been cut through a road the reinstatement material needs not only to infill the trench but to bond the sides of the micro trench back together and to support the sawn edges of the asphalt. Unsupported asphalt edges will collapse over time under traffic load, so a highly flexible product that simply acts as a slot sealant (bitumen for example) is not appropriate as it will provide no support to the saw cut edges of the asphalt. Therefore, it is essential the reinstatement material is a high modulus material once cured and achieves a high bond strength to the cut asphalt faces.

The solution from Stirling Lloyd Highways Maintenance range ([www.highwaymaintenanceproducts.com](http://www.highwaymaintenanceproducts.com)) is the Safetrack Crack Sealing systems.



Generally, if the slot cut width is **10mm or less**, use **Safetrack Overbanding** for reinstatement in flexible and non-flexible pavements.

For micro trenches **greater than 10mm** width, use **Safetrack Crack Infill**.

Both of these products have been tested and approved in the UK as suitable systems for sealing cracks and joints in all types of highway pavement, with a life expectancy in excess of 5 years.

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SAFETRACK CRACK SEALING SYSTEMS FOR HIGHWAYS		SAFETRACK CRACK SEALING SYSTEMS FOR HIGHWAYS	
SAFETRACK CRACK INFILL SYSTEM		SAFETRACK OVERBANDING SYSTEM	

Safetrack systems are cold applied reactive resin technology that flex with the road surface. At the same time they support the sawn edges, and bond the asphalt back together. Fast cure of less than 1 hour, at any time of year, enables rapid progression of the works, with the minimum of protected works behind the cable laying operation, minimising disruption for road users and local residents.

## 6. Overview of high output installation and reinstatement

Using the following process, installation of **600 linear metres per 8 hour** shift are achievable (this assumes a micro trench of 20mm width and 120mm depth).

The process is as follows:



1) Cut the slot with the Ditchwitch to the length suitable for 1 day's installation (approximately 600m). Ensure the line of the cut has been checked to avoid cutting through other services.



2) The slot may be wet and / or contain dust that will reduce the bond strength of Safetrack materials. Using a Safetrack Drying Lance remove dust and moisture from the slot, using just dry compressed air where the slot is dry, and using air and heat where the slot is wet.



3) Install the duct in accordance with the manufacturer's instructions. If the manufacturer calls for protection to the duct use a high density foam strip. Do not use dust or sand as this will reduce the bond strength of the reinstatement material in the slot. However, Safetrack is applied cold and is not compacted, so the duct should not be damaged where no protection strip is used. Selecting the right cut width for the duct should mean the duct stays in place at the bottom of the slot.



4) Set out kits of Safetrack Crack Infill or Safetrack Overbanding along the slot at regular intervals based on consumption rate. Mix the powder catalyst into the Safetrack resin and use immediately. This is a fast curing material so mixing and application should be a continuous process for 2 men. Using simple equipment available from Stirling Lloyd ensure the Safetrack is applied into the slot and extend to a limited width on the asphalt on either side, so provide an effective seal.



5) The completed application is overcast with aggregate to provide appropriate skid resistance and is ready for traffic within 30 – 60 minutes depending on temperature.



Completed application along the road



Completed application into a service chamber

## 7. Frequently Asked Questions

### 7.1. Can the duct be accessed for localised repairs?

Yes. The micro trench should not be cut out directly to avoid cutting through the duct, but the duct should be revealed by cutting parallel saw cuts into the asphalt on either side of the duct line and then breaking out the asphalt between them.



The Safetrack Crack Infill is not bonded directly to the duct but separated from it by a high density foam strip. Therefore the duct will be clean and easily retrieved from the excavation.



The duct / fibre can then be repaired locally before being replaced into the excavation.



The surface can then be reinstated using traditional reinstatement methods or by using Safetrack Crack Infill Patch Packs.



## 7.2. How do we know where ducts are in the road and are they at risk from being damaged by asphalt planing?

Ducts are not at risk from routine asphalt resurfacing operations because typically a duct is installed in a micro trench that is 150mm deep. Resurfacing asphalt would normally only mean planing within the surface course between 25mm and 40mm deep, so there should be no risk of damaging the ducts accidentally.

In addition, a “tracer wire” is routinely installed into micro trenches so that the duct can be located using a standard cable locating device.

As a long term risk avoidance measure, Safetrack Crack Infill is available pigmented yellow as a visual indicator. The micro-trench is reinstated with yellow material to within 20mm of the surface and then asphalt grey to the surface. This means that whilst the reinstatement at the road surface is not a distraction for road users because it blends into the asphalt, planeing at 20mm+ will reveal a yellow indicator layer to indicate proceeding with caution.



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