

Subline Pipeline Renewal

Specification for Pipeline Renewal using the Subline Process

Introduction

The *Subline* process, which has been developed and patented by Subterra, is used for the cold site-folding and insertion of polyethylene (PE) liner pipes into existing pressure pipelines. The Subline liner provides a continuous lining which prevents further internal pipeline corrosion, seals leaking joints and corrosion perforations, and provides a hydraulically smooth surface which, together with the thin-wall sections used, generally results in enhanced flow characteristics after lining.

Individual pipe lengths are butt fused on site into appropriate string lengths to suit particular site conditions and installation lengths. The strings are then processed through the *Subline* hydraulically - operated gripping machine and forming device which produces the characteristic “heart” - form Subline cross section. The cross-section of the Sublined pipe is typically 40% less than the cross-section of the original PE pipe. As the pipe leaves the *Subline* forming equipments it is held in its temporary new configuration by restraining bands.

The deformed pipe may be either inserted directly into the existing pipeline or held above ground temporarily for later insertion. The insertion operation may be stopped and started as required and long continuous lengths can be inserted in a single operation. Depending on site conditions section lengths up to 3300ft (1000m) can be inserted in a single pull over a range of diameters from 3’(75mm) to 64’’ (1600mm).

After the Sublined PE pipe has been inserted into the existing main, the ends of the liner are sealed and the liner is filled with water and pressurised for the reversion process. During the reversion process, the restraining bands burst under the internal pressure, allowing the liner pipe to return to its original round shape and size, forming a tight fit within the host pipe. No subsequent grouting is required. A variety of end terminations can be fitted to complete the system

Design considerations

The following information is required to enable the engineering of a *Subline* system installation:

- Site location/access facilities
- Host pipe type and wall thickness design
- Pipeline internal operating pressure
- Pipeline length
- Type of joint and flange rating of host pipe.
- Conveyed fluid composition
- Operating temperature
- Internal condition of host pipe (scale build up, internal lining / coating etc)
- Site drawings (showing vertical and horizontal offsets)

Materials and fittings

Host pipe material

The host pipe material must be identified and an indication of its structural integrity obtained. The existing pipeline inside diameter must be quantified to allow for optimum sizing of the liner pipe.

Liner material

The polyethylene resin compound must be specified as either medium or high density in accordance with ASTM Standard D3350.

The physical and mechanical performance properties of the polyethylene pipe material to be deformed must be available to optimise the performance and installation of the liner.

End terminations

If *Subline* is being used in a semi-structural capacity, proprietary liner end terminations are to be used. These are typically end load resistant up to the strength of the liner only. Anchoring at fittings and/or flanged ends should be designed for thrust restraint.

If *Subline* is being used in a fully structural capacity, standard PE / metal flange transition fittings can be used. In order to ensure adequate sealing the following information must be supplied:

- Host pipe inside diameter
- Host pipe outer diameter
- Flange rating
- Host pipe and flange specification.

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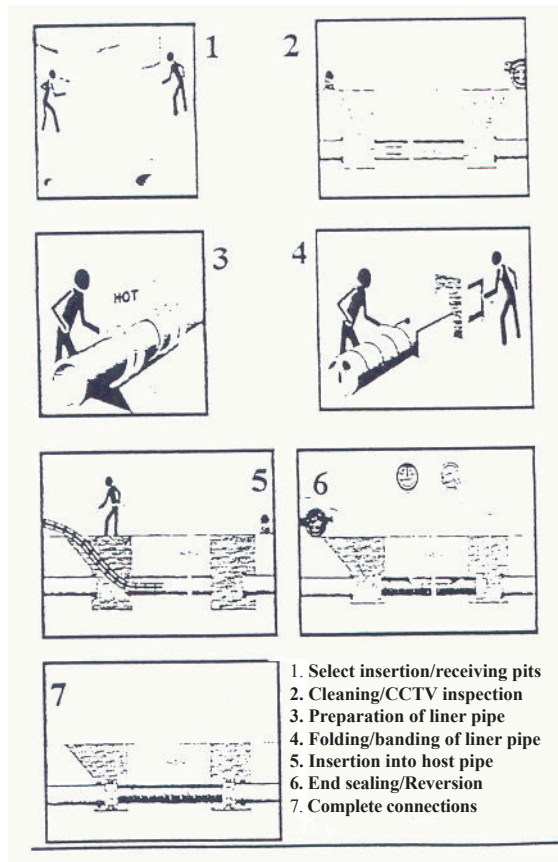
Bends and Fittings

Subline is capable of negotiating bends depending on the liner pipe dimension and site conditions. For semi-structural application bends up to 22.5° can be negotiated, whereas for structural applications 11.25° are typical. All other fittings and tees must be removed. Such excavations may however, conveniently be used as insertion and receiving pits for the *Subline* installation.

Pipeline Preparation

A thorough investigation, including CCTV inspection, should be made of the existing main together with details of other utilities plant along the route. The location and line of the pipeline must be identified paying particular attention to changes in the vertical as well as horizontal plane. The pipeline shall be suitably prepared as described in the following section.

The Subline Process



System Installation

Accessibility

The line of the existing pipeline must be located, noting any potential problems, such as bends, hydrants and valves.

Excavations

Insertion and receiving pits should be excavated at appropriate locations along the length of the existing main. The positioning of the *Subline* machine and space required for liner pipe “stringing out” should be considered when selecting launch sites.

Cleaning

Good host pipe internal diameter surface preparation is required as a basis for the *Subline* lining process. Adequate cleaning processes include the use of scraper pigs followed by a “rubber pull-through”, wire brush, pressure jetting, pressure pigging. Other cleaning processes may be used which can be shown to remove excess debris from the inside of the pipeline.

CCTV inspection

CCTV inspection should be carried out before and after cleaning. Any significant protrusions which will inhibit cleaning should be removed. The post cleaning inspections should confirm the cleanliness of the main, and identify any remaining protrusions into the main; if significant they should be removed prior to lining.

Section lengths

Installation segment lengths are normally determined jointly by the owner/engineer and the *Subline* installer. These are governed primarily by site and pipeline factors such as terrain, accessibility, bends and fittings.

Bends/Fittings

The ability of *Subline* formed PE liner pipe to flex easily about its mirror plane, and its greatly reduced cross-section area makes it possible for *Subline* to negotiate small angle bends. In some semi-structural applications up to and including 45° bends can be satisfactorily lined with minimum bend radii of 8 times the nominal diameter of the liner, depending on the liner wall thickness and host pipe diameter.

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Size Verification

The outside diameter of the PE liner pipe is typically chosen to be approximately 0.2" (5mm) smaller than the actual minimum inside diameter of the host pipe. This is to ensure that the liner (which expands on reversion) will form a wrinkle-free close fit when reverted under pressure inside the host pipe. As such an accurate measurement of the host pipe internal diameter must be available.

Liner Installation

Folding and insertion of the liner can be carried out as a single operation (as the deformation can be a stop/start process). Alternatively the liner may be folded prior to installation and stored alongside the pipeline. Restraining bands hold the liner in its deformed profile during the installation procedure. An approved lubricant (e.g. bentonite) is used to aid the installation process.

Temperature

The PE liner pipe should not be deformed at temperatures less than 42°F (5°C). Care should be taken and advice sought for installation temperatures in excess of 86°F (30°C).

Jointing

Pipe strings must be jointed prior to being pushed through the *Subline* machine. Conventional butt fusion is the desired method and the external weld beads should be removed.

Winch loads

The deformation process involved pushing the liner pipe through the *Subline* machine. as such the winch loads required are low. This enables long lengths to be inserted in one pull.

Machine Capacities

Subterra currently has 4 types of machine, which cater for the following liner outside diameters. Please contact the *Subline* installer for sizes outside of this range.

Machine Type	PE liner Outer Diameter	
	Inches	mm
1	3-8	75-200
2	8-14	200-355
3	14-40	355-1000
4	40-64	1000-1600

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End fittings/Reversion

The ends of each section of the *Subline* liner pipe should be re-rounded to accept a suitable end fitting for reversion. Hydraulic squeeze-off tools may also be used for the reversion of PE. The operating pressure of the system dictates the choice of end connection.

When the *Subline* liner pipe is such that it is not fully structurally rated. all points where the PE leaves the constraints of the host pipe should be supported against the pipeline design internal pressure.

Reversion pressures are dependent on temperature. liner pipe material and DR. The pressure should be maintained for at least 12 hours. During this time. the line and fittings are inspected for leaks. Chlorination (if required) can be carried out at this time.

Before draining the liner both ends of the reverted section should be vented to prevent the occurrence of vacuum collapse.

The end terminations enable standard fittings to be attached.