LINERWASTE RELINING SYSTEM
INSTALLATION HANDBOOK

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CONTENT

INTRODUCTION

This manual offers detailed guidance for the installation of the Linerwaste system in compliance with the quality standards and approvals set by RISE. It forms the foundation for achieving the highest possible standards in installations by clearly defining quality processes and the documentation required to confirm the quality of the work. The company and its listed employees meet these standards and have obtained certification based on the training and procedures outlined in this manual.

SCOPE OF THE SYSTEM'S APPLICATION

The Linerwaste system is used to address damage in stormwater and wastewater systems within buildings. It includes processes such as cleaning, inspection, point repair, relining (lining), branch reinforcement, and milling of the pipe system. The methods are designed to work efficiently for pipe systems made of various materials such as plastic, cast iron, and concrete, whether they are free-standing, embedded in masonry, or located in other parts of the structure.

The Linerwaste method can successfully address the following issues:

- Water leakage at joints, as well as through holes and cracks in the pipe system
- Leakage and contamination from sewer pipes
- Corrosion on cast iron pipes and damage caused by corrosion on concrete and masonry structures
- Damage to branch connections and missing sections of the pipe system
- Cracking in the pipe system
- Incorrectly installed pipe systems causing leakage
- Reduced water flow due to wear and corrosion

Problems related to sags or insufficient slopes in the pipe system cannot be addressed using the Linerwaste system. Before starting work, it is critical to carefully assess the extent of the damage and consider any need for reconstruction or other structural changes.

ENVIRONMENT AND SAFETY

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

Additional safety measures to consider when working with epoxy include:

- **Eye protection**: Wear safety goggles to protect the eyes from splashes and fumes that can cause irritation or injury.
- **Emergency shower and eyewash station**: Ensure that emergency showers and eyewash stations are readily available near the work area to immediately rinse off any epoxy that may have come into contact with the skin or eyes.

- **Training**: Ensure all employees receive adequate training and information about the risks associated with handling epoxy, including how to use personal protective equipment properly and what actions to take in case of exposure.

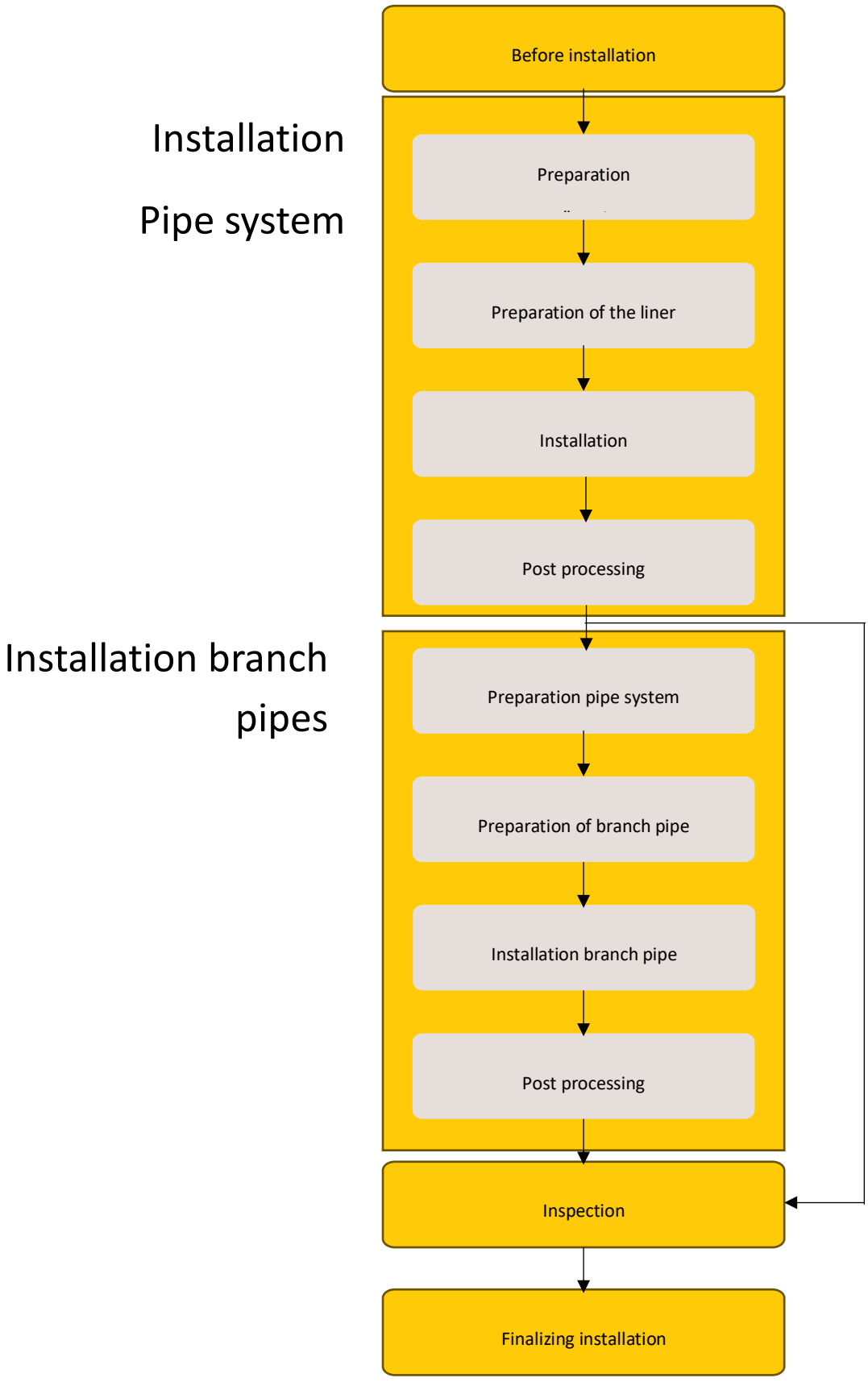
- **Ventilation system**: Use effective ventilation systems or local exhaust to control fumes at the source and reduce the risk of inhalation.

- **Safety data sheets (SDS)**: Always make SDS for epoxy products easily accessible to all employees and ensure they are familiar with the content, especially sections dealing with first aid measures and what to do in case of a spill or accident.

- **Regular monitoring**: Regularly monitor air quality in the work area to ensure that fume levels remain within safe limits.

By implementing these additional safety measures, the risk of harmful exposure to epoxy can be minimized, contributing to a safer work environment for everyone involved.

PROCESS OVERVIEW OF THE LINERWASTE SYSTEM



PREPARATION OF THE PIPE SYSTEM

Before installing the Linerwaste system, the pipe system must be prepared. This means that the pipe must be thoroughly cleaned and inspected, and an assessment of any damage must be made. This initial phase is crucial to make an informed choice of appropriate materials, equipment, and the best installation method for the task.

INSTALLATION OF THE PIPE SYSTEM

PREPARATION OF THE PIPE SYSTEM

CLEANING

Effective cleaning is crucial and should be performed using mechanical methods, such as chain flails, to remove all dirt and sediment from the pipe. This restores the pipe's original dimensions and shape, which is necessary for successful relining. Cleaning machines are recommended for this process, especially those capable of speeds of at least 1500 RPM, ensuring the pipe is as clean as possible. Any obstacles such as roots or foreign objects must also be removed before the liner installation begins. Before starting the work, it is essential to ensure the system is out of operation, which can be achieved by shutting it off and using stoppers or redirecting the system flow.

INSPECTION AFTER CLEANING

Once the pipe system has been cleaned, a thorough inspection should be conducted to verify that the cleaning was successful and to identify any damage or deviations. During this inspection, the pipe's dimensions should also be measured, along with other important aspects such as liner length and the positions of branch connections. If damage is discovered, it should be evaluated to determine whether it can be repaired using the Linerwaste method.

MATERIAL SELECTION

The Linerwaste system includes materials designed to handle multiple bends and/or dimensional changes. This may include felt or knitted materials combined with a specific epoxy system that offers various working times and viscosities, depending on the application and the project's needs. The choice of materials is based on the characteristics of the pipe system, such as the length of the liner, the presence of dimensional changes, bends, and water infiltration. A successful installation requires addressing all factors such as water infiltration, holes, and cracks, which may require the use of a pre-liner or point repairs to address specific damage.

EQUIPMENT SELECTION

The choice of equipment depends on the installation length, pipe dimensions, accessibility, and whether the curing process will involve applied heat or not ("warm" or "cold" curing). It is also essential to plan how to handle branch connections, ensuring access and the understanding of the need for specialized equipment, such as a milling robot or another type of cutter system, to open and clean the connections.

CHECKLIST FOR EQUIPMENT

- Cleaning equipment suitable for sewer pipes of the current dimensions
- Inspection equipment for sewers
- Epoxy and hardener with suitable pot life and viscosity
- Mixing containers for epoxy, complete with scales or measuring glasses
- Mixing equipment for homogeneous mixing
- Liner material suitable for pipe dimensions
- Pre-liner and calibration hose to address water infiltration, holes, and cracks
- Impregnation table and rollers
- Vacuum pump
- Inversion cone with pressure gauge and control clamps
- Compressor with associated air hoses
- Inversion belts/pull ropes
- Cones and transition pieces in appropriate sizes, as well as calibration hoses
- Stoppers and redirection systems to ensure system shutdown during installation
- Equipment for heat curing, including steam/water with associated measuring instruments
- Thermometer suitable for the heat curing process
- Equipment for branch opening, such as a milling robot
- Hand tools and accessories for installation work
- Sanding tools for removing excess epoxy and other obstructions that occurred during the relining process
- Safety equipment for cordoning off work areas
- Personal protective equipment for installation staff.

LINER IMPREGNATION

The liners in the Linerwaste system come in diameters ranging from DN50 to DN225. They are made of 100% polyester fiber and have a thermoplastic polyurethane (TPU) coating. The liners are compatible with room temperature curing, hot water, or steam curing processes up to 80°C. All liners are flexible enough to accommodate variations in pipe diameter, and they only expand radially, not longitudinally. This allows for precise relining of pipes with known lengths.

LINERWASTE LINERS

DN

50–70

70–100

100–150

150–225

EPOXY AMOUNT AND ROLLER SETTINGS

	To reach 3mm wall thickness	
DN	Roller Distance	Epoxy Weight in Liner (kg/m)
50–70	7 mm	0,6 kg /m
70–100	10 mm	1 kg /m
100–150	11 mm	1,3 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 (meter)	Total epoxy weight (kg)	Length (meter)	Total epoxy weight (kg)	Length (meter)	Total epoxy weight (kg)	Length (meter)	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

EPOXY MIXING

The base and hardener should be mixed to a homogeneous mass according to the specifications in the technical data sheet for the respective epoxy product. Use an electric mixer or a mixing unit and ensure the mixer is fully submerged to avoid air bubbles. Mixing should last for at least two minutes to ensure complete and even blending.

Properly following the specified epoxy mixing ratios and monitoring the material temperature are important to accurately calculate pot life, i.e., the time you have to work with the epoxy before it starts to cure. Epoxy should be stored at a temperature between 15 to 20 degrees Celsius to maintain its optimal quality and characteristics.

MIXING RATIOS FOR LINERWASTE EPOXY

All Linerwaste epoxy systems have a mixing ratio of 100:30 (base to hardener).

Example: to get 1,3 kg of finished epoxy version FAST, you mix 1 kg Linerwaste BASE and 300g Linerwaste FAST

MIXING TABLE

Total epoxy weight (kg)	**Linerwaste BASE (gram)**	**Linerwaste Hardener (FAST, MEDIUM or SLOW) (gram)**		**Total epoxy weight (kg)**	**Linerwaste BASE (gram)**	**Linerwaste Hardener (FAST, MEDIUM or SLOW) (gram)**
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

RESIN OPEN TIMES AND CURING TIMES

Linerwaste FAST

- Curing: 3 hours to self-supporting at 20°C
- Open time at 20°C: 15 minutes (time until viscosity doubles)

Linerwaste MEDIUM

- Curing: 6 hours to self-supporting at 20°C
- Open time at 20°C: 35 minutes (time until viscosity doubles)

Linerwaste SLOW

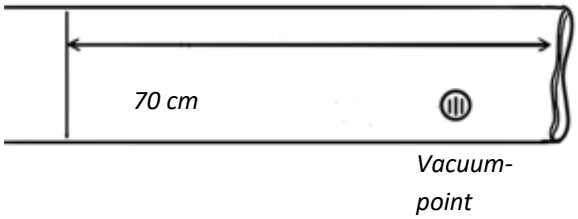
- Curing: 8 hours to self-supporting at 20°C
- Open time at 20°C: 50 minutes (time until viscosity doubles)

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. Curing time is affected by ambient temperature. For every 10°C drop, the curing time doubles. Similarly, for every 10°C increase, the curing time is halved.

- Linerwaste FAST-resin hardens in 10 hours at 5°C and 1,5 hours at 30°C
- Linerwaste MEDIUM-resin hardens in 18 hours at 5°C and 3 hours at 30°C
- Linerwaste SLOW resin hardens in 28 hours at 5°C and 4 hours at 30°C

LINER IMPREGNATION

After the installation length has been measured, e.g., with a fiber-optic camera, the liner should be cut to the correct 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 a vacuum. Of the 70 cm for vacuum, 30 cm is reserved for tying if the installation is to be done with a closed end.



Vacuum-point

Three slits for vacuum

When creating the vacuum, one end is sealed 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. After the vacuum is achieved, the epoxy is filled into the liner while maintaining the vacuum to ensure an even distribution of the epoxy. The liner is then passed through rollers with a predetermined roller spacing adapted to the liner chosen (see table).

When passing through the rollers it is preferable if the arrows (>>>>>) on the liner face the rollers.

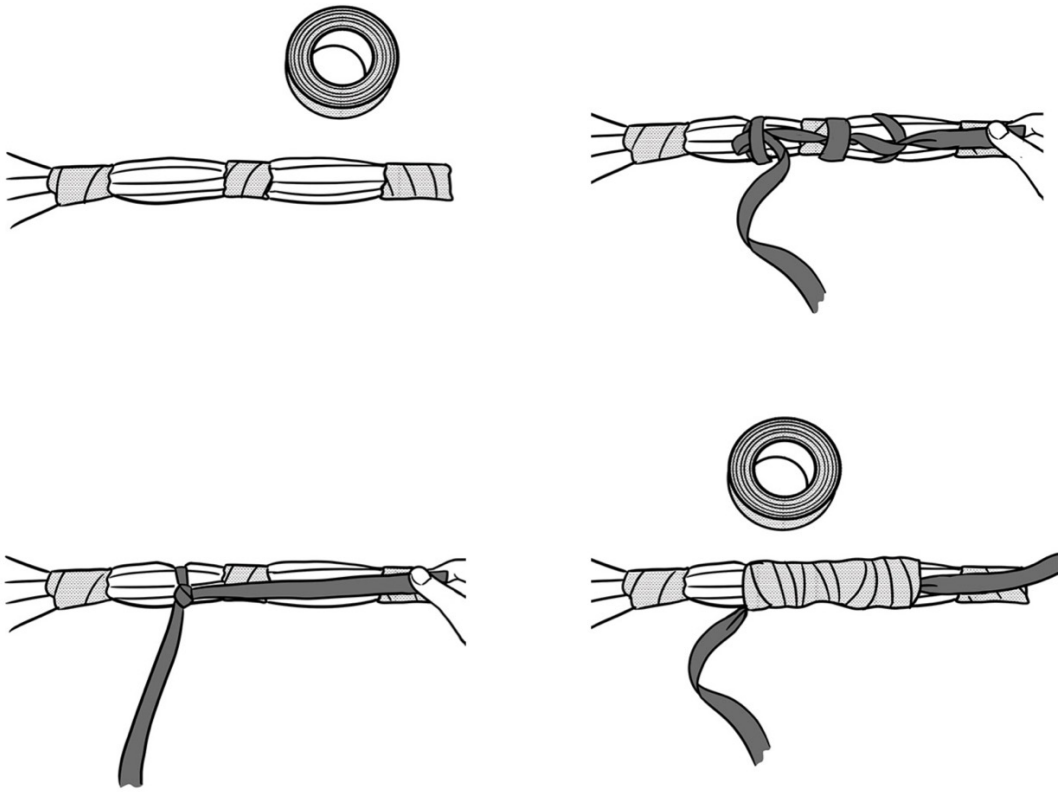
LUBRICATION AND COOLING

When the liner is impregnated with epoxy, it should then be lubricated on the TPU surface to facilitate the installation process. Reducing friction for the liner during inversion into the pipe reduces the load on the liner and makes handling easier. Use biodegradable lubricants such as sunflower oil or soap to avoid environmental impact. If the temperature during impregnation is high, the impregnated liner can be cooled in water to delay the resin curing reaction, which also helps to lubricate the TPU coating evenly. The recommended method is to use a bucket of soapy water that the liner can pass through and become fully lubricated.

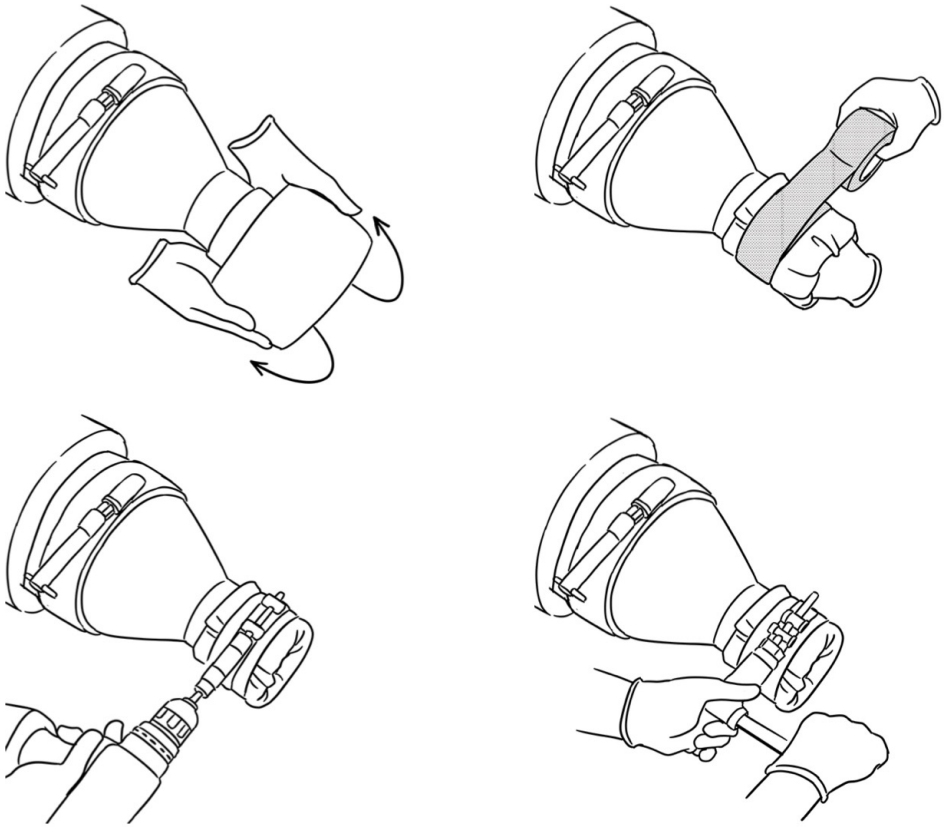
LINER INVERSION

INVERSION OF LINER WITH CLOSED END

Before starting the inversion process, the liner must be properly impregnated and placed in the inversion drum. The inversion belt 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 belt, attached to the extruder, should be long enough to stretch through the entire installation length of the liner. Use the belt to roll the liner into the extruder. The arrows (>>>>) should face the extruder and away from the pipe. The open end of the liner is then folded around the cone connected to the ball and secured with clamps that match the liner's size. Use the appropriate cone size for different liner diameters. For the Linerwaste liner, a supporting hose is used between the cone and the pipe.



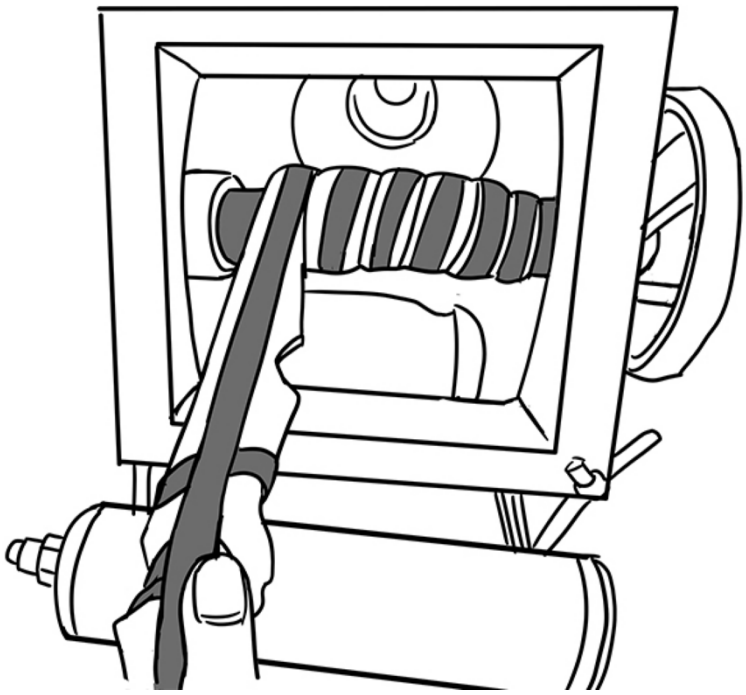
Set the extruder at an angle to the installation point and introduce inversion pressure of around 0.4–0.8 bar using a regulator. This pressure will turn the impregnated liner inside out and start the installation, which continues until the liner has reached its predetermined endpoint.

the result of the inversion is that the resin-impregnated surface of the liner bonds to the inside of the pipe being renovated, and the external coating on the liner becomes the new inner surface of the pipe. If the inversion drum cannot be placed directly at the access point, the liner that runs between the drum and the access point must be supported by a pre-liner or a calibration hose to prevent damage during the inversion process.

After the installation is completed, a pressure of around 0.4–0.8 bar should be maintained to ensure that the liner calibrates and adheres correctly to the pipe walls during the curing process.

INVERSION OF LINER WITH OPEN END

The main difference when installing with an open end, compared to the closed end, is that the length of the liner must be determined precisely. The portion used for vacuum (normally 70 cm) is removed.



In the open-end technique, the end of the liner is sealed with duct tape, rubber bands, or similar material to maintain pressure during inversion. The pull rope used to control the inversion is secured by rolling it tightly around the liner, as this allows the rope to be pulled back once the liner has been fully inverted. When the inversion is complete and the liner is fully inverted, the duct tape comes loose, which is indicated by the release of compressed air pressure and the liner collapsing. To apply pressure during curing, a calibration hose is inserted into the now fully inverted liner. When using the liner with an open end and the diameter is the higher dimension of the flex range, for instance a 150mm pipe for a 100-150DN liner, the liner will shrink 2-5%.

INSTALLATION OF CALIBRATION HOSE

Install the calibration hose into the inverted liner by tying it to the pull rope and lubricating it with sunflower oil or a similar lubricant. The hose must be longer than the liner to ensure the liner is properly pressed against the pipe walls during installation and curing.

If the pipe system contains bends or size changes, invert slowly and with even pressure to give the liner time to expand and adapt to the bends and size changes. Maintain pressure of around 0.4–0.8 bar to support this process.

During the entire inversion process, an inspection camera should be used to verify that the calibration hose has passed through the entire liner. If it's not possible to observe this with a camera, mark the pull rope with tape at the correct length to ensure that the hose reaches the intended position.

Mount the calibration hose around the cone, as in the installation with a closed end, and then pull the impregnated liner over the cone. When the applied pressure reaches about 0.4–0.8 bar, the hose will begin to invert inside the liner, pressing it against the pipe walls.

If there are bends or size changes in the pipe, it is essential to control the inversion process so that it happens slowly and under constant pressure, helping the liner expand correctly and fill in 90-degree bends.

Continue the process until the calibration hose is seen through the inspection camera, or until the tape marker on the pull rope reaches the correct point. After this, a pressure of about 0.4–0.8 bar should be maintained to keep the calibration hose pressing the liner against the pipe walls during the entire curing process.

CURING

The curing of epoxy, whether done with cold curing or with externally applied heat, is highly dependent on the ambient and pipe temperatures. Refer to product-specific data sheets for curing times at 20°C. For cold curing, note that curing time increases significantly at low temperatures.

Recommended working temperature is 15–30°C. At lower temperatures, the viscosity will be high, and the resin will be difficult to work with. Curing time is affected by the ambient temperature. For every 10°C decrease, the curing time doubles. Similarly, for every 10°C increase 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 SUPPLY ("COLD CURING")

When installation is done without external heat, remember that the pipe temperature is often colder than the surroundings, and in winter it can be cold enough that the epoxy nearly freezes. For work in temperatures below 5–10°C, steps such as adding heat or insulating cold sections should be taken.

CURING WITH EXTERNAL HEAT SUPPLY ("HEAT CURING")

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

The Linerwaste system can withstand temperatures up to 80°C without a calibration hose. Higher temperatures result in shorter curing times and a more heat-resistant installation.

HEAT CURING WITH HOT WATER

When starting heat curing with hot water circulation, use a flat hose as a substitute for the pull rope to allow water to fill the liner. Cut two holes in the hose: one for a loop to be tied to the calibration hose, and the other to allow for water circulation. When the liner is filled with water, start the circulation with heated water, but do not begin counting the curing time until the desired temperature, such as 60°C, is reached.

After curing, the process transitions to a cooling phase where heating is stopped, and the water is cooled. The liner should cool down to below 30°C or to ambient temperature to avoid deformation.

HEAT CURING WITH STEAM

Steam curing is a technique particularly suited for vertical pipelines and short horizontal pipelines, as well as branch pipes, where the controlled use of steam helps achieve an efficient curing process. To precisely ensure the process, a temperature gauge is essential, providing vital data to accurately determine the exact curing time.

Preparations for steam curing require thoughtful planning and readiness with all necessary equipment. The steam generator should have enough capacity to continuously supply steam to reach and maintain the desired temperature necessary for proper curing. The use of hoses resistant to high temperatures and pressure is critical, as improper hoses can lead to personal injury or property damage.

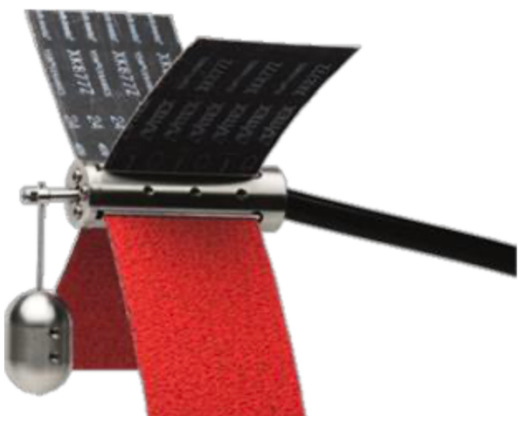
During steam curing of liners in vertical stacks, steam should not be connected directly to the central axis of the equipment to avoid the risk of overheating the equipment. Instead, use an inversion nozzle adapted for steam, which has a steam connection, and place an end plug at the end of the liner. Air pressure and steam are introduced into the system to cure the liner. A pull rope is attached to the plug, and a nozzle is installed in the plug to direct the steam out of the system, for example, via a connected hose.

BRANCH OPENING

After completing a relining with the Linerwaste system, where certain branch connections may temporarily become blocked, steps must be taken to reopen these branches. A cutter system provides an effective solution for this purpose.

A cutter is designed to restore access to branch connections in sizes ranging from DN32 to DN200 without requiring excavation or other interventions into existing structures. This system differs from traditional milling robots by being used directly from the specific branch connection that needs reopening, which allows for more direct access and efficiency.

When using the cutter, it is essential to consider the material of the branch connection. For branches made of plastic materials, the tool should first be used to gently open the liner, followed by a second step to adjust to the original diameter without risking damage to the connection.



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

The milling process should be performed with precision to fully restore the branch's original dimensions, ensuring the system’s flow is maintained and simplifying future interventions, such as additional branch reinforcement or relining.

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

POST-WORK PROCEDURES

After the curing process is completed and all equipment is disconnected, the result is a new pipe inside the existing, now renovated, pipe. It is now time to connect this new segment to the overall pipe system. Do this by sanding and cleaning the liner ends at both the installation point and the closed end to remove any excess epoxy.

For the best results and a watertight connection, it is recommended to use air-powered sanding tools. When connecting the new liner pipe to the existing pipe system, it is crucial to seal the joints to prevent water ingress. Use sealing agents such as Sikaflex, silicone, swelling tape, or another product specifically developed for this purpose.

INSTALLATION OF BRANCH REINFORCEMENT

To prevent leakage at branch connections, it is necessary to install branch reinforcements. These reinforcements are usually installed from the main pipeline but, depending on the situation, can also be inserted directly from the branch line.

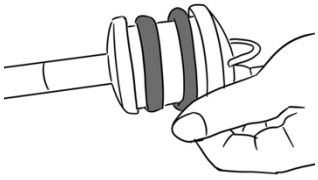
PREPARATION OF THE PIPE SYSTEM FOR BRANCH REINFORCEMENT

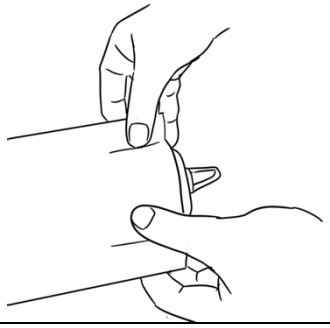
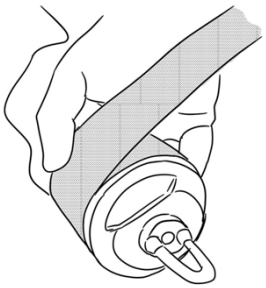
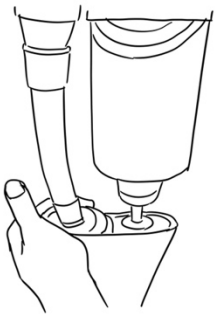
Refer to the section on branch opening for details.

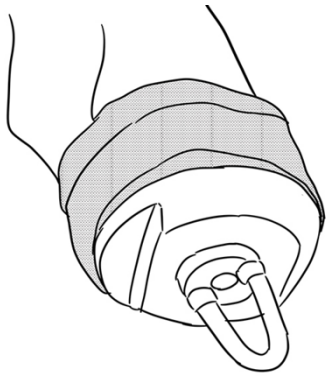
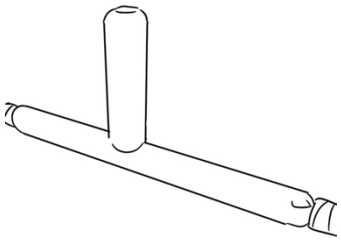
PREPARATION FOR BRANCH REINFORCEMENT INSTALLATION

FÖRBERED VERKTYGET

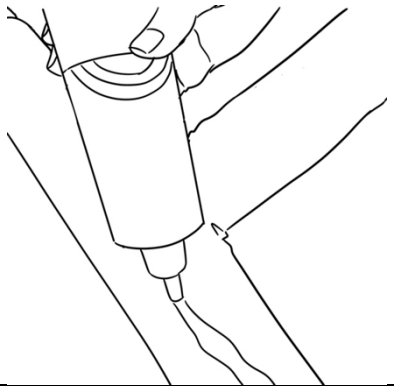
The tool consists of a rubber/silicone bladder that inflates to place a custom-made liner at the junction between pipes. The tool is prepared as follows:

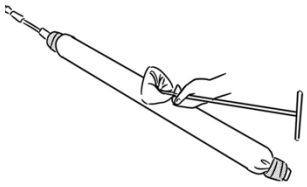
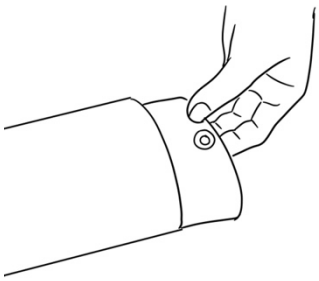
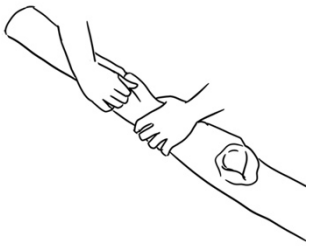
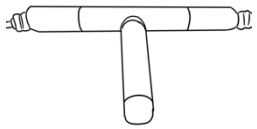
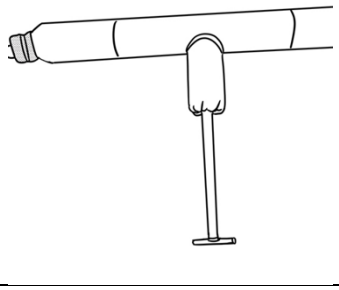
1	Apply a thin layer of sanitary putty along the grooves on the branch reinforcement tool, as illustrated in the accompanying diagram. **Note:** When using steam, ensure that the inside of the tool is clean and free of any sanitary putty, as this could block the steam outlet and extend curing time. A tip is to blow out the rubber without the end plug attached.	

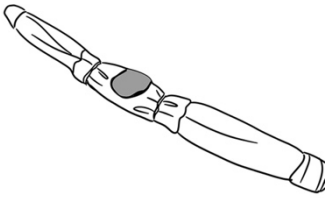
2	Slide the rubber part over the tool and position it evenly with the metal sleeve ends.	
3	Place one end of the metal sleeve in the center of the rubber and fold the excess sides of the rubber in opposite directions.	
4	Secure the rubber with electrical tape or duct tape and then firmly fasten it with hose clamps. Use the tape to protect the rubber from the sharp edges of the hose clamps. Wrap several layers of tape after the clamps to prevent the epoxy from hardening onto them.	
5	After one side of the rubber has been fastened to the tool, lubricate the inside with lubricant specifically developed for branch tools to facilitate installation. It is important to use only approved lubricants after their effectiveness has been confirmed by tests with the manufacturer. Make sure not to apply lubricant to the parts of the rubber that will connect to the sleeve, as this could prevent a proper airtight seal and increase the risk of the rubber coming loose.	

6	Follow steps 3 and 4 to also prepare and mount the other side of the rubber, ensuring that the tool becomes completely airtight. **Note**: When using Steambox, remember to unscrew the outer plug when connecting the air. This step is crucial to blow away any dirt and debris inside the tool. If overlooked, particles may block the airflow, potentially extending the installation time by hindering the free flow of steam.	
7	To verify that the assembly is correct and airtight, the tool should be pressure-tested to a maximum of 0.3 bar. If leakage occurs, adjust or replace the hose clamps to resolve the issue and ensure the necessary tightness.	

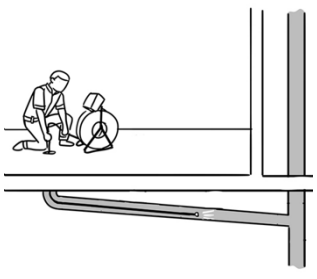
ASSEMBLY OF THE BRANCH REINFORCEMENT TOOL

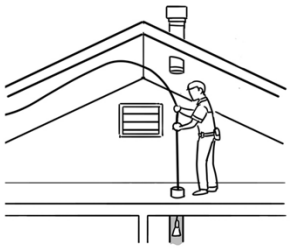
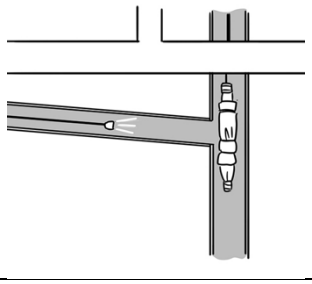
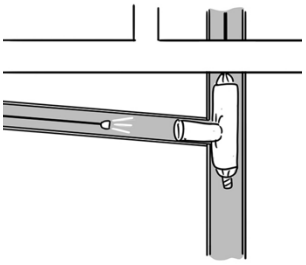
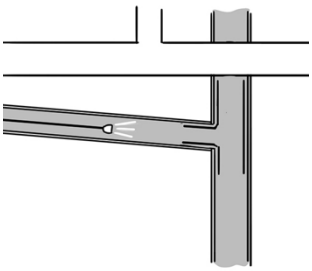
1	Connect the pre-assembled tool to an air source, adjust the air pressure to 0.1–0.2 bar, and apply a lubricant over the entire surface of the rubber or silicone bladder. Carefully inspect the rubber for any damage and replace it if any damaged areas are found.	

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, then use the inversion tool for a smoother process.	
3	Create two holes at the end of the branch reinforcement liner, which will later be used to invert the branch liner during installation.	
4	Slide the branch reinforcement liner over the tool, making sure that the inverted part of the liner aligns with the branch on the branch reinforcement liner.	
5	Mix the epoxy and impregnate the branch reinforcement liner. Note that due to the clarity of the instructional images, no epoxy is used, which 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 check by hand to ensure the liner does not twist or crease and that the opening is as even as possible.	

7	Apply vacuum to the tool to securely fasten the branch reinforcement liner. Use a string to tie the liner to the tool as illustrated in the image. Cut off any excess string. The string will break at approximately 0.4 bar of pressure, indicated by a dull snap. It is important that the string is tight enough to break properly when air is applied. To aid in positioning the branch reinforcement, it can be helpful to mark the branch with spray paint in a visible color. This step simplifies the process of positioning the branch reinforcement correctly.	 
8	With these steps completed, both the tool and the branch reinforcement are ready to be installed into the pipe. This methodical preparation ensures that the branch reinforcement is installed correctly, contributing to a tight and durable seal at the branch connections.	

INSTALLATION OF BRANCH REINFORCEMENT

1	Before applying epoxy to the branch reinforcement liner, check that you have the proper equipment ready for positioning the branch reinforcement. This includes air pins or hoses tailored to the branch pipe's specific location in the line and ensuring that an inspection camera is correctly positioned inside the branch pipe or the main pipe, if the installation is done from a branch connection.	

2	Introduce the tool into the pipe system now with the epoxy-impregnated branch reinforcement liner.	
3	Use the inspection camera to carefully position the tool at the desired location in the branch pipe. The tool will start to move when the air pressure reaches between 0.3 and 0.4 bar, indicating that the tool is correctly positioned.	
4	The camera operator is responsible for determining the necessary air pressure and for verifying that the branch reinforcement part reaches its final position. A distinct sound from the snapping of a string at approximately 0.4 bar indicates that the branch reinforcement piece is in place. If the positioning is not optimal, reduce the air pressure to adjust the position. Once the installation is determined to be correctly positioned, maintain constant air pressure of 0.6 to 0.7 bar during the curing process to ensure that the branch reinforcement adheres firmly.	
5	Complete the process by applying vacuum to the tool to facilitate its removal from the pipe system. The tool should be pulled out in the direction that minimizes disturbance to the newly installed branch reinforcement, which in this example is downward.	

POST-WORK PROCEDURES FOR BRANCH REINFORCEMENT

To protect the tool and avoid spills on the surroundings or clothing, cover it with environmentally friendly plastic wrap before transporting it back to the work site.

After disassembly, the tool should be hung up for easy access and filled with compressed air to stretch out the bladder. Use a cloth to wipe down the tool and remove any remaining epoxy residue. If the tool will be reused according to the instructions outlined in the “Preparation of the Branch Reinforcement Tool” section, compress the tool and store it safely in its container.

If a reverse liner from the branch line needs to be installed, this should be done according to the open-end installation method described in another section of the manual. Ensure that there is an overlap between the reverse liner and the branch pipe to secure a tight and durable connection.

INSPECTION

After the installation of the Linerwaste system is complete, a thorough inspection must be conducted to ensure everything was executed according to plan. All-important observations should be recorded in the self-inspection form (see appendix). If any defects are discovered, they must be addressed immediately and carefully documented.

If necessary, a cutter system can be used to carefully remove any obstructions that the installation may have caused, such as creases or excess epoxy. Due to its design, the tool can selectively remove uneven areas with minimal impact on the rest of the liner.

All such corrections and actions must be thoroughly documented in the self-inspection form as part of the project's quality assurance process.

FINALIZING INSTALLATION

Once all renovation measures are completed and the documentation is prepared, the next step is to reconnect the pipelines at the exposed connection points. It is critical that this work be performed with precision and only with products specifically approved for this purpose to prevent future leakage issues. For this purpose, Relining Connections have been developed to prevent water ingress between the new liner and the existing pipe system.

When the water supply is restored, all faucets and toilets should be flushed to conduct a visual inspection for any leakage before the site is considered finalized. At the end of the project, all relevant documentation, including self-inspection forms and other records, is handed over to the client along with operation and maintenance instructions. The client must then approve and sign for the receipt of the work.

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

APPENDIX

SELF INSPECTION

Appendix 1 Self inspection

MATERIAL SAFETY DATA SHEET (MSDS)

Appendix 2 Material Safety Data Sheet Linerwaste Epoxy

PRODUCT INFORMATION

Appendix 3 Product information Linerwaste liner

Appendix 4 Product information Branch reinforcement