LINERWASTE RELINING SYSTEM INSTALLATION HANDBOOK



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INTRODUCTION

This manual gives detailed guidance for carrying out installations of the Linerwaste system, in line with the quality standards and approvals established by RISE. It is an essential basis for achieving the highest possible standard of installation, as it clearly defines the quality processes and the documentation required to confirm the quality of the work.

The company and its listed employees meet these standards and have been certified on the basis of the training and the procedures contained in this handbook.

SCOPE OF APPLICATION OF THE SYSTEM

The Linerwaste system is used to repair damage in stormwater and sewage systems inside properties. It includes processes such as cleaning, inspection, spot repair, relining, branch reinforcement and milling of the pipe system. The methods are designed to work effectively for pipe systems made of various materials such as plastic, cast iron and concrete, whether they are free-standing, cast into masonry or located in other parts of the structure.

The Linerwaste method can successfully repair the following damage:

- Water leaks at joints, and through holes and cracks in the pipe system.
- Leakage and contamination from sewage pipes.
- Corrosion of cast iron pipes and damage caused by corrosion of concrete and masonry structures.
- Damage to branch connections and missing parts of the pipe system.
- Cracking in the pipe system.
- Incorrectly installed pipe systems that cause leaks.
- Reduced water flow due to wear and corrosion.

Problems related to sags and insufficient gradient in the pipe system cannot be fixed with the Linerwaste system.

Before work starts, it is critical to assess the extent of the damage carefully and to consider any need for rebuilding or other structural changes.

ENVIRONMENT AND SAFETY

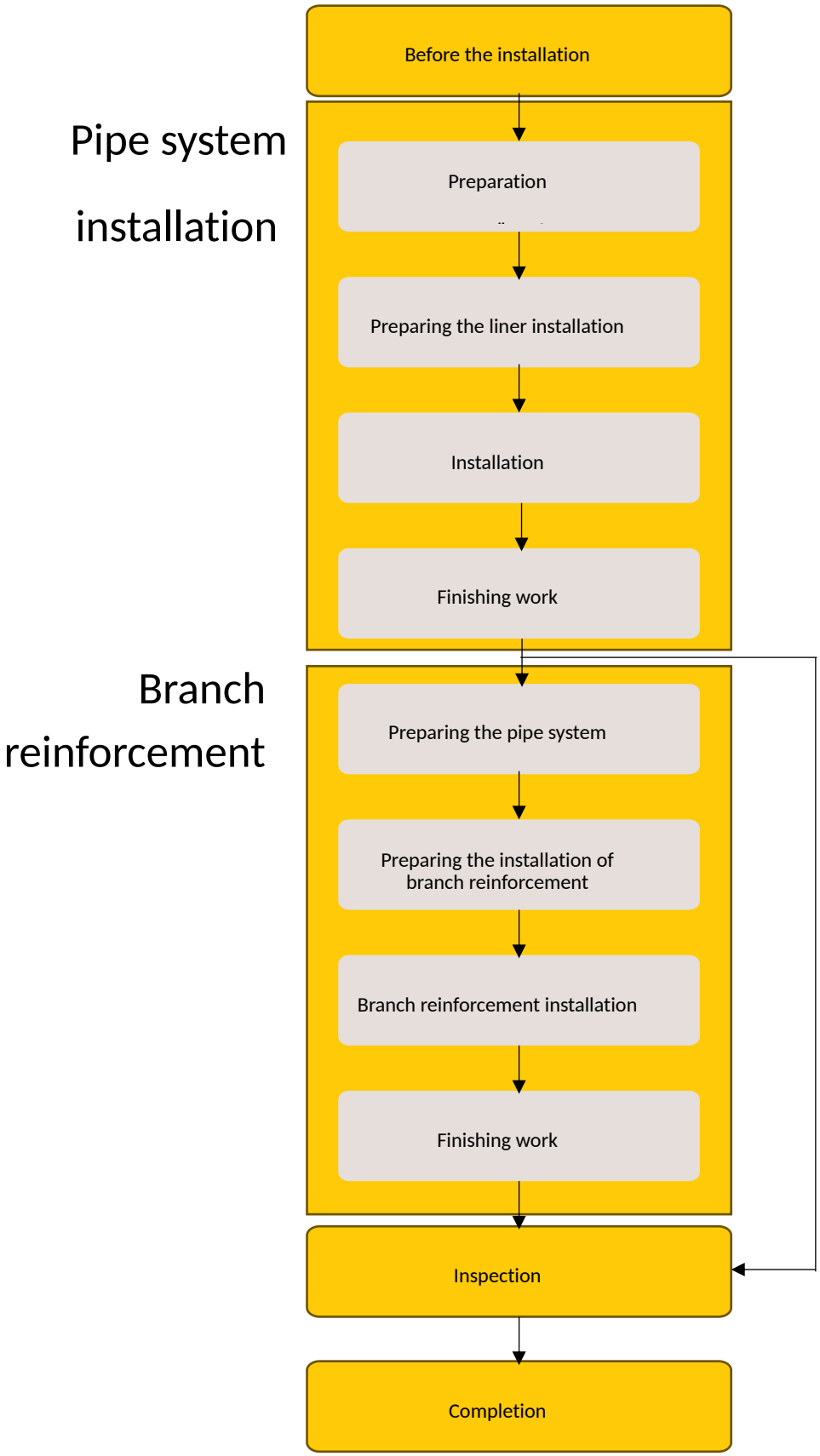
When working with epoxy-based products, it is important always to take the necessary safety measures to protect the health and safety of everyone involved. The work should be carried out in well-ventilated areas to minimise exposure to potentially harmful vapours. Personal protective equipment is essential, including face masks that protect against inhaling vapours, protective gloves to prevent skin contact with epoxy, and protective clothing that covers the skin and prevents direct exposure.

To improve safety further when working with epoxy, consider the following measures:

- **Eye protection:** Use safety glasses to protect the eyes against splashes and vapours that can cause irritation or injury.
- **Emergency shower and eyewash station:** Make sure that an emergency shower and an eyewash station are easily accessible near the work area, so that epoxy that may have come into contact with the skin or eyes can be rinsed off immediately.
- **Training:** Make sure that all employees have received adequate training and information about the risks of handling epoxy, including how to use personal protective equipment correctly and what to do in the event of exposure.
- **Ventilation systems:** Use effective ventilation systems or local extraction to control vapours at the source and reduce the risk of inhalation.
- **Safety data sheets (SDS):** Always make the SDS for epoxy products easily accessible to all employees, and make sure they are familiar with the contents, especially the sections on first aid measures and what to do in the event of a spill or accident.
- **Regular monitoring:** Monitor the air quality in the work area regularly to make sure that vapour levels are kept below safe limits.

By implementing these additional safety measures, the risk of harmful exposure to epoxy can be minimised, which contributes to a safer working environment for everyone involved.

PROCESS OVERVIEW OF THE LINERWASTE SYSTEM



BEFORE THE INSTALLATION

Before the Linerwaste system is installed, the pipe system must be prepared. This means that the pipe must be cleaned and inspected thoroughly, and any damage must be assessed. This initial phase is essential for making an informed choice of suitable material, equipment and the installation method that best suits the task.

PIPE SYSTEM INSTALLATION

PREPARING THE PIPE SYSTEM

CLEANING

Effective cleaning is essential and should be carried out with mechanical methods, such as abrasive chains, to remove all dirt and sediment in the pipe. This restores the original dimensions and shape of the pipe, which is necessary for successful relining. Drain cleaning machines are recommended for this process, especially those that can reach speeds of at least 1500 RPM, which makes the pipe as clean as possible. Any obstructions such as roots or foreign objects must also be removed before the liner installation starts. Before the work starts, it is important to make sure that the system is out of use, which can be achieved by shutting it off and using stopper plugs or diverting the system flow.



INSPECTION AFTER CLEANING

When the pipe system has been cleaned, a thorough inspection must be carried out to verify that the cleaning was successful and to identify any damage or deviations. It is also during this inspection that the pipe dimensions should be measured, as well as other important aspects such as liner length and the positions of branch connections. If damage is found, it should be assessed to decide whether it can be repaired with the Linerwaste method.

CHOICE OF MATERIALS

The Linerwaste system includes materials designed to handle several bends and/or changes in dimension. This can include felt or knitted materials combined with a specific epoxy system that offers different working times and different viscosities depending on the application and the needs of the project. The choice of material is based on the properties of the pipe system, such as the length of the lining, the presence of changes in dimension, bends and water ingress. A successful installation requires that all factors such as water ingress, holes and cracks are dealt with, which may mean using a Pre-Liner or a spot repair to address specific damage.

CHOICE OF EQUIPMENT

The choice of equipment depends on the installation length, the pipe dimensions, the accessibility, and whether the curing process will use added heat or not (“heat” or “cold” curing). It is also important to plan how branch connections will be handled, that is, that there is access and an understanding of the need for special equipment such as a milling robot or another type of cutter system to open and clean connections.

EQUIPMENT CHECKLIST

- Cleaning equipment suited to sewage pipes of the dimensions in question.
- Inspection equipment for sewage pipes.
- Epoxy and hardener with suitable pot life and viscosity
- Mixing containers for epoxy, complete with scales or measuring cups.
- Mixing equipment for a homogeneous mix.
- Liner material suited to the pipe dimensions.
- Pre-Liner and calibration hose to deal with water ingress, holes and cracks.
- Impregnation table and roller.
- Vacuum pump.
- Inversion gun with pressure gauge and control clamps.
- Compressor with compressed air hoses.
- Inversion strap/pull rope.
- Cones and adapters in suitable sizes, and calibration hose.
- Stopper plugs and bypass systems to keep the system out of service during installation.
- Equipment for heat curing, including steam/water, with measuring instruments.
- Thermometer suited to the heat curing process.
- Equipment for branch reopening, e.g. a milling robot.
- Hand tools and accessories for the installation work.
- Grinding tools to remove excess epoxy and other obstructions created during the relining process.
- Safety equipment for cordoning off work areas.
- Personal protective equipment for the installation staff.

IMPREGNATING THE LINER

LINERWASTE LINERS

Linerwaste is available in diameters from DN50 to DN225. It is made of 100% polyester fibre and has a coating of thermoplastic polyurethane (TPU). The liner is compatible with room temperature curing, hot water or steam curing processes up to 80°C. All liners are flexible enough to fill variations in

pipe diameter. The liner stretches minimally in length, only radially. This allows precise relining of pipes of known lengths.

LINERWASTE LINERS

DN
50–70
70–100
100–150
150–225

EPOXY QUANTITY AND ROLLER SETTINGS

	To reach 3 mm wall thickness	
DN	Roller gap	Epoxy weight in liner
50–70	7 mm	0,6 kg /m
70–100	10 mm	0,8 kg /m
100–150	11 mm	1,2 kg /m
150–225	12 mm	2,4 kg /m

TOTAL EPOXY WEIGHT FOR TOTAL LINER LENGTH

DN 50–70		DN 70–100		DN 100–150		DN 150–225	
Length (metres)	Total epoxy weight (kg)	Length (metres)	Total epoxy weight (kg)	Length (metres)	Total epoxy weight (kg)	Length (metres)	Total epoxy weight (kg)
1	0,60	1	0,80	1	1,30	1	2,40
2	1,20	2	1,60	2	2,60	2	4,80
3	1,80	3	2,40	3	3,90	3	7,20
4	2,40	4	3,20	4	5,20	4	9,60
5	3,00	5	4,00	5	6,50	5	12,00

6	3,60	6	4,80	6	7,80	6	14,40
7	4,20	7	5,60	7	9,10	7	16,80
8	4,80	8	6,40	8	10,40	8	19,20
9	5,40	9	7,20	9	11,70	9	21,60
10	6,00	10	8,00	10	13,00	10	24,00
11	6,60	11	8,80	11	14,30	11	26,40
12	7,20	12	9,60	12	15,60	12	28,80
13	7,80	13	10,40	13	16,90	13	31,20
14	8,40	14	11,20	14	18,20	14	33,60
15	9,00	15	12,00	15	19,50	15	36,00
16	9,60	16	12,80	16	20,80	16	38,40
17	10,20	17	13,60	17	22,10	17	40,80
18	10,80	18	14,40	18	23,40	18	43,20
19	11,40	19	15,20	19	24,70	19	45,60
20	12,00	20	16,00	20	26,00	20	48,00
21	12,60	21	16,80	21	27,30	21	50,40
22	13,20	22	17,60	22	28,60	22	52,80
23	13,80	23	18,40	23	29,90	23	55,20
24	14,40	24	19,20	24	31,20	24	57,60
25	15,00	25	20,00	25	32,50	25	60,00
26	15,60	26	20,80	26	33,80	26	62,40
27	16,20	27	21,60	27	35,10	27	64,80
28	16,80	28	22,40	28	36,40	28	67,20
29	17,40	29	23,20	29	37,70	29	69,60
30	18,00	30	24,00	30	39,00	30	72,00
31	18,60	31	24,80	31	40,30	31	74,40
32	19,20	32	25,60	32	41,60	32	76,80
33	19,80	33	26,40	33	42,90	33	79,20
34	20,40	34	27,20	34	44,20	34	81,60
35	21,00	35	28,00	35	45,50	35	84,00
36	21,60	36	28,80	36	46,80	36	86,40
37	22,20	37	29,60	37	48,10	37	88,80
38	22,80	38	30,40	38	49,40	38	91,20
39	23,40	39	31,20	39	50,70	39	93,60
40	24,00	40	32,00	40	52,00	40	96,00

MIXING THE EPOXY

The epoxy base and the hardener must be mixed into a homogeneous mass according to the specifications in the technical data sheet (TDS) for each epoxy product. Use an electric mixer or a mixing unit and make sure the mixer is fully submerged to avoid air bubbles. Mixing must continue for at least two minutes to ensure a complete and even mix.

It is also important to follow the specified proportions for the epoxy mix correctly and to note the material temperature carefully, as it is needed to calculate the pot life correctly, that is, the time you have to work with the epoxy before it cures.

For the epoxy to keep its optimal quality and properties, it should be stored at a temperature between 15 and 20 degrees Celsius. Correct storage makes sure that the material is in the best possible condition when work starts.

When you handle epoxy, it is important always to follow the instructions in the safety data sheets. Follow the rules for handling hazardous substances and use suitable personal protective equipment.

MIXING RATIOS FOR LINERWASTE EPOXY

All Linerwaste epoxy has a mixing ratio of 100:30, base:hardener

Example: to make 1.3 kg of ready epoxy of the FAST variant, mix 1 kg of Linerwaste BASE and 300 g of Linerwaste FAST

MIXING TABLE

Total epoxy weight (kg)	**Linerwaste BASE (grams)**	**Linerwaste hardener (FAST, MEDIUM or SLOW) (grams)**		**Total epoxy weight (kg)**	**Linerwaste BASE (grams)**	**Linerwaste hardener (FAST, MEDIUM or SLOW) (grams)**
0,5	385	115		15,5	11 923	3 577
1,0	769	231		16,0	12 308	3 692
1,5	1 154	346		16,5	12 692	3 808
2,0	1 538	462		17,0	13 077	3 923
2,5	1 923	577		17,5	13 462	4 038
3,0	2 308	692		18,0	13 846	4 154

3,5	2 692	808		18,5	14 231	4 269
4,0	3 077	923		19,0	14 615	4 385
4,5	3 462	1 038		19,5	15 000	4 500
5,0	3 846	1 154		20,0	15 385	4 615
5,5	4 231	1 269		20,5	15 769	4 731
6,0	4 615	1 385		21,0	16 154	4 846
6,5	5 000	1 500		21,5	16 538	4 962
7,0	5 385	1 615		22,0	16 923	5 077
7,5	5 769	1 731		22,5	17 308	5 192
8,0	6 154	1 846		23,0	17 692	5 308
8,5	6 538	1 962		23,5	18 077	5 423
9,0	6 923	2 077		24,0	18 462	5 538
9,5	7 308	2 192		24,5	18 846	5 654
10,0	7 692	2 308		25,0	19 231	5 769
10,5	8 077	2 423		25,5	19 615	5 885
11,0	8 462	2 538		26,0	20 000	6 000
11,5	8 846	2 654		26,5	20 385	6 115
12,0	9 231	2 769		27,0	20 769	6 231
12,5	9 615	2 885		27,5	21 154	6 346
13,0	10 000	3 000		28,0	21 538	6 462
13,5	10 385	3 115		28,5	21 923	6 577
14,0	10 769	3 231		29,0	22 308	6 692
14,5	11 154	3 346		29,5	22 692	6 808
15,0	11 538	3 462		30,0	23 077	6 923

LINERWASTE RESIN, OPEN TIMES AND CURING TIMES

Linerwaste FAST

Curing: 3 hours to self-supporting at 20°C

Open time at 20°C: 15 minutes (the time until the viscosity doubles)

Linerwaste MEDIUM

Curing: 6 hours to self-supporting at 20°C

Open time at 20°C: 35 minutes (the time until the viscosity doubles)

Linerwaste SLOW

Curing: 8 hours to self-supporting at 20°C

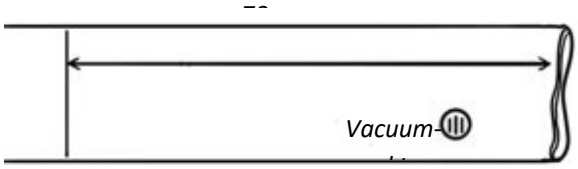
Open time at 20°C: 50 minutes (the time until the viscosity doubles)

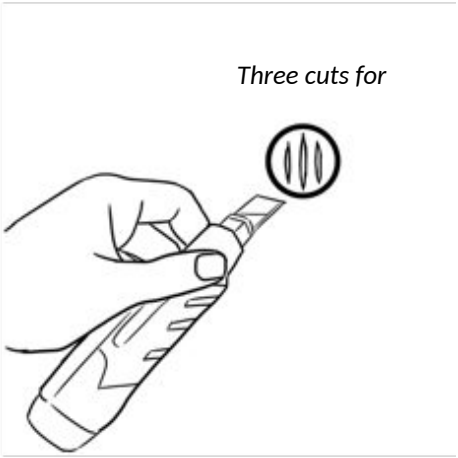
The recommended working temperature is 15–30°C. At lower temperatures the viscosity will be high and the resin will be difficult to work with. The curing time is affected by the ambient temperature. For every 10°C the temperature drops, the curing time doubles. In the same way, for every 10°C above the recommended working temperature, the curing time is halved.

- Linerwaste FAST resin cures in 10 hours at 5°C and 1.5 hours at 30°C
- Linerwaste MEDIUM resin cures in 18 hours at 5°C and 3 hours at 30°C
- Linerwaste SLOW resin cures in 28 hours at 5°C and 4 hours at 30°C

IMPREGNATION

When the installation length has been measured, for example with a fibre optic camera, the liner must be cut to the right length. To the measured length of the pipe, add 10 cm for the cone, at least 30 cm between the inversion drum and the access point, and 70 cm to create the vacuum. Of the 70 cm for the vacuum, 30 cm is kept for a knot if the installation will be done with a closed end.





To create the vacuum, one end is closed with tape and two to three cuts of 10-15 mm are made for the vacuum pump, which is connected to suck out the air. Once the vacuum has been reached, the epoxy is filled into the liner while the vacuum is maintained to ensure an even distribution of epoxy

The liner is then run through the roller with a preset roller gap suited to the chosen liner (see table). When the liner is rolled, the arrows (>>>>>) on the liner should point towards the rollers.

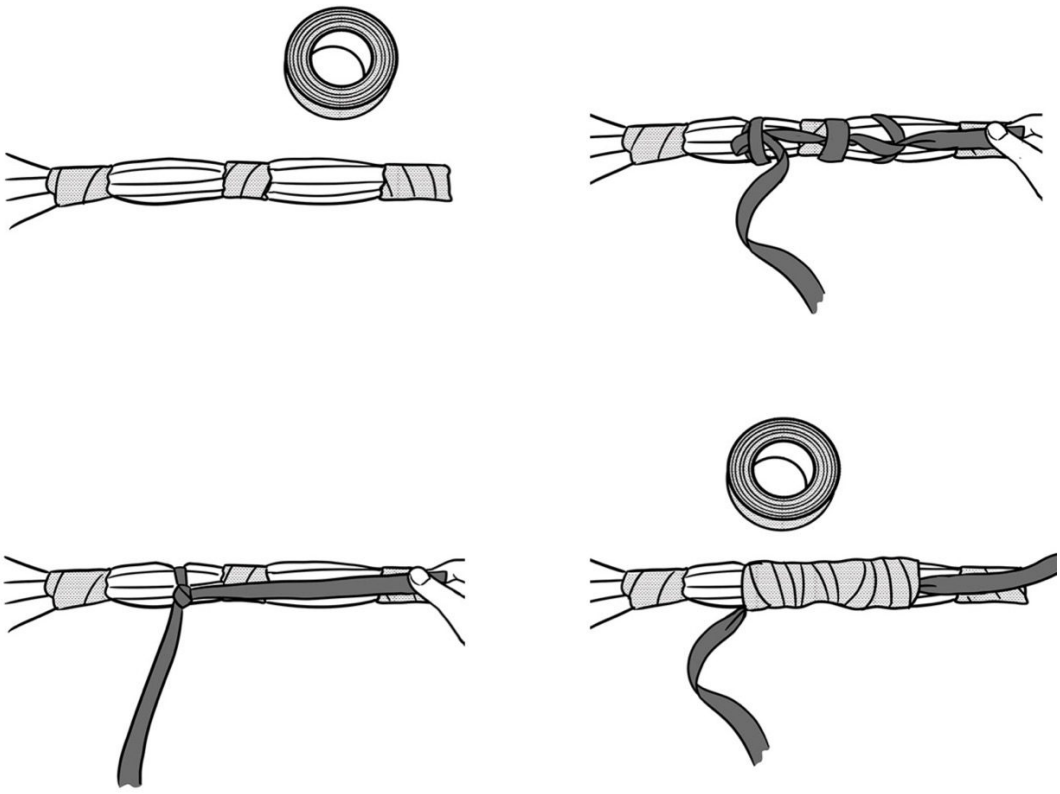
LUBRICATION AND COOLING

When the liner is impregnated with epoxy, it should then be lubricated on the TPU surface to make the installation process easier. Reducing the friction of the liner as it is inverted into the pipe reduces the load on the liner and makes handling easier. Use biodegradable lubricants such as sunflower oil or soft soap to avoid environmental impact. If the temperature during impregnation is high, the impregnated liner can be cooled in water to delay the curing reaction of the resin, which also helps to lubricate the TPU coating evenly.

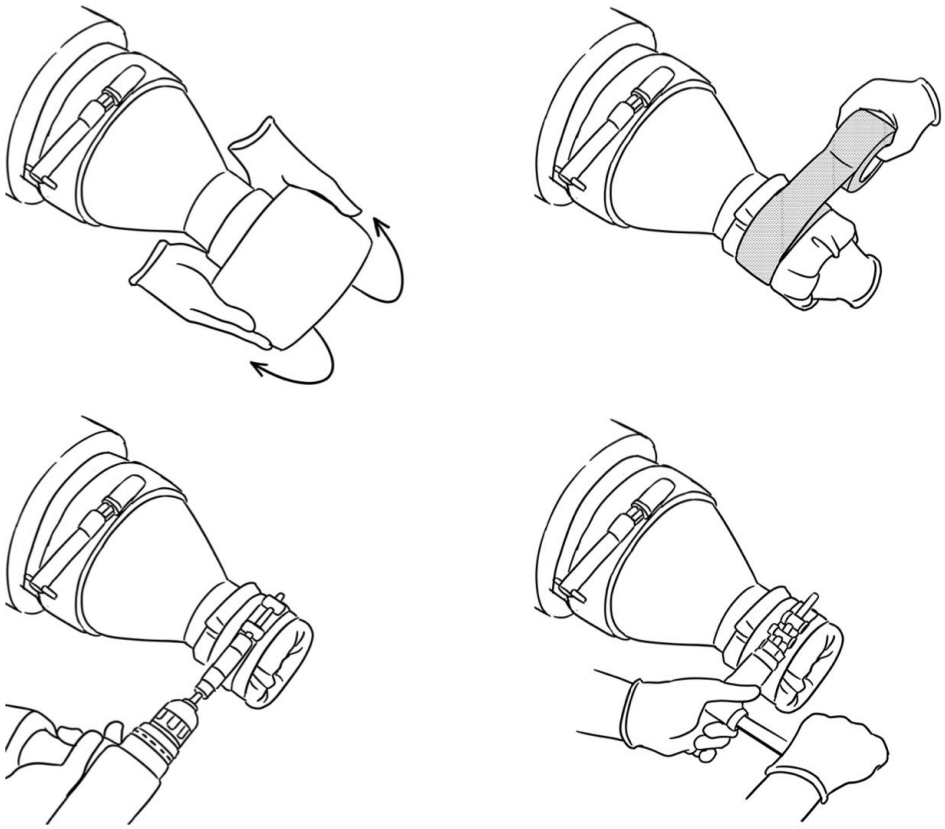
INVERTING THE LINER

INVERTING THE LINER WITH A CLOSED END

Before inversion starts, the liner must be impregnated correctly and placed in the inversion drum. The inversion strap is attached to the closed end of the liner, where a knot is formed and secured with a hose clamp.



The other end of the strap, which is attached to the inversion gun, must be long enough to reach through the whole installation length of the liner. Use the strap to roll the liner into the drum. When the liner is rolled in, the arrows (>>>>>) should point towards the drum and away from the section to be lined. The open end of the liner is then folded around the cone, which is connected to the gun, and secured with clamps that match the size of the liner. Use a suitable cone size for different liner diameters. For Linerwaste liners, use a supporting hose between the cone and the pipe.



Set the gun at an angle to the installation point and apply a correct inversion pressure of about 0.2 to 1.0 bar, depending on the diameter, using a regulator. This pressure will turn the impregnated liner inside out and start the installation, which continues until the liner has reached its set end point. It is recommended to brake the advance of the liner minimally.

If for any reason the pressure must be increased for the liner to navigate the pipe, it is strongly recommended not to hold back the liner with the extruder.

Size	Installation pressure	Curing pressure
DN 50-70	0.4-1.0	0.4-0.8
DN 70-100	0.3-0.7	0.3-0.7
DN 100-150	0.3-0.6	0.3-0.6
DN 150-225	0.2-0.4	0.2-0.4

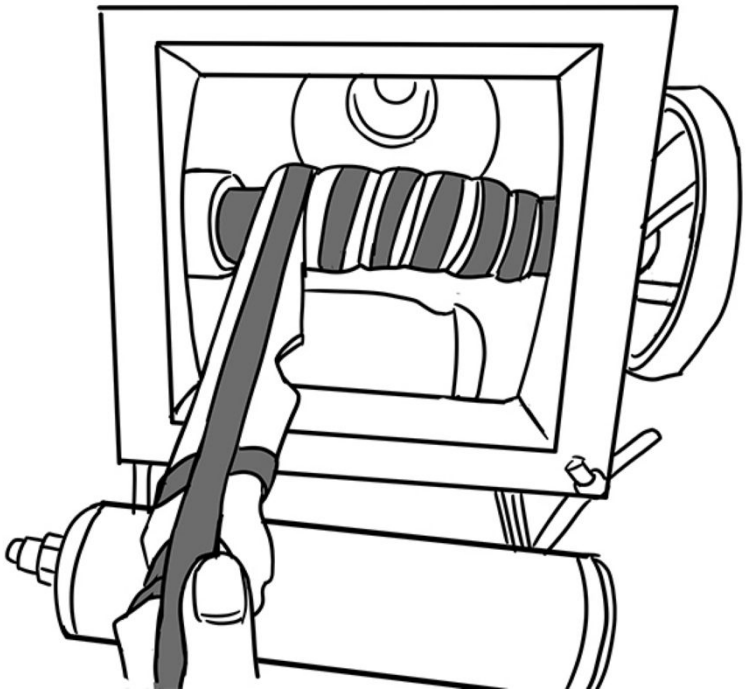
The result of the inversion is that the resin-impregnated surface of the liner is bonded to the inside of the pipe being renovated, and the outer coating of the liner becomes the new inside of the pipe. If the inversion drum cannot be placed directly at the access point, the liner running between the drum and the access point must be supported by a pre-liner or a calibration hose to prevent the liner from being damaged during the inversion process.

After the installation is complete, a suitable pressure should be maintained to make sure that the liner calibrates and adheres correctly to the pipe wall during the curing process.

Note that the pressures in the table are recommendations and that other pressures may be needed, depending on the pipe system. In that case, note the recommendation not to brake the liner while it is inverted.

INVERTING THE LINER WITH AN OPEN END

The difference between an open-end and a closed-end installation is that the length of the liner must be determined exactly. Here, the part used to create the vacuum is removed (normally 70 cm).



With the open-end technique, the end of the liner is closed with masking tape, a rubber band or a similar material to maintain the pressure during the inversion. The pull rope used to control the inversion is locked to the liner by friction, that is, it is rolled in, as we want to be able to roll the strap back once the liner has been inverted. When the inversion is complete and the liner is fully inverted, the masking tape comes loose, which is shown by the compressed air pressure being released and the liner collapsing. To get pressure for the curing, a calibration hose is inserted through the now fully inverted liner. When a liner is inverted with an open end in a pipe with a diameter in the upper part of its stretch range, for example a DN100-150 liner in a 150 mm pipe, expect it to shrink by 2-5%

INSTALLING THE CALIBRATION HOSE

Install the calibration hose in the inverted liner by tying it to the pull rope, and lubricate it with sunflower oil or a similar lubricant. The hose must be longer than the liner to be able to press the liner firmly against the pipe wall during installation and curing.

If the pipe system contains bends or changes in size, invert slowly and with an even pressure to give the liner enough time to expand and adapt to the bends and changes in size. Maintain a pressure of approximately 0.4-0.8 bar to support this process.

Throughout the inversion process, an inspection camera should be used to confirm that the calibration hose has passed all the way through the liner. If this cannot be observed with the camera, you can mark the pull rope with tape at the right length to make sure the hose reaches the right position.

Fit the calibration hose around the cone, as in the closed-end installation, and then pull the impregnated liner over the cone. When the applied pressure reaches approximately 0.4-0.8 bar, the hose will start to invert inside the liner and press the liner against the pipe walls.

If there are bends or changes in size in the pipe, it is important to control the inversion process so that it is slow and at a constant pressure, which helps the liner to expand correctly and fill out 90-degree bends.

Continue this process until you see the calibration hose through the inspection camera or notice that the tape mark on the pull rope has reached its correct point. After this, a pressure of approximately 0.4-0.8 bar should be maintained so that the calibration hose keeps the liner firmly pressed against the pipe wall throughout the curing process.

CURING

For curing epoxy, both in cold curing and in processes where heat is added, the ambient and pipe temperatures are critical factors. Refer to the product-specific data sheets for curing times at 20 degrees Celsius. In cold curing, note that the curing time increases considerably at cold temperatures.

The recommended working temperature is 15–30°C. At lower temperatures the viscosity will be high and the resin will be difficult to work with. The curing time is affected by the ambient temperature. For every 10°C the temperature drops, the curing time doubles. In the same way, for every 10°C above the recommended working temperature, the curing time is halved.

- Linerwaste FAST resin cures in 10 hours at 5°C and 1.5 hours at 30°C
- Linerwaste MEDIUM resin cures in 18 hours at 5°C and 3 hours at 30°C
- Linerwaste SLOW resin cures in 28 hours at 5°C and 4 hours at 30°C

CURING WITHOUT EXTERNAL HEAT, “COLD CURING”

When the installation is done without external heat, remember that the pipe temperature is often colder than the surroundings, and in winter it can be so cold that the epoxy almost freezes. For work at temperatures below 5-10 degrees Celsius, measures such as adding heat or insulating the cold parts should be taken.

CURING WITH EXTERNAL HEAT, “HEAT CURING”

The Linerwaste system uses two methods for heat curing: hot water circulation and steam. Steam is advantageous because it is easily distributed in both short and long pipelines and vertical sections, and it generates heat faster than hot water.

Linerwaste withstands temperatures up to 80°C without a calibration hose. A higher temperature gives a shorter curing time and a more heat-resistant installation.

HEAT CURING WITH HOT WATER

When curing with hot water circulation starts, a lay-flat hose is used instead of a pull strap so that the liner can be filled with water. Cut two holes in the hose, one for a loop that is tied to the calibration hose and the other for water circulation. When water fills the liner, start circulating heated water, but do not count the curing time until the desired temperature, for example 60 degrees Celsius, has been reached.

After curing, the process moves to a cooling phase, in which the heating is stopped and the water is cooled. The liner should cool to below 30 degrees Celsius or to the ambient temperature to avoid deformation.

HEAT CURING WITH STEAM

Steam curing is a technique especially suited to vertical stacks and shorter horizontal stacks, as well as to branch pipes, where the controlled use of steam contributes to an effective curing process. For precision, a temperature gauge is essential, as it provides vital data for determining the exact curing time.

Preparing for steam curing requires a well-thought-out plan and all the necessary equipment at the ready. The steam generator must have enough capacity to supply steam continuously to reach and maintain the desired temperature needed for correct curing. Using hose packages that are resistant to high temperatures and pressures is critical, as an unsuitable hose can lead to both personal injury and damage to property.

When steam curing liners in stacks, the steam should not be connected directly to the central shaft of the equipment, to avoid the risk of the equipment overheating. Instead, an inversion nozzle adapted for steam with a steam connection is used, and an end plug is fitted at the end of the liner. Compressed air and steam are fed into the system to cure the liner. The pull strap is attached to the plug, and the plug also has a nozzle installed to lead the steam out of the system, for example through a connected hose.

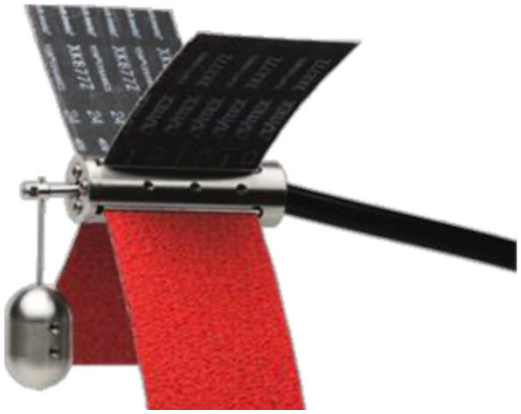
When steam curing branch pipes, the connection to the steam generator is made with hoses designed for the purpose. Normally this is a twin hose, where one part of the hose feeds the steam and compressed air mixture to the tool, while the other part returns the condensate from the work area to the steam generator. The exact design of the tool can vary between manufacturers.

BRANCH REOPENING

After relining with the Linerwaste system, where some branch lines are temporarily blocked, these must be reopened. A cutter system offers an effective solution for this purpose.

A cutter is designed to restore access to branch lines in sizes from DN32 to DN200, without digging or other interventions in existing structures. This system differs from traditional milling robots in that it is used directly from the branch line to be reopened, which gives more direct access and efficiency.

When the cutter is used, it is important to consider what material the branch line is made of. For branches in plastic materials, the tool should first be used to open the liner carefully, followed by a second step to adjust to the original diameter without risk of damaging the line.



For branches made of materials such as cast iron, concrete or steel, the cutter can be used both for the initial opening and for fully restoring the size of the branch.

The milling must be done with precision to fully restore the original dimension of the branch, which keeps the flow of the system and makes future work such as further branch reinforcement or relining easier.

The cutter system can be driven effectively by either a drain cleaning machine or a powerful drill, set to a speed of at least 2500 RPM, for optimal results in the restoration work.

FINISHING WORK

When the curing process is complete and all equipment has been disconnected, we are left with a new pipe inside the existing, now renovated pipe. It is now time to connect this new section to the overall pipe system. Do this by grinding and cleaning the end points of the liner, both at the installation point and at the closed end, to remove any excess epoxy.

For the best result and a tight connection, air-driven grinding tools are recommended. When the new liner pipe is connected to the existing pipe system, it is important to seal the joints to prevent water ingress. Use a sealant such as Sikaflex, silicone, swelling tape or another product developed for the purpose.

BRANCH REINFORCEMENT INSTALLATION

To prevent leaks at branch connections, branch reinforcements must be installed. These reinforcements are usually fitted from the main line but can, depending on the situation, also be inserted directly from the branch line.

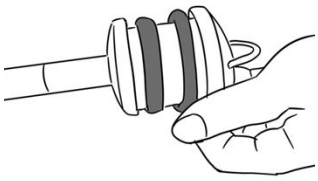
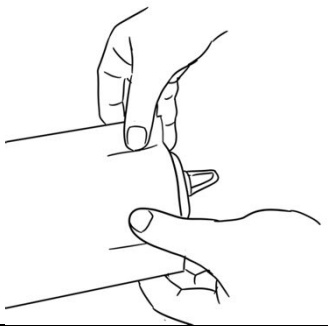
PREPARING THE PIPE SYSTEM FOR BRANCH REINFORCEMENT

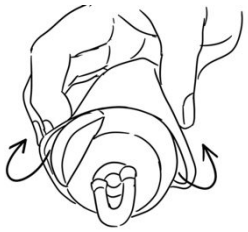
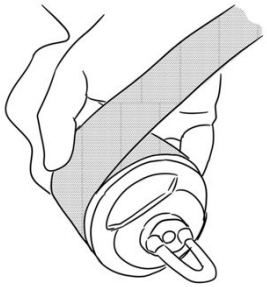
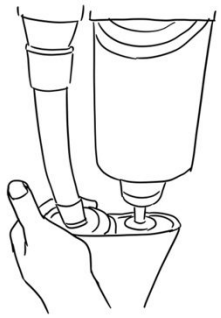
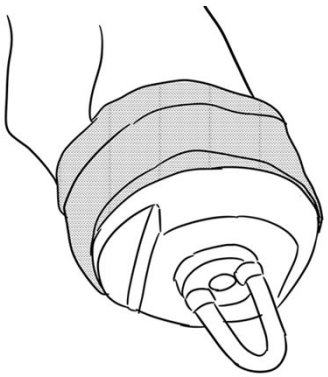
See the section on branch reopening

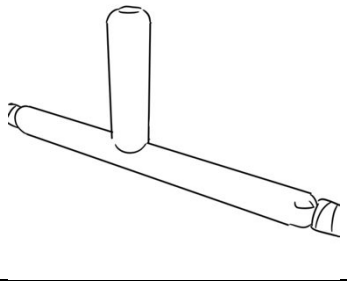
PREPARING THE BRANCH REINFORCEMENT INSTALLATION

PREPARING THE TOOL

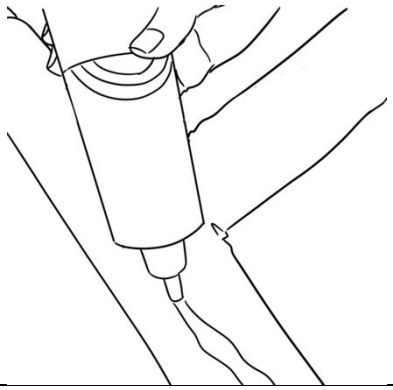
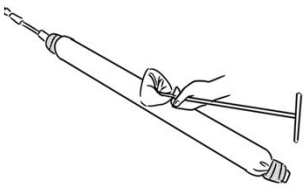
The tool consists of a rubber/silicone bladder that is inflated to set a custom-sewn liner in place at the transition between pipes. The tool is prepared as follows

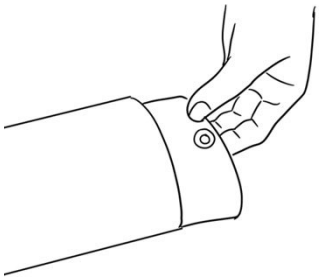
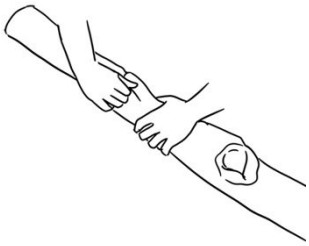
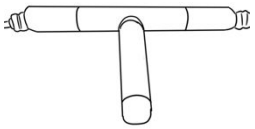
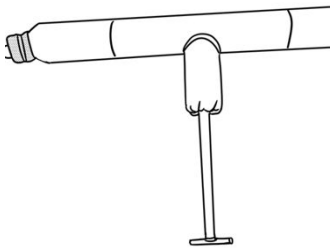
1	Apply a thin layer of sanitary sealant along the grooves on the branch reinforcement tool, as shown in the diagram. **Note:** When using steam, make sure that the inside of the tool is clean and that no Unigum gets inside, as it can block the steam outlet and extend the curing time. A tip is to blow the rubber clean without the end plug fitted.	
2	Thread the rubber part over the tool and position it evenly with the ends of the metal sleeves.	
3	Place one end of the metal sleeve in the middle of the rubber and fold the overlapping sides of the rubber in opposite directions.	

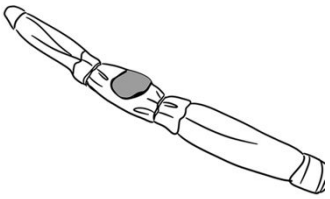
		
4	Fasten the rubber with electrical tape or duct tape, and then secure it carefully with hose clamps. Use the tape to protect the rubber from the sharp edges of the hose clamps. Apply several turns of tape after the hose clamps so that epoxy does not cure onto them.	
5	When one side of the rubber has been fastened to the tool, the inside should be lubricated with Repiper Lubricant or Repiper Lubricant Blue to make mounting easier. It is important that only these approved lubricants are used, as their effectiveness has been confirmed in tests with the manufacturer. Make sure that the lubricant is not applied to the parts of the rubber that will be connected to the sleeve, as this can make an airtight seal harder to achieve and increase the risk of the rubber coming loose.	
6	Follow the steps described in points 3 and 4 to prepare and mount the other side of the rubber as well, which makes the tool fully airtight. Note: When using a Steambox, remember to unscrew the outer plug when air is connected. This step is essential for blowing away any dirt and debris inside the tool. If this is overlooked, particles can block the air flow, which can extend the installation time by preventing the steam from flowing freely.	

7	To verify that the assembly is correct and airtight, the tool should be pressure tested to a maximum of 0.3 bar. If there is a leak, adjust or replace the hose clamps to fix the problem and achieve the necessary tightness.	

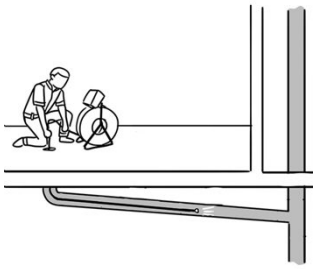
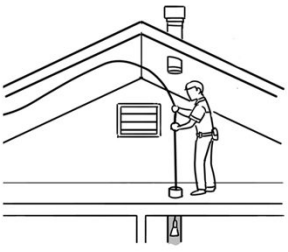
MOUNTING THE BRANCH REINFORCEMENT TOOL

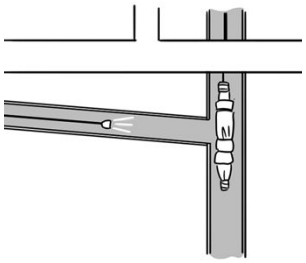
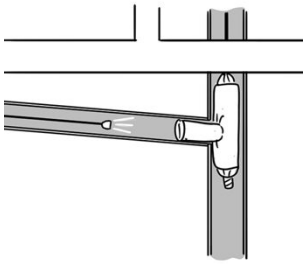
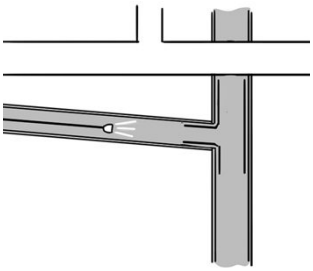
1	Connect the pre-assembled tool to an air source, adjust the air pressure to 0.1-0.2 bar and apply a lubricant over the whole surface of the rubber or silicone bladder. Inspect the rubber carefully for any damage and replace it if a damaged area is found.	
2	Reduce the air pressure to just below 0.1 bar and position the branch reinforcement part in the main tool. Start by inserting it by hand and then use the inversion tool for a smoother process.	

3	Make two holes in the end of the branch reinforcement liner, which will later be used to invert the branch liner during the installation.	
4	Thread the branch reinforcement liner over the tool, fitting it so that the inverted part of the liner lines up with the branch on the branch reinforcement liner.	
5	Mix the epoxy and impregnate the branch reinforcement liner. Note that no epoxy is used in the instruction pictures, for clarity. Using epoxy would normally require full personal protective equipment.	
6	Use the inversion tool to roll the branch liner over the tool. Start by inserting the tool into the holes you made and feel with your hand to make sure that the liner does not twist or wrinkle, and that the opening is as even as possible.	
7	Apply vacuum to the tool to attach the branch reinforcement liner securely. Use a string to fasten the liner to the tool, as shown in the picture. Cut off any excess string. The string will break at a pressure of about 0.4 bar, which is shown by a dull bang. It is important that the string is tight enough to break correctly when air is applied. To make positioning the branch reinforcement easier, it can help to mark the branch with spray paint in a visible colour. This step makes it easier to place the branch reinforcement correctly.	

		
8	With these steps completed, both the tool and the branch reinforcement are ready to be fitted into the pipe. This methodical preparation makes sure that the branch reinforcement is installed correctly, which contributes to a tight and durable seal of the branch connections.	

INSTALLING THE BRANCH REINFORCEMENT

1	Before epoxy is applied to the branch reinforcement liner, you should check that you have the right equipment ready for positioning the branch reinforcement. This includes air rods or hoses suited to the specific position of the branch pipe in the line, and an inspection camera correctly positioned inside the branch pipe or the main stack if the installation is done from a branch line.	
2	Insert the tool into the pipe system, now with the epoxy-impregnated branch reinforcement liner.	

3	Use the inspection camera to position the tool carefully at the desired place in the branch pipe. The tool starts to move when the air pressure reaches between 0.3 and 0.4 bar, which shows that the tool is correctly positioned.	
4	The camera operator is responsible for deciding which air pressure to apply and for checking that the branch reinforcement part reaches its final position. A distinct sound of a breaking string at about 0.4 bar shows that the branch part is in place. If the placement is not optimal, the air pressure can be reduced to adjust the position. When the installation is judged to be correctly placed, keep a constant air pressure of 0.6 to 0.7 bar during the curing process to make sure that the branch reinforcement adheres properly.	
5	Complete the process by applying vacuum to the tool to make it easier to remove from the pipe system. The tool should be pulled out in the direction that disturbs the newly installed branch reinforcement least, which in the example is downwards.	

FINISHING WORK, BRANCH REINFORCEMENT

To protect the tool and avoid spills on the surroundings or clothing, cover it with environmentally friendly plastic film before it is transported back to the workshop.

After removal, the tool should be hung up for easy access and filled with compressed air to stretch out the bladder. Use a cloth to wipe the tool and remove any remaining epoxy. If the tool is to be used again, follow the instructions in the section “Mounting the branch reinforcement tool”. If it is not to be used straight away, compress the tool and store it safely in its container.

When a counter-liner from the branch line needs to be installed, this should be done using the open-end installation method, described in more detail in another part of the manual. Make sure that the counter-liner and the branch pipe overlap, to ensure a tight and durable connection.

INSPECTION

When the installation of the Linerwaste system is complete, a thorough inspection must be carried out to verify that everything has gone to plan. All important observations must be recorded in the self-inspection form (see appendix). If any defects are found, they must be fixed immediately and documented in detail.

If necessary, cutter systems can be used to remove carefully any obstructions the installation may have created, such as folds or excess epoxy. Thanks to their design, such tools can remove unevenness selectively with minimal effect on the rest of the liner pipe.

All such corrections and measures must be carefully documented in the self-inspection form as part of the quality assurance process of the project.

COMPLETION

When all renovation measures have been carried out and the documentation has been prepared, the next step is to reconnect the pipelines at the exposed connection points. It is critical that this work is done with precision and only with products specifically approved for this purpose, to avoid future leakage problems. Relining Connections have been developed for this purpose, and they prevent water ingress between the new lining and the existing pipe system.

When the water supply has been restored, all taps and toilets should be flushed for a visual check of the tightness of the waste water system before the site is considered finished. At the end of the project, all relevant documentation, including self-inspections and other documentation, is handed over to the client together with operating and maintenance instructions. The client must then approve and sign for receipt of the work.

Waste material consisting of cured epoxy is treated as combustible waste, while other construction waste is sorted and handled according to local waste regulations

APPENDICES

SELF-INSPECTION

Appendix 1 Self-inspection

SAFETY DATA SHEET (SDS)

Appendix 2 Safety data sheet Linerwaste Epoxy

PRODUCT INFORMATION

Appendix 3 Product information Linerwaste liner

Appendix 4 Branch reinforcement