RSM Lining Supplies
CHOICE AND TECHNOLOGY

Fero Force
Pressure Liner

A structural pressure pipe rehabilitation system: manufactured and factory impregnated in the UK

INSTALLATION MANUAL

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Fero Force Installation and Preparation Guide

1. CCTV Inspection and pre measure the pipeline to be repaired prior to cleaning.
2. Clean the pipeline and de-scale where appropriate.
3. CCTV inspect post cleaning taking a measurement of the line, taking note and information of any bends within the line.
4. Complete the design questionnaire as supplied by RSM for the material to be designed in accordance with ASTM F12-16.
5. Once the design is approved, calculate the required installation head using the Fero Force Formula. ***NB. It may be necessary to take into account the fall of the pipe and water table when considering the installation head, along with allowing sufficient safety factor to account for any necessary increases in head or temperature fluctuations which could stiffen the material.***
6. Order the necessary liner including turn back (allowing for enough static head based on the above calculations) when installing with either water or air.
7. Erect a suitable platform over the installation access point accounting for the installation head and method of installation/cure.
8. Once the impregnated liner is delivered to site attach the necessary hold back strapping and recirculation hose.
9. Attach the top of the turn back to the scaffold tower/inversion ring carefully, ensuring that the turn back is the correct length to account for the installation head and heel before the resin impregnated liner meets the pipe wall.
10. Ensure the turn back has sufficient support using calibration hose, PVC pipe or dry liner support tube as appropriate for the installation.
11. Once the liner is set begin to apply pressure to the liner to begin the eversion process (this can be in the form or air or water). At this point only allow the liner to move forwards in the eversion process when the minimum installation head is reached at all times.

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12. Continue the eversion process, constantly monitoring the installation head at all times.

13. Once the liner reaches the termination point lift the head to the ideal installation head, ensuring the liner is meeting the pipe wall at all points and is sufficiently braced at the termination point.

14. Once the liner is up to profile and has met the termination point and pipe wall in all areas the curing process can begin. We recommend the attached curing schedule.
NB. Please note as the liner begins to heat this will cause pressure fluctuations, therefore we must continually manage the curing head at all times.

15. Please note if the liner is being everted into a pipe above ground or a pipe manufactured from PE or Cast Iron, it may be necessary to amend the curing schedule to prevent blistering or pipe distortion.

16. Once the liner is cured we must ensure we install suitable liner end seals, commensurate with the pressure resistance being required before pipe reinstatement can begin.

17. The pipe then is to be re-coupled and backfilled.

NB. At all times it is necessary to observe site MSRA and PPE requirements. Installation should only be performed by suitably trained and authorized personnel.

INSTALLATION HEADS

Fero Force issue guidance on the installation heads to be used with their liners.
The definition of these heads is as follows:

MINIMUM INSTALLATION HEAD	The head applied to the eversion face during installation, below which it is likely that severe wrinkling and/or finning will occur. Note that this is the head which is at the point where the liner is everting and can be significantly different from the head at the installation manhole for steep gradient installations.
IDEAL HEAD	The head at which the liner is designed to yield the optimum surface finish and also meet as a minimum the ordered thickness. Where the ideal head cannot be used, Applied Felts should be advised to ensure the correct thickness is obtained. Generally, we recommend that this is the head at which eversion liners should be installed.
MAXIMUM HEAD COLD	The maximum head at which a liner should be installed. If site conditions require this head to be exceeded, then Applied Felts need to be advised. This is to ensure seam failure does not occur.
MAXIMUM HEAD HOT	The maximum head at which a liner should be installed. If site conditions require this head to be exceeded, then Applied Felts need to be advised. This is to ensure seam failure does not occur.

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INSTALLATION HEADS

For a standard liner, the installation head can be calculated as follows:

MINIMUM INSTALLATION HEAD (BAR)	=	THICKNESS (MM) / DIAMETER (MM)	X	15.4
IDEAL HEAD	=	THICKNESS (MM) / DIAMETER (MM)	X	20.1
MAXIMUM HEAD COLD	=	THICKNESS (MM) / DIAMETER (MM)	X	30.8
MAXIMUM HEAD HOT	=	THICKNESS (MM) / DIAMETER (MM)	X	26.9

CURING TIMES

The following cure procedures are recommended when using the Fero Force Vinylester Resin in Cured In Place Pipe applications.

Fero Force Vinylester Resin can be cured using either hot water or steam. The recommended post cure temperatures are a minimum of 80°c for water cure and 100°c for steam cure.

Recommended post cure times, interface temperatures, and minimum cool down times are listed in the table below. Note that the shorter cure times can be used in some cases based on achieving a higher interface temperature. For steam cure on liners greater than 120 metres, add a minimum of 0.5hrs to the corresponding minimum hold time.

Liner Thickness	Water Cure Hold Time (hours)	Steam Cure Hold Time (hours)	Minimum Interface Temperature (°c)	Minimum Cool Down (hours)
< 10.5mm	3	2	55	0.5
< 10.5mm	3	1.5	65	0.5
10.5mm to 18mm	3.5	2.5	55	0.75
10.5mm to 18mm	3	2	65	0.75
19.5mm to 30mm	4	3	50	2
> 30mm	5	4	45	4

Additional cure time is recommended in very cold or very wet conditions. Interface temperatures should be monitored. If interface temperatures are low, additional cure time is recommended.
If the pipe to be lined contains a bituminous coating, the use of a pre liner is recommended.
The liner shall be cooled to a minimum of 38°c using the minimum cool down period listed in the table above.

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