

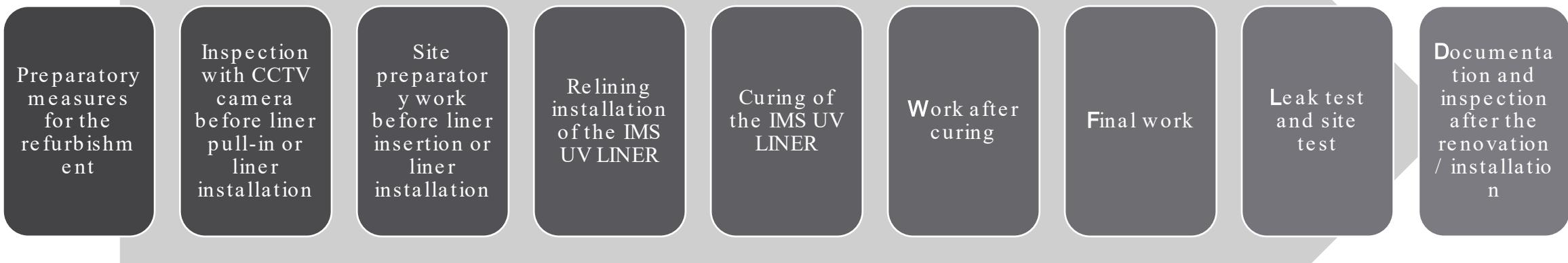
SEWERrehabilitation with UV
and previous removal of
obstacles with UHP water
jetting up to 2.500 bar



SEWER REHABILITATION PROCESS

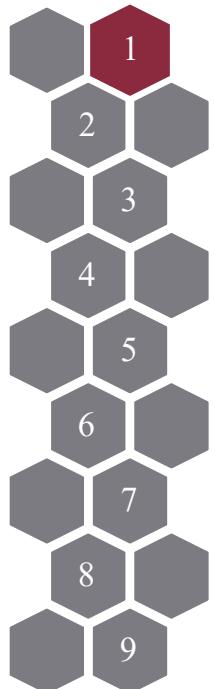
THE WORK STEPS OF PIPE REHABILITATION USING GLASSFIBER LINER

Optimum refurbishment is carried out in several steps. These are as follows:



SEWER REHABILITATION PROCESS

1) PREPARATORY MEASURES FOR THE RENOVATION



CONSTRUCTION SITE SAFETY

It is essential that the construction site is adequately secured before the renovation work begins. All necessary signage, diversions and barriers must be provided in a country - specific and professional manner.

Any closures must be notified to the relevant authorities in good time and agreed in advance.

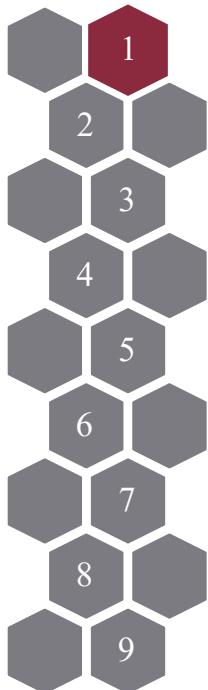
WATER CONTAINMENT

Depending on the type and dimensions of the sewer to be rehabilitated, the maintenance of the receiving water must be ensured. During installation, it must be ensured that the rehabilitation section is not in operation. If necessary, appropriate shut -off valves must be installed and the wastewater diverted.

Shut-off bladders must be installed with great care! The pressure generated by the dammed water can cause life -threatening situations!

SEWER REHABILITATION PROCESS

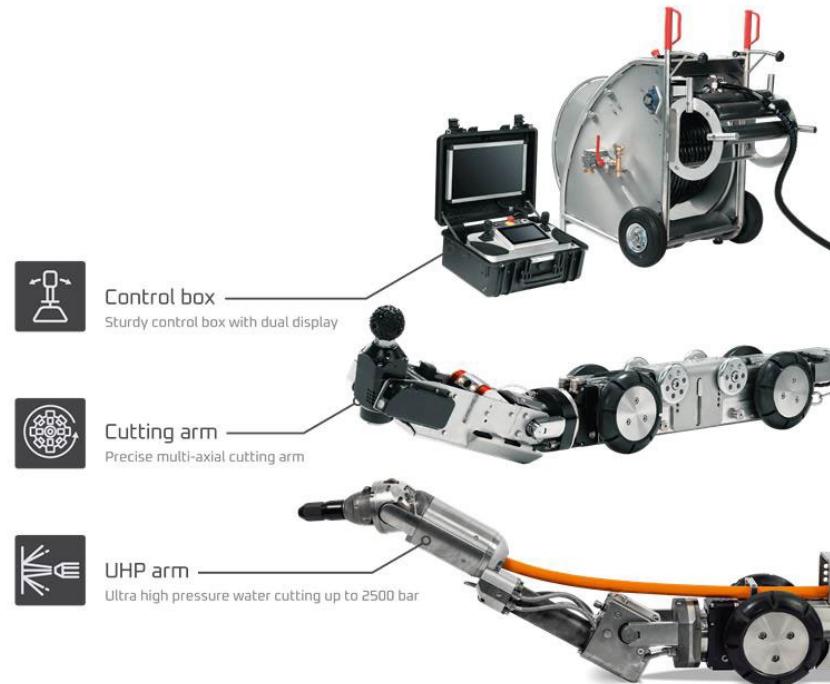
1) PREPARATORY MEASURES FOR THE RENOVATION



UHP & MILLING WORK

Obstacles such as root ingrowth, deposits, concrete, shards or socket displacements that prevent continuous pipe cleaning or could cause damage to the UV liner when it is pulled in must be removed by suitable robots.

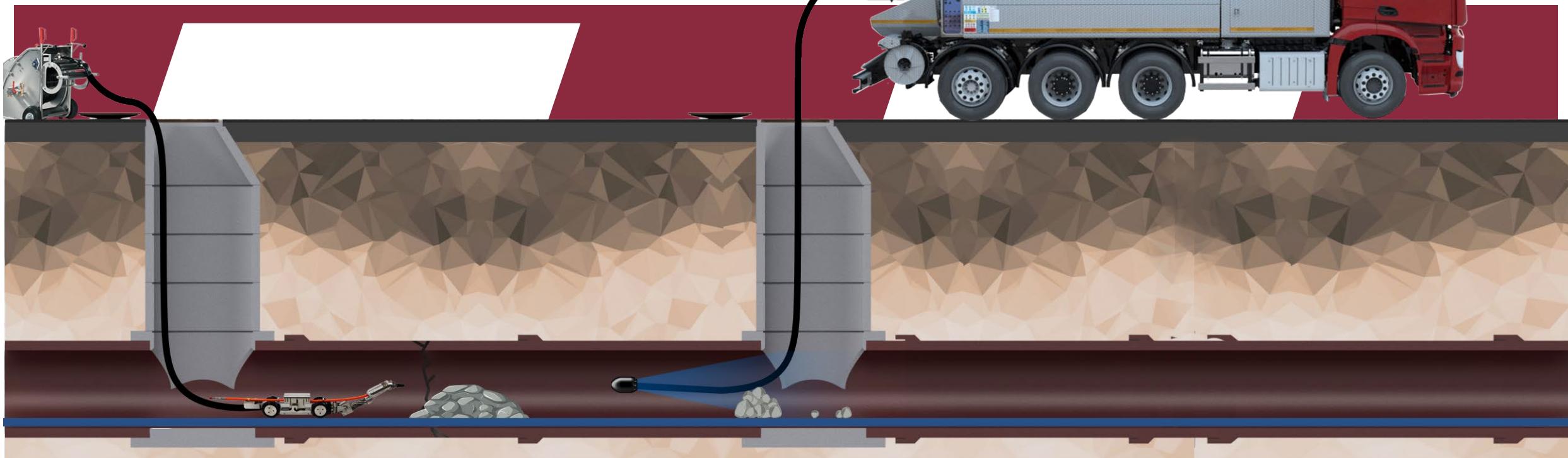
With Ultra High Pressure UHP water jetting, you are able to remove almost everything inside the pipe with up to 2500 bar. If there is anything left, you can do either finishing with a rotary nozzle or using the cutting robot from the same system



SEWER REHABILITATION PROCESS

UHP, MILLING & JETING

REMOVE EXTERNAL OBJECTS DIRT AND
OTHER DEPOSITS FROM THE PIPE



SEWER REHABILITATION PROCESS

2) Inspection with CCTV camera before liner pull-in or liner installation



CLEANING THE PIPE

The cleaning methods must be selected in such a way that further damage to the damaged sewer is avoided. As a rule, a high -pressure water and hydro -mechanical cleaning process is used to remove incrustations.

CCTV CAMERA INSPECTION & MASURING CONNECTIONS

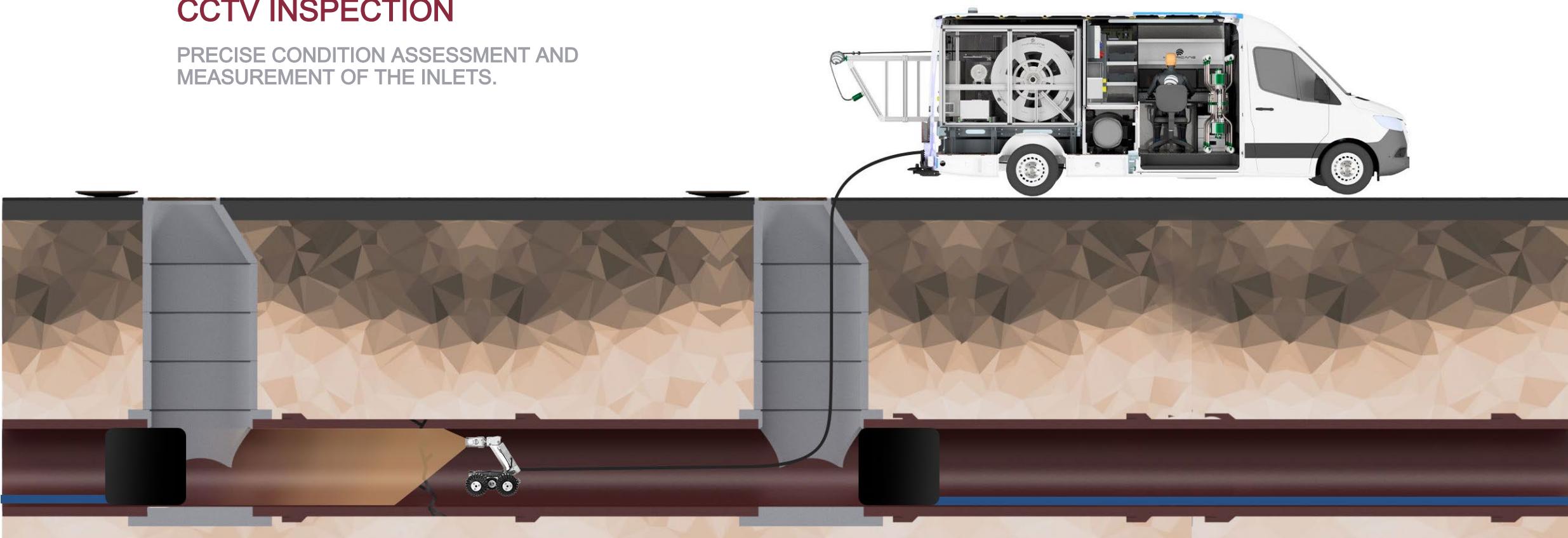
The CCTV inspection serves as a final check of the pipe to be rehabilitated before the liner installation. This CCTV inspection must be recorded in order to document that the sewer fulfils the necessary requirements for the rehabilitation measure.

Inlets must be measured precisely before installing the liner. This ensures that the inlets can be reopened after installation without drilling any incorrect holes. It has been proven in practice that the same person opens and reopens the connections.

SEWER REHABILITATION PROCESS

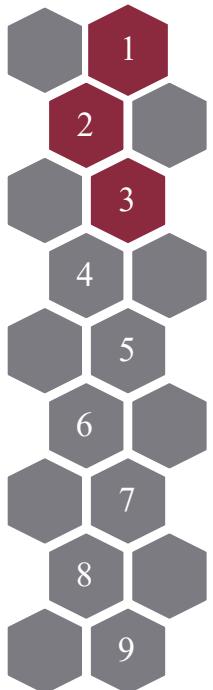
CCTV INSPECTION

PRECISE CONDITION ASSESSMENT AND
MEASUREMENT OF THE INLETS.



SEWER REHABILITATION PROCESS

3) Site preparatory work before liner insertion or liner installation



INSERTION OF THE SLIDING FOIL

After the CCTV inspection, a rope should be pulled into the pipe via the camera or the flushing equipment. This rope is used to pull the pull rope and the sliding film into the pipe. Check the position of the sliding foil after pulling it in.

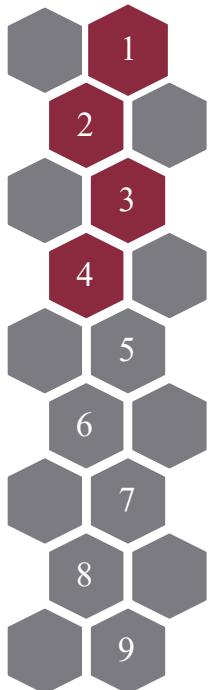
The sliding foil must be fastened in the initial manhole under a barrier bubble in the opposite manhole or at the bottom of the manhole with ground anchors. The film serves as a sliding and protective film for inserting the GRP LINER into the damaged wastewater pipe.

INTEGRATE LINER HEAD

Before the liner can be pulled in, a so -called 'pulling head/liner end' must be tied. The winch cable is then attached to this liner head with a DRALL CATCH. The liner must be folded to half its width before being lowered into the shaft. The folded liner is then handed over to an employee in the shaft.

SEWER REHABILITATION PROCESS

4) Relining installation of the UV LINER



PULL-IN OF THE UV LINER – STEP I.

The UV liner should remain in the transport packaging (wooden crate with protective film) for as long as possible to avoid unnecessary external influences. Please note that at low temperatures, the liner inner film loses its elasticity and the resin tends to delaminate (white crack).

The storage and processing temperatures of 5 – 25 °C must not be exceeded or fallen below. Please observe the UV -Liner accompanying label on the wooden crate. The inner temperature can be checked using an infrared measuring device.

An technician inserts the liner into the pipe and monitors the correct insertion. The liner is continuously pulled into the pipe to be rehabilitated in the direction of flow using a cable winch and the appropriate guide rollers.

The feed speed must never exceed 5 m/min. Furthermore, the dimension -dependent maximum pull -in forces must not be exceeded.

SEWER REHABILITATION PROCESS

4) Relining installation of the UV LINER



PULL-IN OF THE UV LINER – STEP II.

The cable winch continues to pull the liner in until the pulling head has reached approx. 30 - 40 cm into the downstream shaft. Depending on the shaft depth, the end of the liner is lowered into the shaft using a rope.

As soon as the liner has reached its final position, the retraction is complete, and the steel cable and pulleys can be removed.

Finally, the liner is cut off at the end shaft so that approx. 0.5 m of the liner still protrudes into the shaft.

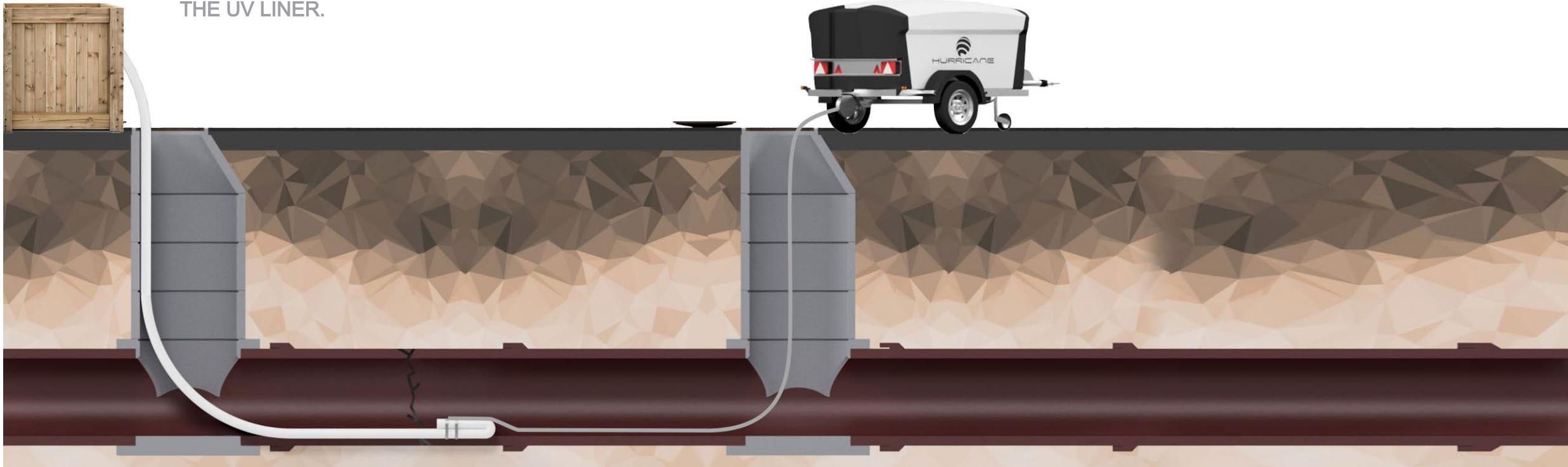
FITTING THE SUPPORT CAPS

Support caps must be fitted at the start of the liner, at the end of the liner. The support caps ensure that the liner does not overstretch and burst during installation in areas where it cannot be supported on the inner pipe wall.

SEWER REHABILITATION PROCESS

UV LINER PULL-IN START

SECURE STORAGE AND SAFE INSERTION OF
THE UV LINER.



SEWER REHABILITATION PROCESS

4) Relining installation of the UV LINER



ASSEMBLY OF THE UV LINER PACKER

The packer is now fitted to the initial shaft and secured with at least two tension belts. The curing rope can now be inserted into the liner. To do this, the packer is connected to the compressor and blower with compressed air.

At the end shaft, the liner must be pressed down so that it slowly rises. The curing rope must be replaced via the Kevlar thread inserted by the technician.

It is essential to ensure that the rope is pulled straight and not over the corner. Otherwise, there is a risk that the rope will cut through the inner film.

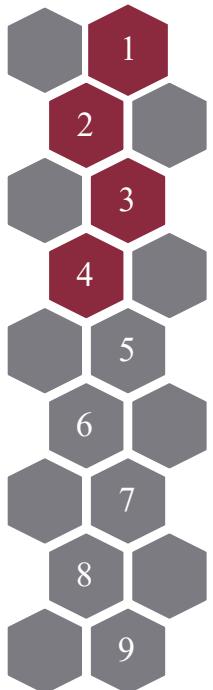
INSERTING THE IMS UV LIGHT SOURCE

The nominal width -related light source is now attached to the curing rope and lowered into the shaft. Compressed air is used to slightly raise the liner again so that the chain can be inserted without damaging the inner film.

The light source must be inserted into the liner with the utmost care. Care must be taken to ensure that the wheels or chain parts do not damage the inner film.

Once the UV light source has been installed, the packer can now be mounted in the end chute.

SEWER REHABILITATION PROCESS



4) Relining installation of the UV LINER

Once the UV packers have been installed in the start and end shaft and connected to the compressed air hose. The yellow outer foil must be cut open at the start and end shaft or cut off completely in dry positions.

In the intermediate shafts, an approx. 5 - 10 cm long longitudinal cut must be made in the outer liner film so that the air that was trapped when the packers were installed can escape.

SETTING/CALIBRATION UP THE UV LINER

Setting up with compressed air must be carried out in several steps. The liner is set up slowly and in stages at about **0.05-0.1 bar/min** until the working pressure is reached.

The working pressure must be maintained at a **constant level** during the entire curing phase!

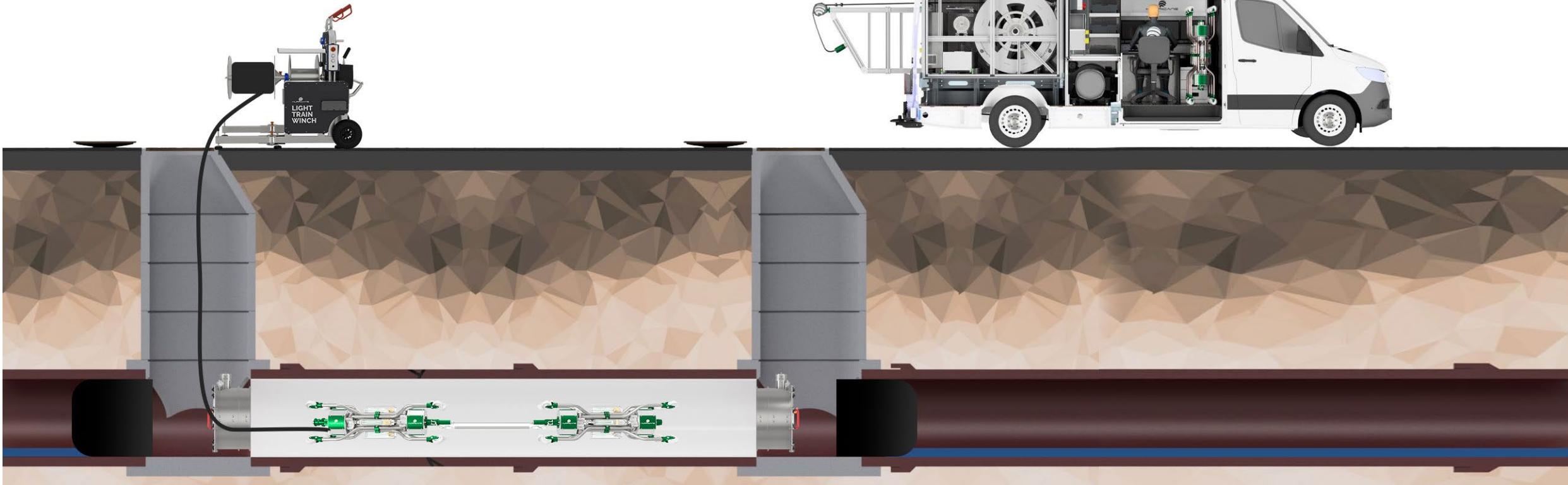
SWIPE OF THE IMS UV LIGHT SOURCE WITH CAMERA MONITORING

Once the working pressure has been reached, hold it for approx. five minutes to ensure that the liner has not been damaged when the UV light source is drawn in. During this time, you can begin to pull the light source, which is still switched off, into the start shaft. The liner must be visually inspected using a camera. This pulling through must also be documented by video recording.

SEWER REHABILITATION PROCESS

LIGHT TRAIN PULL-IN

INSTALLATION OF UV PACKERS AND
INSERTION OF LIGHT SOURCES.



SEWER REHABILITATION PROCESS

5) CURING OF THE UV LINER



CURING OF THE UV LINER

After the visual inspection, curing can begin by switching on the UV lamps and then moving the light source towards the target shaft. The ignition times, speeds and exposure times depending on the nominal width must be observed in accordance with the installation manual.

Furthermore, the speed and the measured temperatures must be continuously checked and recorded via the temperature sensors during the entire curing phase.

Once the light source has reached the end packer, switch off the lamps according to the table. This completes the curing of the UV LINER.

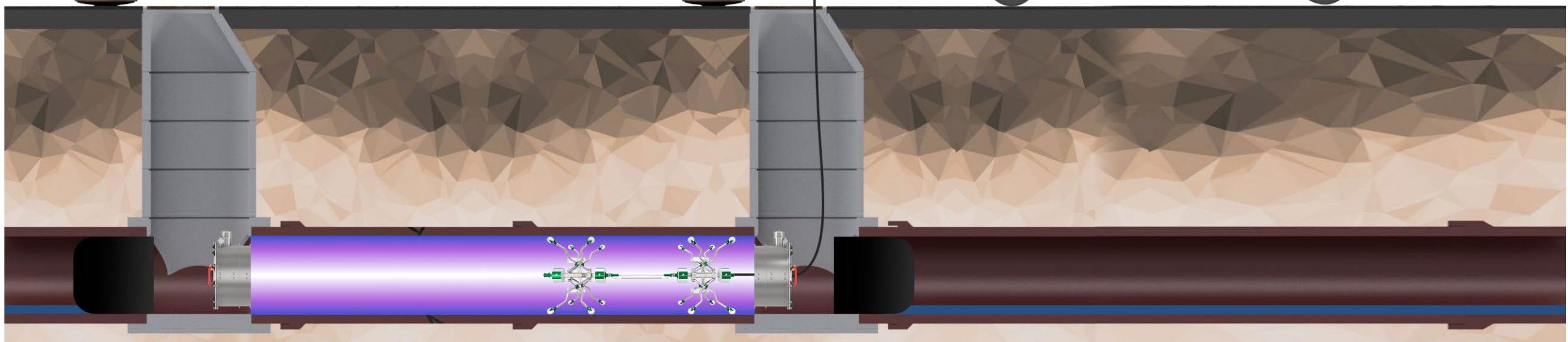
The entire installation and curing phase must be documented!

UV LINER IS INSTALLED.

SEWER REHABILITATION PROCESS

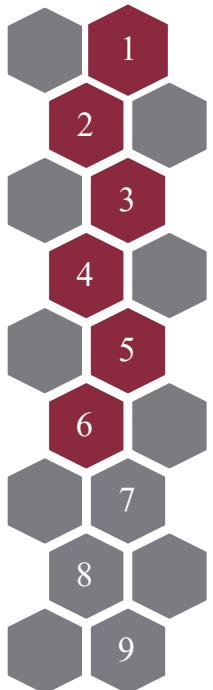
UV CURING PROCESS END

PASSAGE OF THE LIGHT SOURCE IN THE DIRECTION OF THE TARGET SHAFT - CURING IN THE UV LINER.



SEWER REHABILITATION PROCESS

6) WORK AFTER LINER CURING



REMOVING THE PACKER AND CUTTING OFF THE LINER

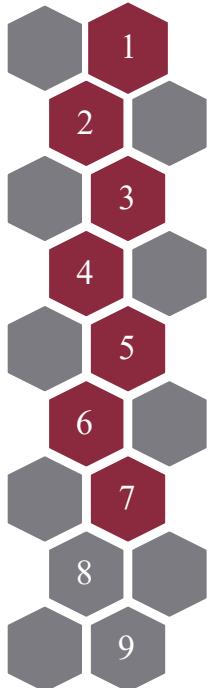
After the liner has cooled down gently (approx. ten minutes), the packers are removed. The liner is cut off at the pipe ends using an air flex. This area must later be connected to the old pipe using a suitable system.

REMOVING THE INNER FILM

The inner foil must be pulled out of the enclosure after cutting. To do this, a rope should be connected to the end of the inner film at the downstream shaft. The inner film is then pulled out by pulling the rope at the upstream shaft.

SEWER REHABILITATION PROCESS

7) LEAK TEST AND CONSTRUCTION SITE TEST



LEAK TEST

The posture -by-posture leak test serves as an intermediate test of the hardened liner before the side inlets are opened. The test with the corresponding test pressure, pressure drop, and test time must be carried out in accordance with DIN EN 1610.

CONSTRUCTION SITE SAMPLE

The representative sample is the reference for your **own work performance** and the **company's business card** .

In principle, every construction site sample must be visually inspected after it has been taken. The following points must be observed:

- The composite wall thickness must be checked after deducting the pure resin layers and the outer fleece!
- The surface of the test piece must not have any pores, wrinkles or blowholes!
- Sufficient UV irradiation / curing of the removal area must be ensured!
- The sample must not show any obvious abnormalities in the laminate!

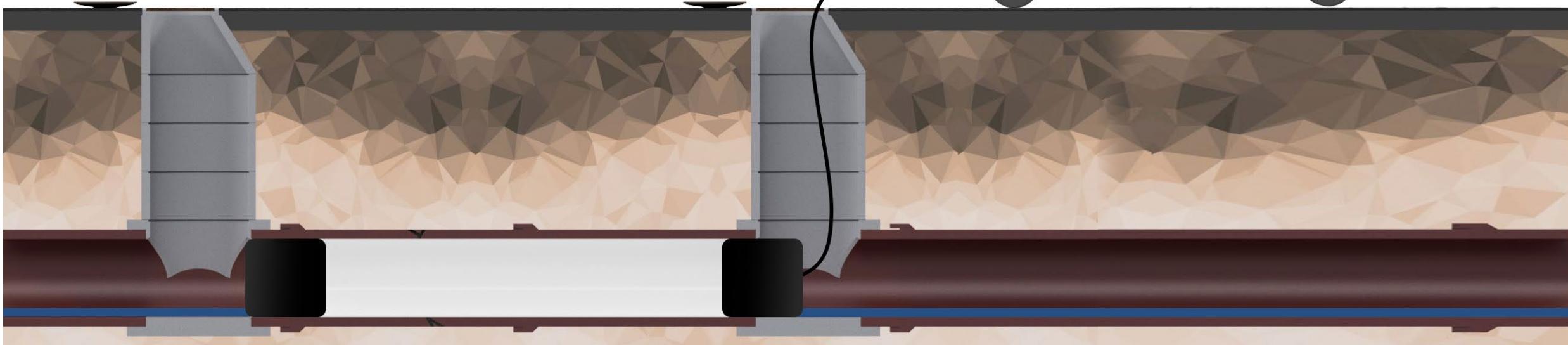
The samples are usually taken from the shaft area. If no representative sample is available in the manhole area, a sample must be taken from the mounting.

SEWER REHABILITATION PROCESS

PRESSURE TEST & FINAL WORKS

LEAK TEST. TAKING A SITE SAMPLE.

UV CONSTRUCTION SITE FINISHED.



SEWER REHABILITATION PROCESS

8) FINAL WORK

RESTORING THE INLETS

Compressed air or electrically operated milling robots under camera monitoring are used to restore the inlets. Once the original measuring points in the manhole have been aligned with the new pipe end, the user can start the milling work from the control and monitoring vehicle.

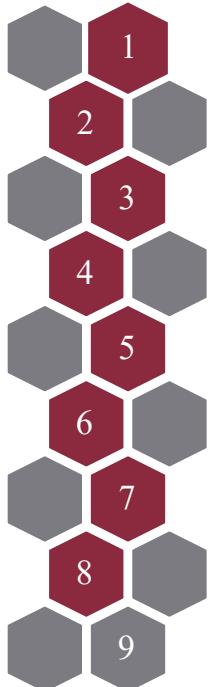
RENOVATION OF INLETS

If necessary, the inlets must also be rehabilitated using suitable methods such as top hat profile technology or injection methods.

CONNECTION OF THE LINER END

Various systems can be used to connect the liner to the old pipe. Systems for the watertight formation of the connection areas:

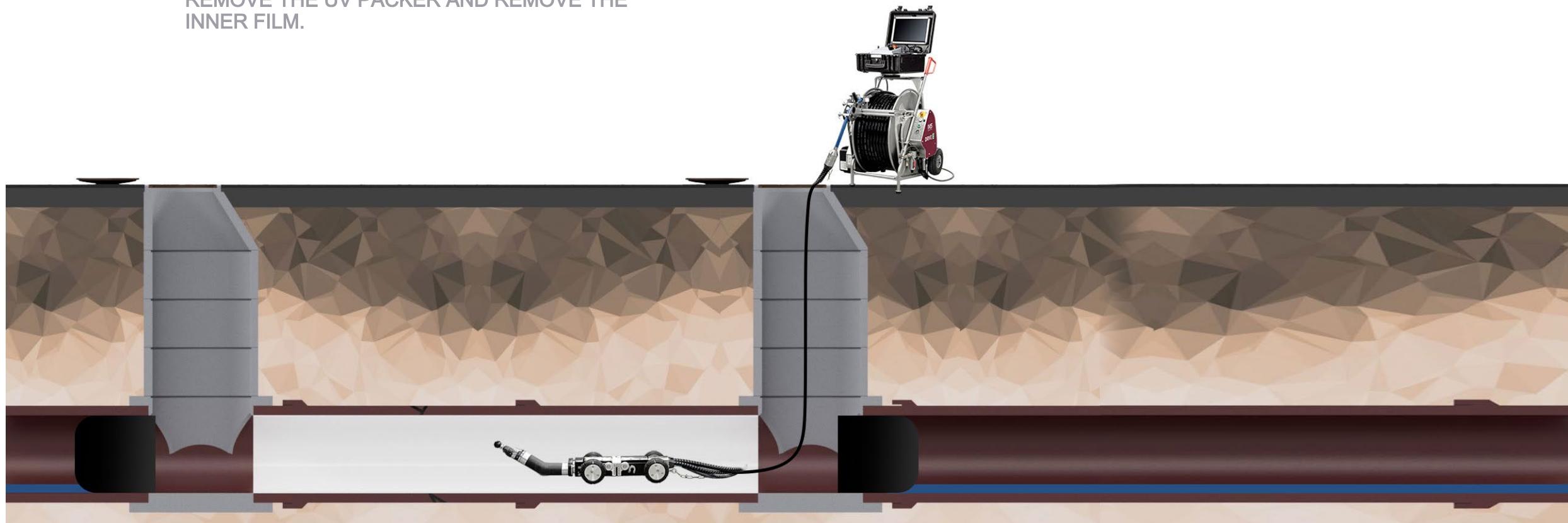
- Connection of the pipe liner using epoxy resin filler
- Bonding the tube liner using synthetic resin mortar
- GRP laminates- Grouting with PU or EP resins
- Installation of a pipe liner end sleeve



SEWER REHABILITATION PROCESS

FINAL MILLING & INSPECTION

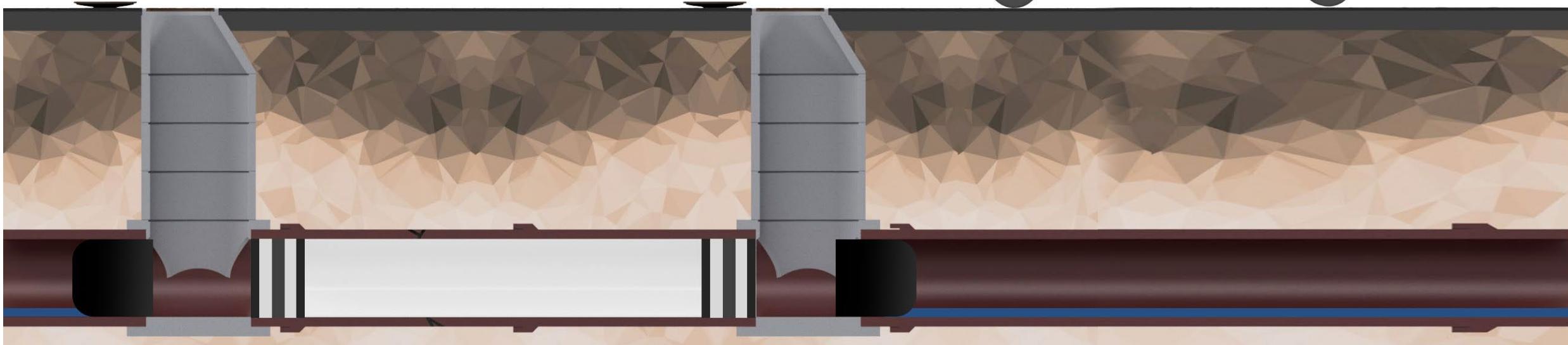
REMOVE THE UV PACKER AND REMOVE THE
INNER FILM.



SEWER REHABILITATION PROCESS

FINISHING & END SEAL INSTALLATION

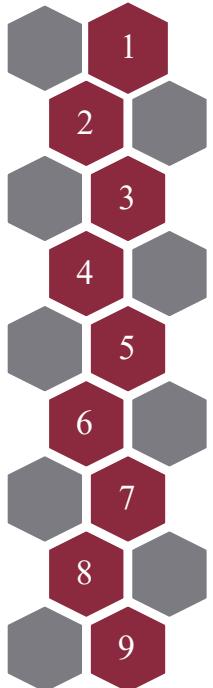
CONNECTION OF THE LINER END.



SEWER REHABILITATION PROCESS

9) DOCUMENTATION AND INSPECTION AFTER THE RENOVATION/INSTALLATION

DOCUMENTATION



Once the work has been completed, the pipe is flushed, and the rehabilitated pipe section is then visually inspected. This TV inspection serves as proof that the rehabilitation has been carried out correctly. Furthermore, appropriate markings should be made at the start and end manholes.

- UV LINER / UV CURING
- Casing designation
- Nominal diameter and wall thickness of the IMS UV Liner
- Date of installation
- Documentation and testing

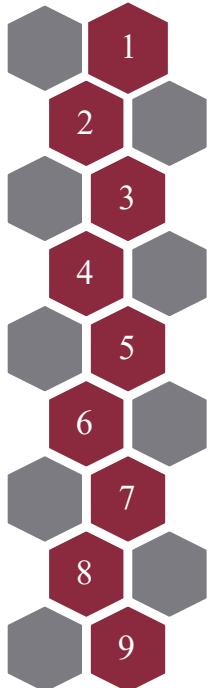
SEWER REHABILITATION PROCESS

9) DOCUMENTATION AND INSPECTION AFTER THE RENOVATION/INSTALLATION

DOCUMENTATION DURING UV CURING

The following parameters must be recorded during installation:

- Pull-in forces
- Installation pressures
- Working pressures
- Temperatures measured
- Draw-through speed of the IMS UV LIGHT SOURCE



TESTING OF CONSTRUCTION SITE SAMPLES IN THE LABORATORY:

- Modulus of elasticity and flexural strength
- Wall thickness
- Water tightness.

In principle, a retained sample (construction site sample) must be archived in the company for the duration of the warranty period.

SEWER REHABILITATION PROCESS

RESULT



RESULT



RESULT





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