Specification for Pipeline Renewal using the Rolldown Process

Introduction

The patented *Rolldown* process, is used for the on-site cold reduction of close fit polyethylene (PE) liner for insertion into existing pressure pipelines. The *Rolldown* process can be used to install a *fully-structural* liner i.e. where the liner pressure rating is equal to or greater than that of the host pipe. It can equally well be used to install *semi structural* liner into higher pressure pipelines which are essentially in structurally sound condition, but which are suffering from localized corrosion perforation and/or leaking joints and/or deterioration of conveyed fluid quality arising from internal pipeline corrosion and/or deposition.

Individual pipe lengths are butt fused on site into appropriate lengths to suit particular site conditions and installation lengths. The fused lengths are then pushed through a set of specially designed rollers at ambient temperature, to concentrically reduce the liner diameter. The diameter is typically reduced by about 10%. A corresponding increase in wall thickness is observed at this stage. The reduced diameter is normally retained without the need for any external mechanical restraint.

The pipe must be reduced in diameter as a separate operation prior to installation into the host pipe. Long continuous lengths can then be inserted in a single operation. Depending on site conditions section lengths up to 5000ft (1500m) can be inserted in a single pull. Rolldown is available over a range of diameters from 4”(100mm) to 20” (500mm).

After the Rolled PE pipe has been inserted into the existing host pipe, the ends of the liner are sealed off the liner is filled with water and pressurised for the reversion process. During the reversion process, the liner expands to form a close fit with the host pipe. No subsequent grouting is required. A variety of end terminations can be fitted to complete the system.

Design considerations

Depending on the DR of liner pipe the Rolled liner may fall into the category of either fully structural or semi-structural liner. The following information is required to enable the engineering of a Rolldown 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.

Jointing and End terminations

If *Rolldown* is being used in a fully structural capacity, standard PE fusion and/or mechanical jointing technology can be used. The liner can be mechanically expanded to suit the size of standard couplers, provided the final outside diameter does not exceed 5% of the liner’s *original (i.e.* as-manufactured) outside diameter. When 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. Anchorage at fittings and/or flanged ends should be designed for thrust restraint. In order to ensure adequate installations the following information must be supplied:

- Host pipe inside diameter
- Host pipe outside diameter

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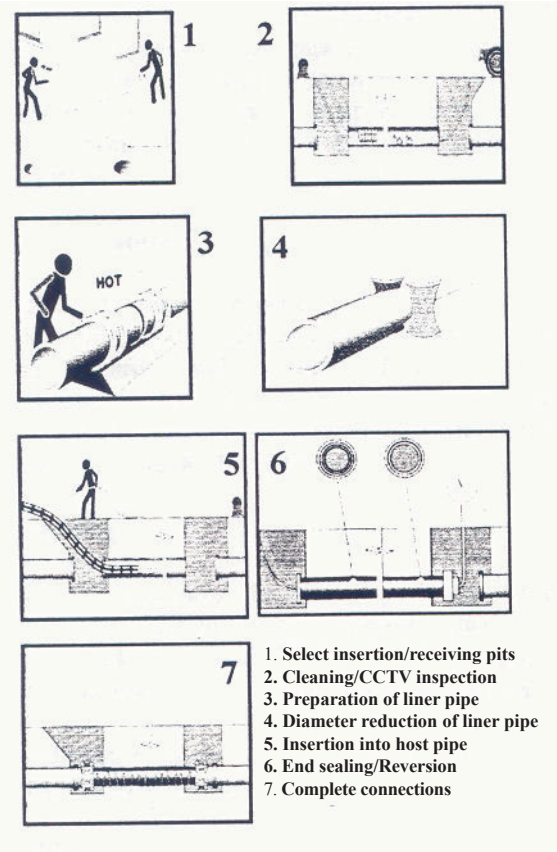
- Flange and joint rating
- Host pipe and flange specification.

Bends and Fittings

Rolled pipe is typically capable of negotiating bends up to 11.25° subject to appropriate pipe dimension and site conditions. All other fittings and tees must be removed. Such excavations may however, conveniently be used as insertion and receiving pits for the *Rolldown* insertion.

The *Rolldown* Process



Pipeline Preparation

A thorough investigation, including CCTV inspection, should be made of the existing host pipe together with details of other utility systems along the route. The location and alignment 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.

System Installation

Accessibility

The alignment of the pipeline must be located, noting any potential problems, such as bends or fittings, 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 *Rolldown* machine and space required for liner pipe "stringing" should be considered when selecting launch sites.

Cleaning

The host pipe should be cleaned prior to lining. Adequate cleaning processes include the use of scraper pigs followed by a "rubber pull-through", wire brush, pressure jetting, or 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. A proving pig may also be used to check for protrusions into the main.

Section lengths

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

Bends/Fittings

Bends greater than 11.25° must be removed prior to lining. The minimum allowable bend radii for the *Rolldown* liners is typically 25x the liner outer diameter for DR 11-17 and 37.5x liner outer diameter for DR 26-33. These must be taken into consideration when excavating the bend sections.

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Size Verification

The outside diameter of the PE liner pipe is typically chosen to be slightly larger (approximately 5%) than the minimum clear bore of the host pipe. The *Rolldown* process will then produce a liner that is smaller than the minimum clear inside diameter of the host pipe, to ensure ease of insertion. The liner outer diameter is limited during reversion to a maximum of 5% greater than the original outer diameter, ensuring a tight fit with the host pipe when reverted. An accurate measurement of the host pipe internal diameter must be available.

Liner Installation

The liner is deformed prior to installation and stored alongside the pipeline. The liner deformation is held without the need for mechanical restraints. An approved lubricant (e.g. bentonite) is used to aid the installation process.

Temperature

The diameter reduction, and subsequent retention of this deformation is dependent on temperature as well as specific PE resin and DR values. The *Rolldown* process can be successfully carried out in the temperature range 42°F (5°C) to 86°F (30°C).

Jointing

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

Adjacent sections of rolled PE liner can also be butt fused and satisfactorily reverted.

Winch loads

The deformation process involves pushing the liner pipe through the *Rolldown* rollers, and therefore the liner elongation is kept to below 3%.

Machine Capacities

Subterra currently has 3 types of machine, which are applicable for the following liner outside diameter ranges. Please contact the *Rolldown* installer for sizes outside of this range.

Machine Type	PE liner Outer Diameter	
	Inches	mm
1	4-8	100-200
2	8-14	200-350
3	16-20	400-500

End fittings/Reversion

A swabbing pig should be inserted into the liner pipe and suitable end fittings attached to the end of each section of *Rolldown* liner pipe for reversion. The pipeline should then be carefully filled with clean water. All air should be expelled from the system to enable adequate expansion control. The reversion pressures are determined by the temperature, DR of the liner and the PE resin type.

If the *Rolldown* 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 carefully monitored and suitable measures taken to ensure over expansion does not occur.

During the reversion process, the liner and fittings are inspected for leaks. The reversion pressure should be maintained for a minimum of 12 hours to ensure complete reversion and a close fit between the liner and the host pipe.

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