TRELLEBORG
ENGINEERED SYSTEMS

Manual of Procedure epros®DrainPacker
For Trenchless Repair of Damaged Buried Sewer Lines

General Technical Approval by the German Institute for Construction Engineering (DIBt) No. Z-42.3-385
Quality Protection in Sewer Construction : Güteschutz Kanalbau e.V. – Quality Mark No. S15.16

epros® DRAIN PACKER

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Manual of Procedure

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epros® DRAIN PACKER

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Introductory Remark

In trenchless rehabilitation methodology, a general distinction is made between sectional or part repairs by means of patch or short liners and complete renovation of sewers and pipe runs using the cured-in-place pipe lining techniques.

The sectional repair of non man-entry sewer lines with the help of short liners has established itself as a sophisticated economical and technical alternative to traditional repair techniques with digging.

This method is meanwhile a proven economical method for extending the remaining service lives of pipe runs in need of spot repairs until full-scale renovation will be required.

A basic condition is that the materials used in sectional repairs are suitable for this type of application and that the installation process meets stringent quality criteria.

I Applications

The epros®DrainPacker method is suitable for the sectional repair of buried damaged gravity sewer pipes and pressurized pipelines. The process provides structural repair with a frictional fit in sewer pipes of public and private sewage systems. Repairable pipe sizes range between DN 50 and DN 1200 (General Technical DIBt Approval for DN 100 to DN 800) and include diverse egg-shaped cross-sections.

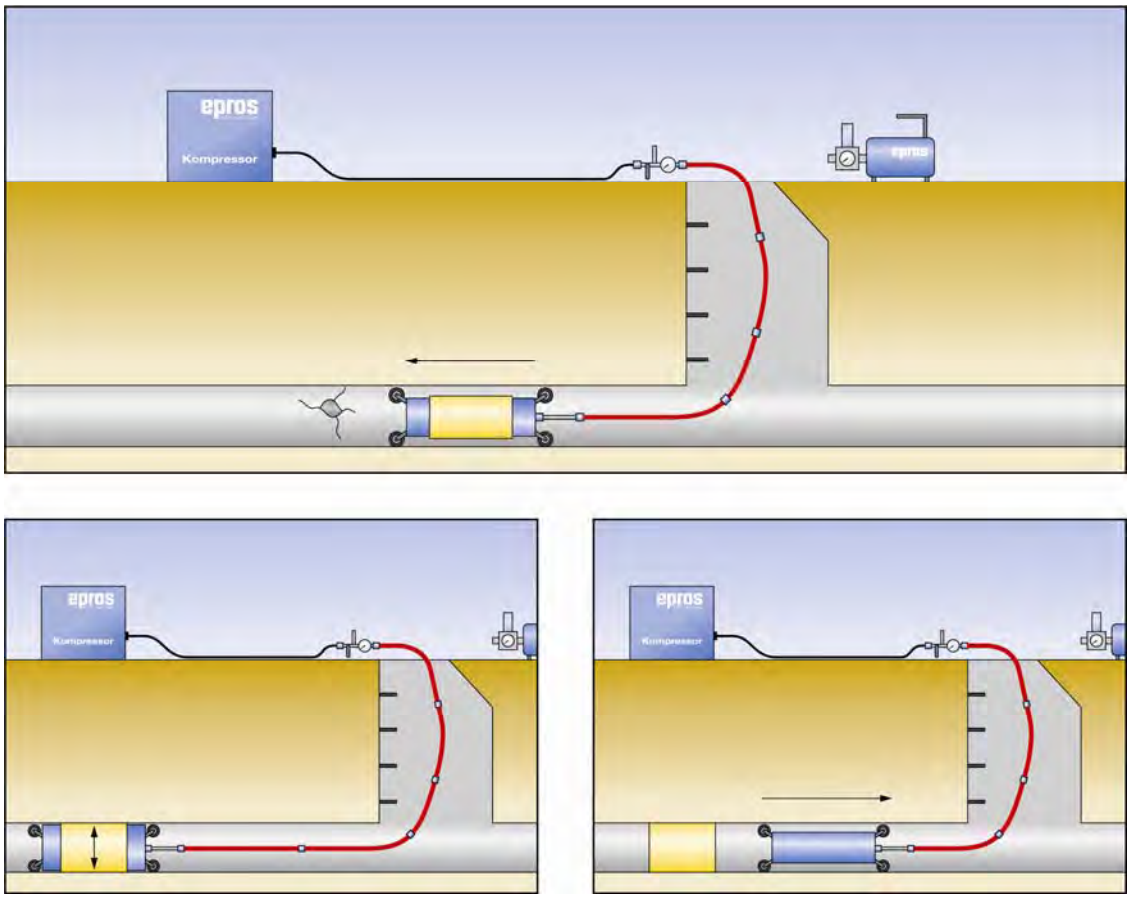
Repair lengths are between 0.5 metres and about 5 metres, depending on the packer design (please refer to the related operation and maintenance manual of the packer).

For repair lengths exceeding 5 metres, it is possible to use the epros®DrainPacker process in an overlapping approach, but it is important not to change the at least 3-layered fibreglass mat construction.

Longer pipe segments need to be repaired from pipe joint to pipe joint. Circular and egg-shaped pipes in concrete, asbestos cement, plastics (PVC, PP, HDPE), cast iron, ductile cast iron, reinforced concrete and vitrified clay can be repaired.

Lateral junctions that will no longer be used can be obstructed.

The Method at a Glance



A renovation packer carrying a wrapped-around resin-wetted fibreglass mat is pushed with the help of air push rods or pulled by means of a rope to the point of repair. The exact position of the point in need of repair is determined beforehand by TV inspection.

When the epros®DrainPacker has reached the correct position, it is gradually inflated by means of compressed air. This causes the packer to expand towards the pipe wall and press the impregnated fibreglass mat in a tight fit against the host pipe with excessive reaction resin penetrating into the damage. This creates a permanent bond between the fibreglass mat and the host pipe wall.

The resin-impregnated fibreglass mat will be cured at ambient temperature according to the resin manufacturer's instructions. The required cure times depend on the climatic conditions in the sewer.

After complete cure of the reaction resin, the packer is deflated and removed from the pipe.

The cured fibreglass mat covers the full area of the repaired pipe section without obstructing the service flow. The pipe-in-pipe system thus created forms an integral system with the host pipe and fully meets the hydraulic requirements.

In the end, the repaired pipe section will be inspected and documented with a CCTV camera. The leakage test will be performed according to EN 1610.

Damage Evaluation

As mentioned in the beginning, the epros®DrainPacker process was designed as a trenchless sectional repair method for performing spot repairs in sewer pipes by means of short liners.

To come to a conclusion whether or not a given damage qualifies for the sectional repair process or would require a manhole-to-manhole relining job, it is indispensable to pass a TV camera through the pipe run in a first step.

The sectional repair method can be used for renovating damages up to a continuous length of about 5 metres in the pipe or joint area. For repair lengths exceeding 5 metres, the epros®DrainPacker process can be used in an overlapping approach.

Damage Types

The epros®DrainPacker method is suitable for the following types of damage:

- Leakage with or without groundwater infiltration or exfiltration at pipe joints, pipe walls, junctions, etc.
- Offset pipes, cracks and debris, ruptures
- Mechanical wear
- Corrosion

ATTENTION! 	The epros®DrainPacker process cannot be used for repairing extreme offsets, collapsed pipes, large cross-sectional reductions in conjunction with bedding problems and longitudinal cracks of pipe connections.

Calculation and Final Proof

If the Client requires proof of structural integrity, a preparatory structural calculation of the short/long liners according to Worksheet ATM M 127-2 will be made before starting the job. Said calculations may be submitted for verification to a generally accepted independent institute. Further proof and documentary evidence regarding the performance and result of the repair job will be generated within the scope of self-assessment and self-control (refer to page 17 -> “Self-Control”).

Operating Conditions

- The leakage test will be performed according to EN 1610 and thus meet the requirements laid down therein.
- Resistant to pH range 3 to 12.
- Withstands sewage temperatures up to 85 °C.
- Abrasion resistance according to DIN 19545-1.
- Future sewer cleaning operations must always observe the instructions given in Worksheet ATV 143-7.
- Maximum cleaning pressure: 80 bar.
- Maximum cleaning speed: 0.3 m/s. Flush nozzle design with maximum 270 l/min.

II Job Preparation

Equipment / Materials

The installer must provide:

- Compressor
- Power generating set
- Equipment for service flow management
- Sewer cleaning accessories
- Sewer inspection equipment
- Cutting robot or mechanical pipe cleaning device
- Inflatable pipe plugs
- Material for sampling
- Personal protective equipment
- Usual hand tools (screwdriver etc.)
- Equipment for site safety and accident prevention according to applicable regulations

Components of the epros®DrainPacker method

Trelleborg epros offers various lining packers including accessories and required consumables, which are geared to the needs of a given application and designed for easiest handling with optimal lining results.

Section V gives a summary of all components for the implementation of the method.

The functional description of the packers can be found in the operation and maintenance manual of the given model.

The method description also refers to the following epros®DrainPacker materials:

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CRF fibreglass matting
Trade name:
epros®FibreGlassMat CRF (+) 1050g/m²
epros®FibreGlassMat CRF (+) 1400g/m².

IMPORTANT! 	Detailed information ➔ Safety Data Sheets (Appendix) epros®FibreGlassMat CRF (+) 1050 g/m² epros®FibreFlassMat CRF (+) 1400 g/m².

Hardener
Trade name:
epros®Hardener for resin types W01, W, S, L30E1, L30E3

IMPORTANT! 	Detailed information ➔ Safety Data Sheet (Appendix) epros®Hardener for silicate resins W01, W, S, L30E1, L30E3 (Component A)

Resins
Trade names:
a epros®ResinType W01
b epros®ResinType W
c epros®ResinType S

IMPORTANT! 	Detailed information in the Appendix ➔ Safety Data Sheet epros®ResinType W01 (Component B) ➔ Safety Data Sheet epros®ResinType W (Component B) ➔ Safety Data Sheet epros®ResinType S (Component B)

ATTENTION! 	Observe the storage temperatures and shelf lives of resins and hardeners. ➔ Safety Data Sheets in the Appendix

Job Preparation Measures

Site Safety
Site safety measures must comply with the generally applicable rules and regulations. The installer is solely responsible for site safety.

Site Visit

1. Inspect and record the damages with a TV camera (➔ Chapter“Damage types”, page 9). When doing so, also record the positions of lateral connections to be re-opened after lining. Note this in the site report ➔ Appendix

2. Define/check:

   - Length to be repaired (e.g. 0.5 m)
   - Distance of point of repair from beginning of pipe run
   - Pipe diameter (e.g. DN 150)
   - Loads and condition of the pipe
   - Temperature conditions
   - Sewer depth
   - Exact position of lateral connections

3. Diverse camera systems are equipped with length meters to determine the accurate lining position. We recommend the following procedure:

   - Position the camera at the very centre of the damaged section.
   - Read the length meter (if this option is available).
   - Use adhesive tape to mark the camera connection cable at the starting point of the pipe run.
   - Withdraw the camera from the pipe and measure the length of the cable from the adhesive tape mark to the lens of the camera.

4. Make sure the site is accessible.

5. Fix the period for the lining job. Within such period, no sewage shall be allowed to be discharged into the pipe section to be repaired. Take preparatory measures to ensure this.

6. Check the entire equipment.

7. Mill off any flow obstacles that might cause damage to the packer during installation.

8. For ensuring a permanent bond with the host pipe, the wall of the host pipe must be cleaned and given a preparatory treatment immediately before the installation of the short or long liner. Take care to remove any grease or other residues from the pipe wall surface.

   For smooth-walled pipes such as vitrified clay pipes, it is important to prepare the walls by grinding. Concrete pipes and pipes with similar surface structure must be prepared by milling. Said preparatory grinding or milling operation should be performed at least in the two end regions of the short or long liner as follows: Nominal diameter (DN) divided by two – but in any case no less than 300 mm (according to Worksheet ATV-DVWK-M 143 Part 7 Section 4.4.1)

9. The complete pipe section to be repaired must be properly cleaned before the lining operation is started.

III Step by Step Procedure

IMPORTANT! 	To provide a high-quality lining job (repair) it is imperative to follow the instructions described below. All lining operations will be documented for quality assurance purposes ➔ Preparation & Installation Report.

Packer Preparation

Define the packer you need (model, length and diameter). Remember that the repair length of the fibreglass mat should never exceed the maximum contact pressure area of the chosen packer. Please refer to Chapter 3 “Technical Data” in the operation and maintenance manual of the packer.

Adjust the wheel sets of the epros®DrainPacker to the given nominal diameter.
(➔ Instructions for Packer Wheel Set Adjustments).

ATTENTION! 	Improper wheel set adjustments can cause complications during packer installation and impair the final quality of the liner.

ATTENTION! 	When using long or lateral packers, please follow the instructions given in the section “Protection of epros®FibreGlassMats CRF (+)”.

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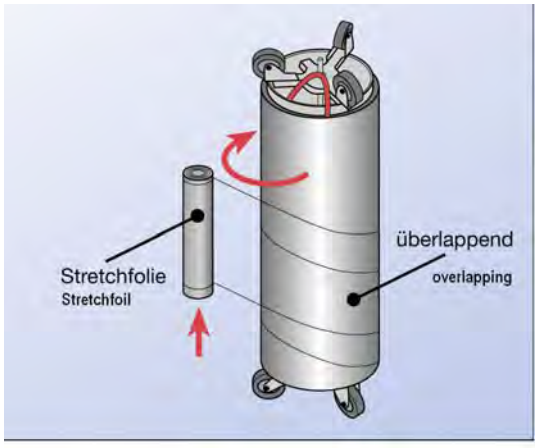
Check the epros®DrainPacker for proper operation and protect the rubber body by lubricating the entire surface with epros®SeparatingAgent.

Also wrap separating PE stretch foil around the entire epros®DrainPacker by overlapping the wraps and fix both ends with adhesive tape.



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Calculation of Required Fibreglass Amount

IMPORTANT! 	In case of need, add additional impregnated epros®FibreGlassMats CRF(+) to the at least 3-layered construction (for epros®FibreGlassMat CRF(+) 1050 g/m²) or to the at least 2-layered construction (for epros®FibreGlassMat CRF(+) 1400 g/m²), Refer to the section “Insertion of additional epros®FibreGlassMats CRF (+)”

Chart for resin usage amounts and format sizes for epros®FibreGlassMats CRF (+) 1050g/m²
Resin system: epros®SilicateResins W01, W and S

Pipe diam.	Fibreglass mat CRF(+) 1050 g/m²						Resin system amount	Water glass	Resin	Fibreglass layers
	Circum-ference	Fibreglass roll width	Surface area	Surface area	Resin system factor	Calcu-lation	(Comp. A + B)	Comp. A	Comp. B	single wraps
mm	**mm**		**m²**	**m²**	**Litre/m²**		**Litre *2**	**Litre**	**Litre**	
100	350	1.27m	0.44		1.6	0.70	0.75	0.25	0.50	3
125	450	”	0.57		1.6	0.91	0.90	0.30	0.60	3
150	550	”	0.70		1.6	1.12	1.20	0.40	0.80	3
200	700	”	0.89		1.6	1.42	1.50	0.50	1.00	3
225	800	”	1.02		1.6	1.63	1.65	0.55	1.10	3
250	900	”	1.14		1.6	1.82	1.80	0.60	1.20	3
300	1100	”	1.40		1.6	2.24	2.40	0.80	1.60	3
350	1250	”	1.59		1.6	2.54	2.70	0.90	1.80	3
375	1320	”	1.68		1.6	2.69	2.85	0.95	1.90	3
400	1400	”	1.78		1.6	2.85	2.85	0.95	1.90	3
450	1580	”	2.01		1.6	3.22	3.30	1.10	2.20	3
500	1750	”	2.22	0.875	1.6	4.95	5.20	1.70	3.40	4
525	1840	”	2.34	0.92	1.6	5.22	5.40	1.80	3.60	4
600	2100	”	2.67	1.05	1.6	5.95	6.00	2.00	4.00	4
675	2400	”	3.05	2.40	1.6	8.72	9.00	3.00	6.00	5
700	2500	”	3.18	2.50	1.6	9.09	9.30	3.10	6.20	5
750	2650	”	3.37	2.65	1.6	9.63	9.60	3.20	6.40	5
800	2850	”	3.62	4.28	1.6	12.63	12.60	4.20	8.40	6

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Chart for resin usage amounts and format sizes for epros®FibreGlassMats CRF (+) 1400g/m²
Resin system: epros®SilicateResins W01, W and S

	Fibreglass mat CRF(+) 1400 g/m²								Resin system amount[1]	Water glass[1]	Resin[1]
Pipe diam.	Circum-ference D x 3.5	Repair length example	Num-ber of layers	Add. lay-ers/n	Cut size length x width	Cut size of additonal layer/n	Total area[1]	Resin amount factor	Compo-nents A and B	Comp. A	Comp. B
mm	m	m	units	units	m	m	m²	Litre/m²	Litres	Litres	Litres
100	0.350	1	2	0	2.01 x 0.35	n.a	0.70	1.8	1.35	0.45	0.90
125	0.450	1	2	0	2.01 x 0.45	n.a	0.90	1.8	1.65	0.55	1.10
150	0.550	1	2	0	2.01 x 0.55	n.a	1.10	1.8	2.10	0.70	1.40
200	0.700	1	2	0	2.01 x 0.70	n.a	1.40	1.8	2.55	0.85	1.70
225	0.800	1	2	0	2.01 x 0.80	n.a	1.60	1.8	3.00	1.00	2.00
250	0.900	1	2	0	2.01 x 0.90	n.a	1.80	1.8	3.30	1.10	2.20
300	1.100	1	2	0	2.01 x 1.10	n.a	2.20	1.8	3.90	1.30	2.60
350	1.250	1	2	0	2.01 x 1.25	n.a	2.50	1.8	4.50	1.50	3.00
375	1.320	1	2	0	2.01 x 1.32	1.0 x 1.32	4.00	1.8	7.20	2.40	4.80
400	1.400	1	3	1	2.01 x 1.40	1.0 x1.40	4.20	1.8	7.65	2.55	5.10
450	1.580	1	3	1	2.01 x 1.58	1.0 x 1.58	4.80	1.8	8.70	2.90	5.80
500	1.750	1	3	1	2.01 x 1.75	1.0 x 1.75	5.30	1.8	9.60	3.20	6.40
525	1.840	1	3	1	2.01 x 1.84	1.0 x 1.84	5.55	1.8	9.90	3.30	6.60
600	2.100	1	4	2	2.01 x 2.10	1.0 x 2.10	8.40	1.8	15.00	5.00	10.00
675	2.400	1	4	2	2.01 x 2.40	1.0 x 2.40	9.60	1.8	17.40	5.80	11.60
700	2.500	1	4	2	2.01 x 2.50	1.0 x 2.50	10.0	1.8	18.00	6.0	12.0
750	2.650	1	5	3	2.01 x 2.65	1.0 x 2.65	13.25	1.8	24.00	8.0	16.00
800	2.850	1	5	3	2.01 x 2.85	1.0 x 2.85	14.30	1.8	25.80	8.60	17.20

Legend[1]: Rounded values for ease of dosing.

IMPORTANT!

The factor for calculating the circumference for packer overlap: pipe diameter (D) x 3.5

Overlap allowance for 2-layered fold:
1 cm

Cut size of additional layer/n:
Repair length (m) x diameter (m) x 3.5 = area (m²)

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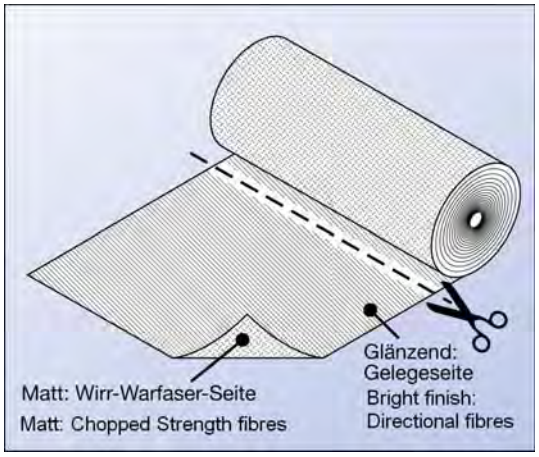
Cutting the Fibreglass Mat



Cut the required fibreglass mats to size and place them onto the sheeting with the woven side up (glossy long-fibred side – see picture above). The side with the random-laid fibres (short max. 5-cm-long fibres) must always face the service flow after installation in the sewer.

No less than 3 layers must be used for the epros®FibreGlassMat CRF(+) 1050 g/m², and no less than 2 layers for the epros®FibreGlassMat CRF(+) 1400 g/m²,

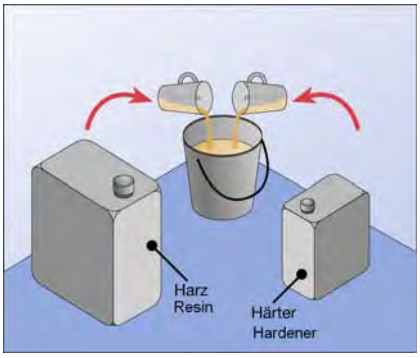
Calculation of Resin Usage Amount

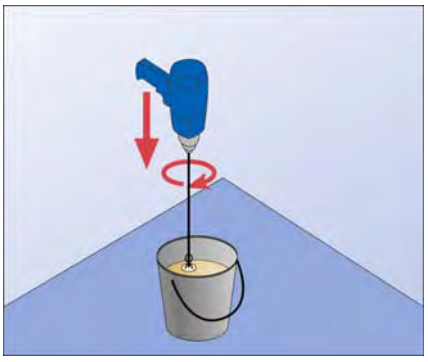
Calculate the required amount of resin on the basis of the aforesaid epros® charts for resin usage amounts and cut sizes. Make appropriate allowance for local circumstances like temperature etc.

Mixing the Resin

ATTENTION! 	• Silicate resins can release CO2. • The resin (component B) shall not come into contact with water or grease (oil) before mixing. • Use personal protective equipment as prescribed and observe the safety data sheets.
ATTENTION! 	• The pot time starts immediately after the components are mixed. It largely depends on the amount of resin used and on the prevailing temperature. Larger resin amounts may cause the pot time to be four times shorter than indicated, as given for the theoretic pot time. • Never mix amounts of more than 15 litres per bucket. • For pipe diameters above DN 400, mix the resin system in two steps. • Mixing ratio (by volume) for epros®SilicateResins: 2 parts of resin (component B) to 1 part of hardener (component A). Example: Total volume of 3 litres = 2 litres of resin (B) : 1 litre of hardener (A) • Measure the exact amount of resin. • Clean the locks of the resin containers thoroughly after use and close the containers properly. • Make sure no water ever penetrates into the containers. • Store the resin and hardener containers in compliance with the information contained in the Safety Data Sheets.

Pour the required amount of resin in a bucket and mix slowly and thoroughly without any air entrapment until the mixture shows a uniform colour. Observe the minimum mixing time according to the handling instructions of the resin.





Pot times

epros®Resin type W & type S data

Mixing ratio by volume					
No.	Comp. A epros®Hardener (water glass)	Comp. B **epros®Resin Type W**	Comp. B **epros®Resin type S**	Pot time at 20 °C (min)	Cure time at 15 °C (min)
1	3	6	-	15	115
2	3	5	1	18	120
3	3	4	2	21	140
4	3	3	3	25	165
5	3	2	4	28	180
6	3	1	5	31	200
7	3	-	6	32	260

Cure temperature of 15 °C in the sewer pipe.

epros®Resin type W01 data

Mixing ratio by volume						
No.	Comp. A apros®Hardener (water glass)	Comp. B epros®Resin type W01	Pot time at 10°C	Pot time at 22°C	Cure time at 12°C (min)	Cure time at 20°C (min)
1	1	2	13-15	4.5 – 7.5	35	20

ATTENTION! 	As this type is a highly reactive silicate resin, it should be used only in cold seasons by installers specifically trained by Trelleborg epros.

Impregnating the Fibreglass Mat

Wet the entire surface of the fibreglass mat thoroughly with a suitable tool (e.g. filling knife). In doing so, make sure:

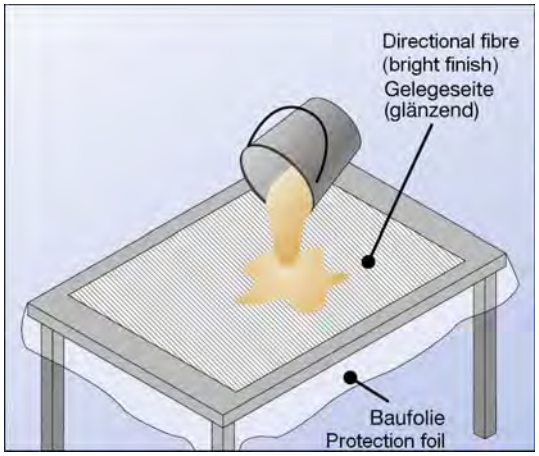
- the corners and edges of the fibreglass mat are thoroughly impregnated
- there is no fibre lift
- to press the epros®ResinSystem firmly into the epros®FibreGlassMat CRF(+) with the filling knife
- to properly fill the epros®FibreGlassMat CRF(+) and smooth away any air bubbles by moving the knife all over the mat.

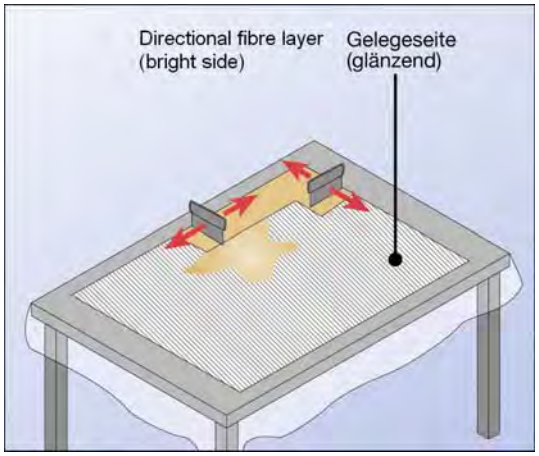
ATTENTION! 	In case of ambient temperatures more than 25°C or less than 5°C, impregnate the material in the truck or in an air-conditioned room. Impregnation is not allowed at ambient temperatures below 5°C or above 25°C. • The fibreglass mat must be absolutely dry. • Record the impregnation ➔ Preparation & Installation Report (Appendix)

Folding of epros®FibreGlassMat CRF (+) 1050 g/m²

The following describes the impregnation process for a 0.5-metre-long epros®DrainPacker by way of example. Lengths exceeding 0.5 metres shall be lined in a similar way.

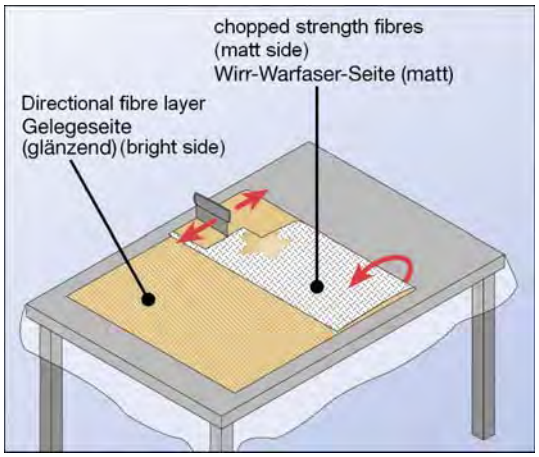
The first step is to spread the fibreglass laminate on a base sheeting with the woven side up. Then impregnate the entire surface of the epros®FibreGlassMat CRF+.



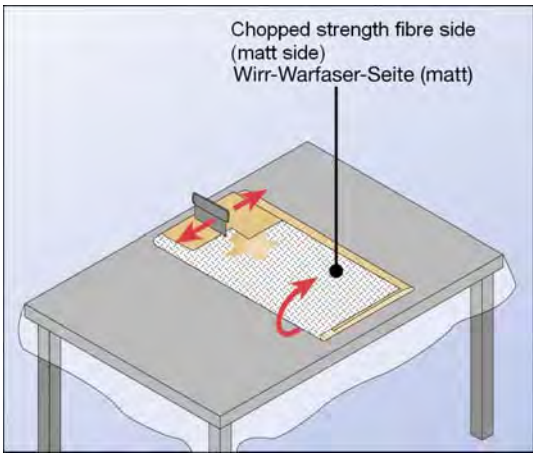


Wet out the epros®FibreGlassMat CRF(+) 1050 while folding it into three layers.

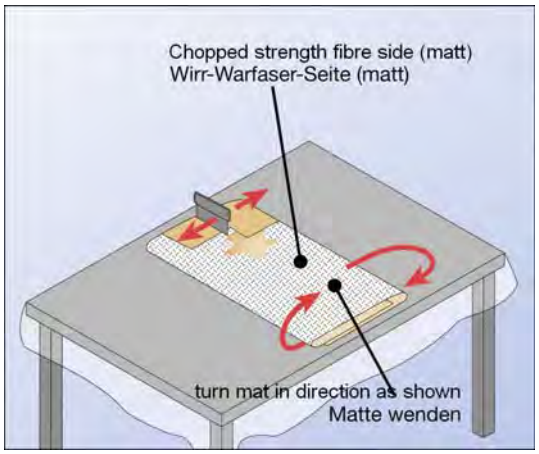
Right-hand fold



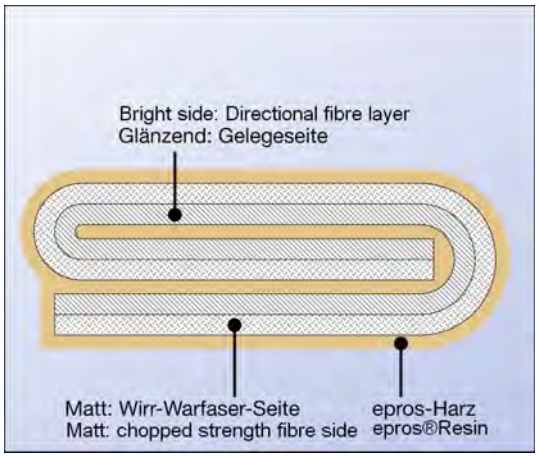
Left-hand fold



Turn the fibreglass mat and wet out the reverse side



Fibreglass mat fully impregnated and folded



IMPORTANT!	
	The impregnation process for epros®FibreGlassMat CRF(+) 1400 g/m² is the same as for epros®FibreGlassMat CRF(+) 1050 g/m², just the folding technique is different.

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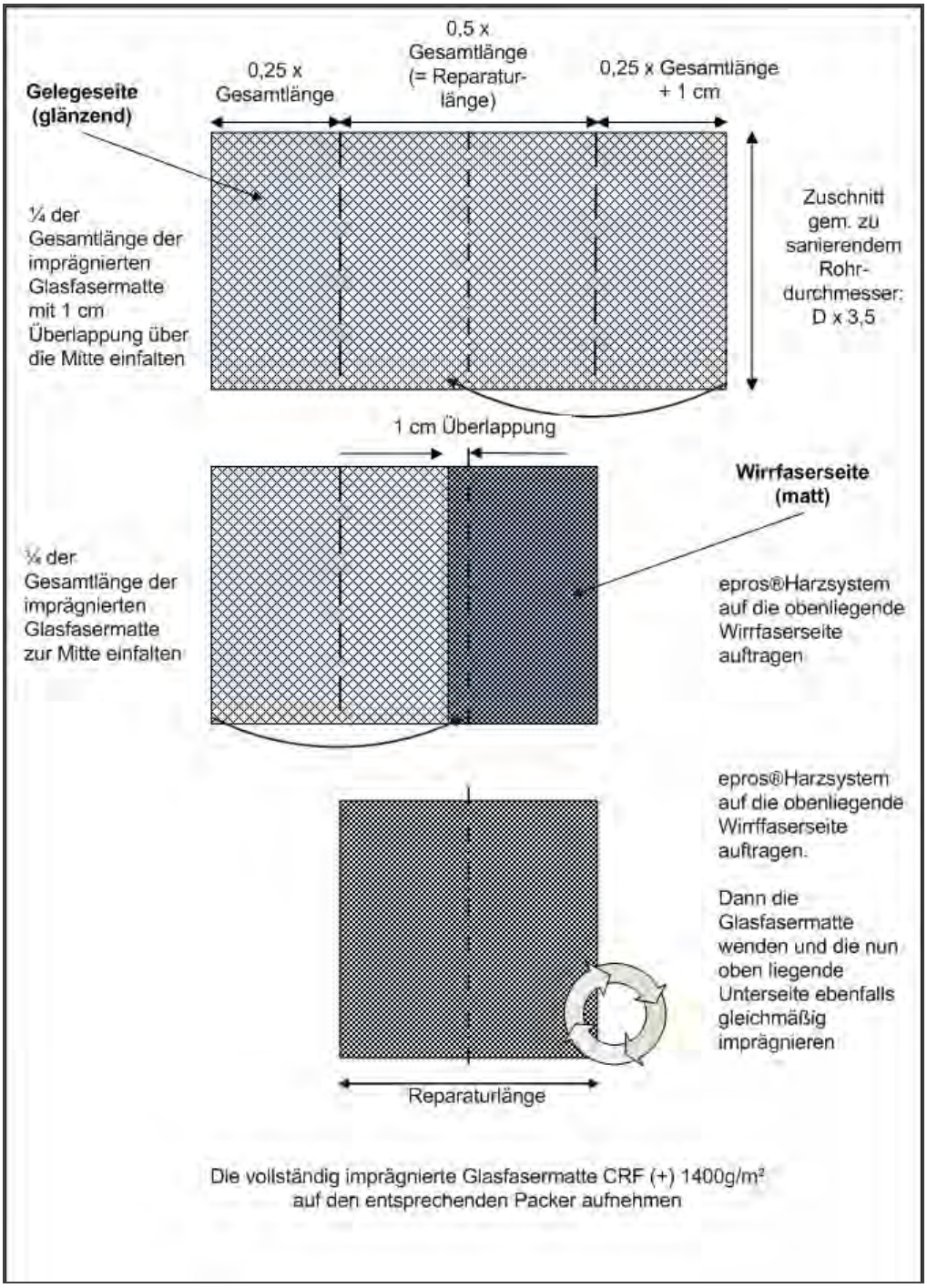
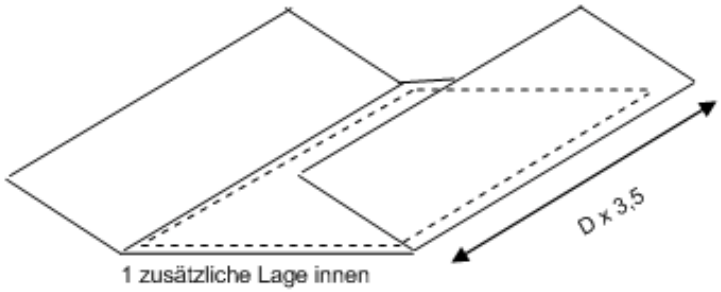
Folding of epros®FibreGlassMat CRF (+) 1400 g/m²

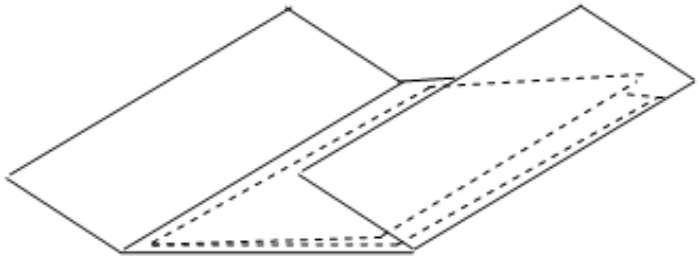


Insertion of additional epros®FibreGlassMats CRF (+)

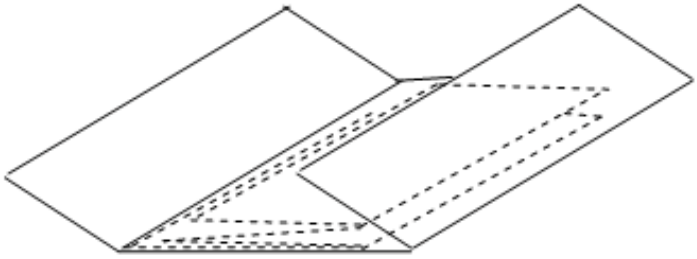
Zusätzliche Glasfaserlagen CRF (+) 1050 g/m² und 1400 g/m²



1 zusätzliche Lage innen



2 zusätzliche Lage innen



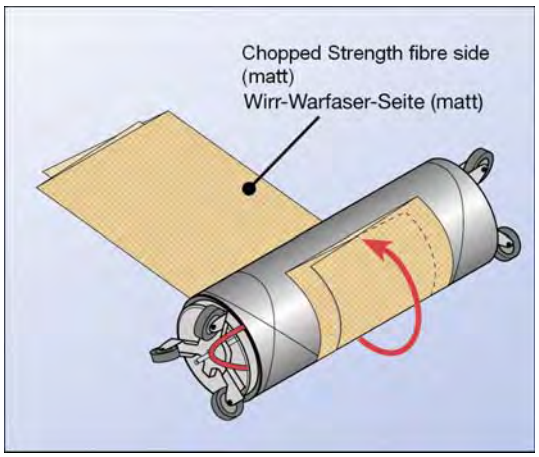
3 zusätzliche Lage innen

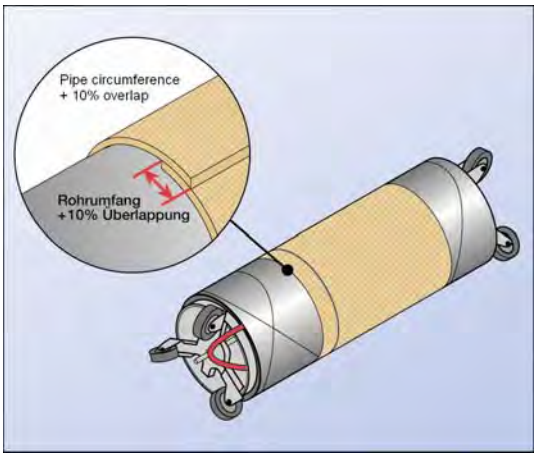
Anzahl Zusatzlagen innen	**CRF (+) 1050 g/m²** bei Rohrdurchmesser (mm)	**CRF (+) 1400 g/m²** bei Rohrdurchmesser (mm)
1	500, 525, 600	375, 400, 450, 500, 525
2	675, 700, 750	600, 675, 700
3	800	750, 800

Placing Impregnated Fibreglass Mats onto the Packer

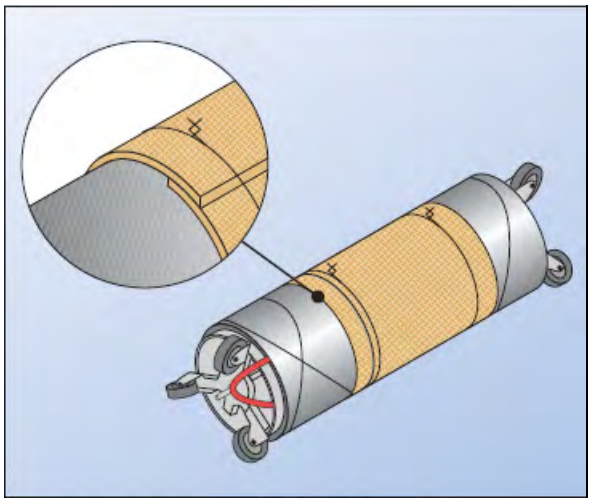
After complete impregnation, fold the fibreglass mat according the above described epros® method, wrap it around the packer and fix it in place.

For this purpose, use the same winding direction as for the separating stretch foil to wrap the fibreglass mat tightly around the prepared epros®DrainPacker.





Then pass the epros®SpecialBindingWire (0.65 mm diameter) around the packer and fibreglass mat at about 5 cm from the edge of the mat and twist both ends three times to fix the mat. Cut off any protruding wire.



ATTENTION! 	After liner installation, the random-laid fibre side must always be inside in contact with the service flow. The final wall thickness shall be no less than 3 mm.

Protection of epros®FibreGlassMat CRF (+)

In case of the epros®ShortPacker or epros®FlexPacker, the correct wheel setting provides basic protection for the wrapped epros®FibreGlassMat CRF(+). However, it is always indispensable to use appropriate care when introducing the packer into the host pipe.

In case of epros®LongPackers or epros®LCRPackers, which have no wheel sets, it is advisable to protect the packed epros®FibreGlassMat CRF(+) with an additional foil before inserting the packer and moving it to the point of repair.

IMPORTANT! 	It is necessary to have access to both ends of the pipe run (start and exit point).

Use epros®Sheeting or equivalent material for this purpose.
The length and width to be cut can be calculated according to the following formulae:

Calculation of sheeting width	Calculation of sheeting length
B (mm) = pipe diameter x 3.14 : 2	L (mm) = packer length + 1000

Example at DN 300

W (mm) = 300 x 3.14 = 942 : 2 = 471 mm

Spread the sheeting in two layers below the entire surface of the packer. Roll up the narrow edge on the pull side (pull-in direction) towards the centre without creasing and fix it in place with a rubber band.

Apply a suitable pull-in device to the end of the sheeting (rear end of packer) and attach a separate rope.

Attach an additional retaining rope to the provided pull (or holding) eye.

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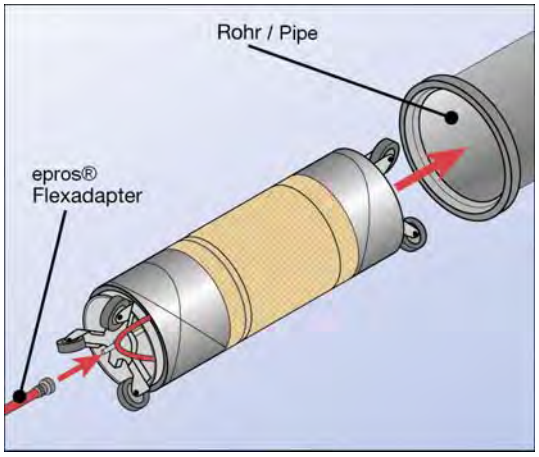
Introduction of Packer in the Pipe Run

Introduce the pre-assembled epros®DrainPacker into the pipe run. The outer end of the packed epros®FibreGlassMat CRF(+) points downwards in the abutment region, Protect the epros®FibreGlassMats CRF(+) from slipping or falling during transport (refer to Section “Placing Impregnated Fibreglass Mats onto the Packer”).

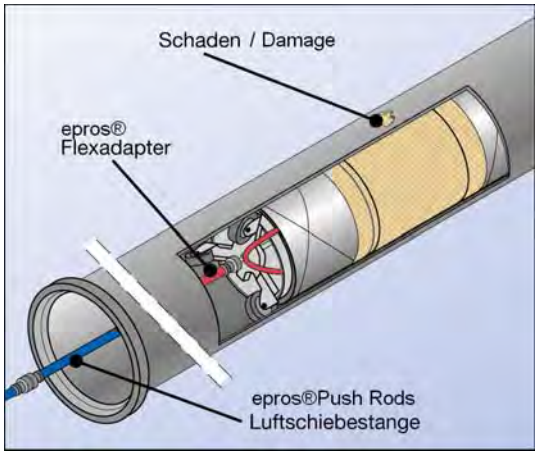


For epros®ShortPacker or epros®FlexPacker, make sure the wheel sets are correctly adjusted (refer to packer wheel setting unstructions).

Where possible, the packer should be positioned in the centre of the pipe. The wheel sets provide basic protection to the wrapped epros®FibreGlassMat CRF(+). However, it is always indispensable to use appropriate care when introducing the packer into the host pipe.

ATTENTION! 	Prevent the wetted-out fibreglass mat from hitting obstacles in the pipe invert, e.g. large joint offsets, or scraping off epros®ResinSystem.

Move the epros®DrainPacker with the attached pulling rope, retaining rope, or air push rods down to measured point of repair and place it in position.



ATTENTION! 	Before inflating the packer, it may be necessary to remove any protective film from the packer. To do so, pull out the protective film with the separate rope previously attached for this purpose.

Then inflate the epros®DrainPacker at an appropriate pressure as required by the given type of damage. Such pressure lies between the pipe wall contact pressure of the epros®DrainPacker and the operating pressure indicated by the manufacturer. (Refer to the Operation and Maintenance Manual.)

The required pressure must be recorded in the preparation and installation report (see Appendix).

There is no need to interrupt the service flow, if the epros®DrainPacker with bypass is used.
For epros®DrainPackers without bypass, appropriate service flow management is required.

Cure Times

The following charts show the pot times (resin and ambient temperature) and cure times (temperature inside the sewer) over the various temperature ranges.

epros®Resin type S

Resin type	S	S
Temperature [°C]	Pot time [minutes]	Cure time [minutes]
10	45-48	310-330
15	42-44	260-280
20	32-34	210-230
25	28-29	180-200
30		150-170
50		50-60

epros®Resin type W

Resin type	W	W
Temperature [°C]	Pot time [minutes]	Cure time [minutes]
10	20-22	130-135
15	19	115-120
20	17	60-90
25	13	40-55
30		30-45
50		20-25

Cure times for Resin Mixes

epros®Resin type W & type S data

Mixing ratio by volume					
No.	Comp. A epros®Hardener (water glass)	Comp. B **epros®Resin Type W**	Comp. B **epros®Resin type S**	Pot time at 20°C (min)	Cure time at 15 °C (min)
1	3	6	-	15	115
2	3	5	1	18	120
3	3	4	2	21	140
4	3	3	3	25	165
5	3	2	4	28	180
6	3	1	5	31	200
7	3	-	6	32	260

Cure temperature of 15°C in the sewer pipe.

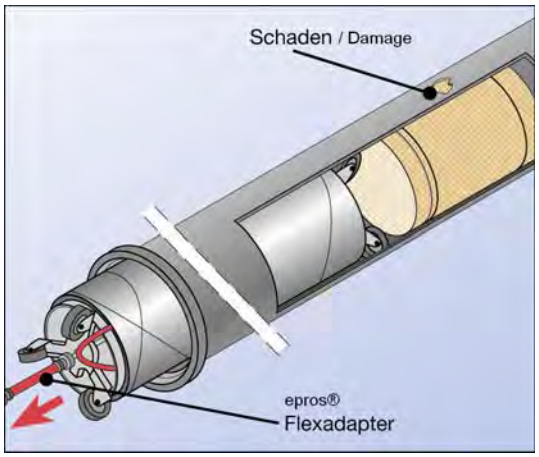
epros®Resin type W01 data

Mixing ratio by volume						
No.	Comp. A apros®Hardener (water glass)	Comp. B epros®Resin type W01	Pot time at 10°C	Pot time at 22°C	Cure time at 12°C (min)	Cure time at 20°C (min)
1	1	2	13-15	4.5 – 7.5	35	20

ATTENTION! 	As this type is a highly reactive silicate resin, it should be used only in cold seasons by installers specifically trained by Trelleborg epros.

Packer Removal

After complete cure according to the instructions, remove all air from the packer and pull the fully deflated packer out of the pipe using the retaining rope attached to the packer before installation.



Remove the stretch foil carefully without using knives, cutters, scissors or any other sharp objects to avoid any damage to the packer (rubber).

Make a final check and cleanup of the packer (➔ Operation and Maintenance Manual).

ATTENTION! 	Any damage to the packer must be repaired professionally before the next use.

Final Operations and Inspections

After completion, clean the sewer, run an optical inspection and record the repair job for documentation. We recommend that the repaired section be subjected to a leakage test according to EN 1610.

IV Self-Control / Quality Assurance

General Rules

Clean the tools and then dispose of the cleaning agents, foils, films, waste and material wrappings in compliance with the safety data sheet instructions and according to the information given in the operating instructions.

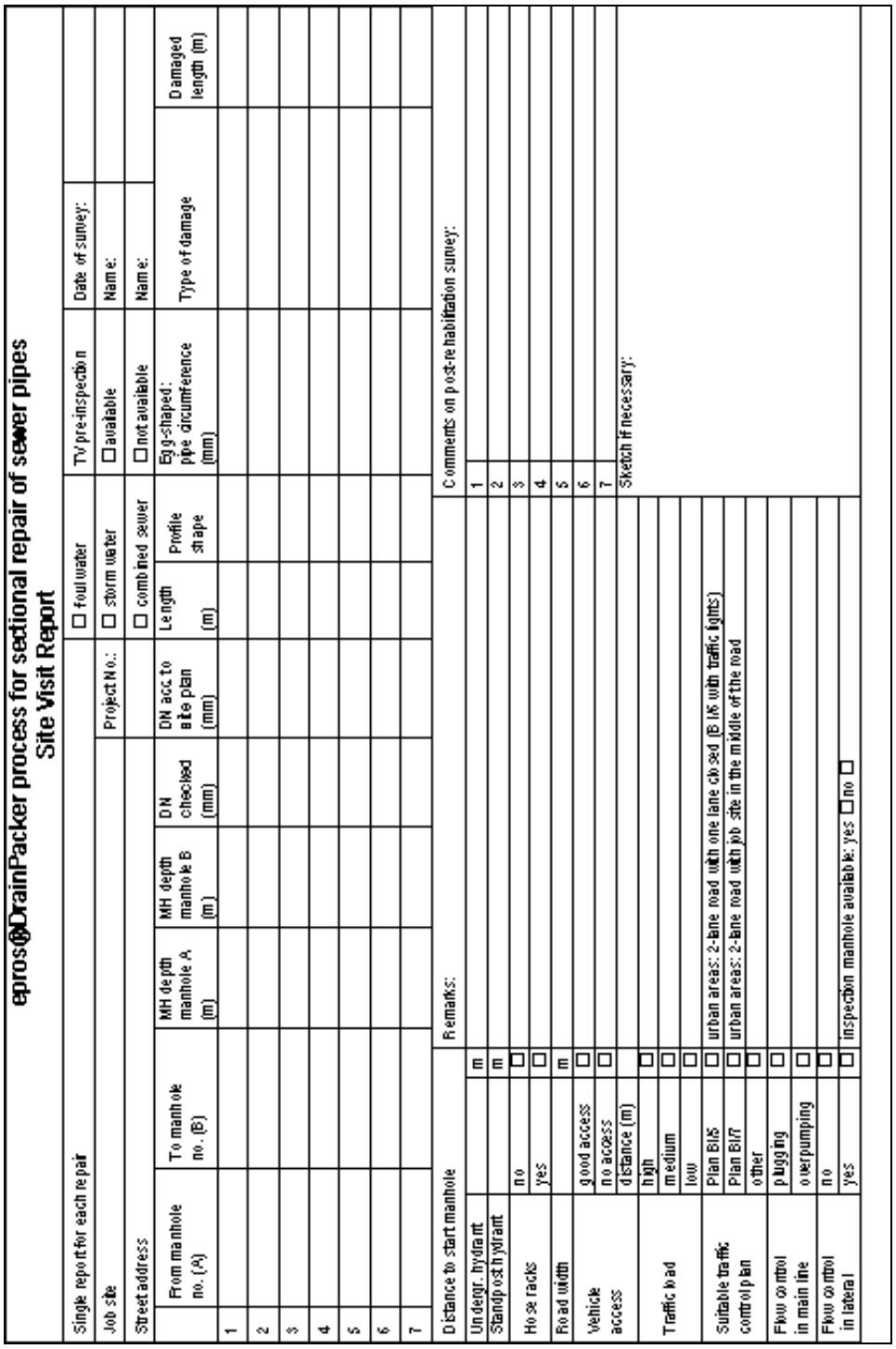
For the preparation of short/long liners, it is necessary to provide the Client with retention samples of the materials used.

Site Documentation

ATTENTION! 	For systematic sewer repair, it is absolutely necessary to fill in the following forms (site documentation). In case of customer claims, the entire job and process can be retraced at any later point of time. The site documentation must be kept for a minimum period of 5 years.

Manual of Procedure

Site Visit Report Form



epros®DrainPacker process for sectional repair of sewer pipes
Site Visit Report

Single report for each repair ☐ foul water TV pre-inspection Date of survey:
Job site Project No.: ☐ storm water ☐ available Name:
Street address ☐ combined sewer ☐ not available Name:

	From manhole no. (A)	To manhole no. (B)	MH depth manhole A (m)	MH depth manhole B (m)	DN checked (mm)	DN acc.to site plan (mm)	Length (m)	Profile shape	Egg-shaped: pipe circumference (mm)	Type of damage	Damaged length (m)
1											
2											
3											
4											
5											
6											
7											

Distance to start manhole Remarks: Comments on post-rehabilitation survey:

Undergr. hydrant		m	1
Standpost hydrant		m	2
Hose racks	☐ no	☐	3
	☐ yes		4
Road width		m	5
Vehicle access	☐ good access	☐	6
	☐ no access	☐	7
	☐ distance (m)		Sketch if necessary:
Traffic load	☐ high		
	☐ medium		
	☐ low		
Suitable traffic control plan	☐ Plan BilS	☐	urban areas: 2-lane road with one lane closed (B I/S with traffic lights)
	☐ Plan BilT	☐	urban areas: 2-lane road with job site in the middle of the road
	☐ other	☐	
Flow control in main line	☐ plugging	☐	
	☐ overpumping	☐	
Flow control in lateral	☐ no	☐	inspection manhole available: yes ☐ no ☐
	☐ yes	☐	

Manual of Procedure

Preparation & Installation Form

epros®DrainPacker process / Installation & Fabrication Report

Project No.					
Client:			Contractor:		
Street address: Town/city:			Street address: Town/city:		
Contact: Telephone:			Contact: Telephone:		
Job site					
Town/city: From manhole/connection point:			Street address: To manhole/connection point:		
Pipe section no.: _____ Section length _____ m Inner diameter:			Pipe material: Short liner positioned at:		
DVD / VIDEO:			Picture no.:		
Job preparations					
Approval required:	☐ YES	☐ NO	Site safety measures required:	☐ YES	☐ NO
Flow control required:	☐ YES	☐ NO	Sewer pipe in operation:	☐ YES	☐ NO
Flow control by:	☐ plugging ☐ overpumping		Repair area free of faeces Date pipe was flushed:	☐ YES	☐ NO
Preparatory treatment of point of repair					
Directly before installation:	☐ high-pressure cleaning ☐ mechanical cleaning ☐ milling ☐ grinding / milling		Important: Smooth pipe walls must be prepared by grinding, concrete or similar pipe walls by milling. Make sure the surface treatment at both liner ends overlaps by half the pipe diameter to the inside (DN divided by 2), at least 300 mm either side.		
Weather conditions:	☐ dry	☐ wet	Outdoor temperature (ACTUAL) Sewer temperature (ACTUAL)		_____ °C _____ °C
Material storage & delivery					
epros® resin type (Component B)	☐ 1001 ☐ W ☐ S		Batch number: Batch number: Batch number:		
epros® hardener (Component A)			Batch number:		
epros®CRF(+) fibreglass matting	☐ 1050 g/m² ☐ 1400 g/m²		Batch number: Batch number:		
Storage temperature between +5 and +25 °C (TARGET)			Storage temperature (ACTUAL)		_____ °C
Storage time = 6 months	☐ YES	☐ NO	Maximum 6 months after delivery		
Material undamaged	☐ YES		If damaged, specify:		
Anomalies found in handling	☐ NO		If yes, specify:		
Mixing process					
Total usage amount in litres _____ (ACTUAL) Maximum mixing volume 15 litres			epros® resin type (Component B)		epros® hardener (Component A)
Mixed to homogenous colour:	☐ YES	☐ NO	☐ 1001 _____ litres ☐ W _____ litres ☐ S _____ litres		_____ litres _____ litres _____ litres
Mixing time (duration):			from (time) _____		to (time) _____
Repair operation					
Packer used: Repair length: Number of CRF(+) layers _____ Contact pressure maintained: Processing time vs. pot time: Working pressure: Cure time: Ventilation of packer:			Length: _____ Length: _____ epros®CRF(+)1050 g/m² (TARGET: = 3 layers) from start time: _____ _____ minutes (ACTUAL) _____ bar (ACTUAL) _____ minutes (ACTUAL) _____ (time)		Type: _____ epros®CRF(+)1 400 g/m² (TARGET: = 2 layers) to end time: _____ _____ minutes (TARGET) _____ bar (TARGET) _____ minutes (TARGET)
					Date, signature

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Leakage Test Report Form

epros®DrainPacker process / Tightness Test according to EN 1610, Section 13.3, Method „W"	
Project-No.	
Client:	Contractor:
Street address:	Street address:
Town/city:	Town/city:
Contact:	Contact:
Telephone:	Telephone:
Job site	
Town/city:	Street address:
From manhole / connection point:	To manhole / connection point:
Pipe section no.: _____	Section length: _____ m
Inner diameter (D): _____	Inner surface area of pipe section: A = 3.14 x L x D
Parameters	
Allowable rate of loss (rate of top-up):	0.15 l/m² in 30 ±1 min
Allowable volume of top-up water for pipe section (inner surface area x allowable rate of loss)	_____
Test procedure	
Pre-fill time (stabilisation period)	_____ hours Normally, 1 hour is sufficient. A longer standing period may be required for concrete pipes under dry weather conditions.
Test started:	_____ (time)
Test ended (duration: 30 +/-1 Min.)	_____ (time)
Test pressure (maximum 50 kPa – minimum 10 kPa at pipe crown)	_____ bar
Amount of water added	_____ litres
Allowable volume of top-up water for pipe section	_____ litres
Tightness test passed	☐ YES ☐ NO
Remarks:	
This is to certify that the tightness test was performed in accordance with the standard. Date: _____ Name: _____	

Staff Guidance

The operating personnel shall be composed of no less than three persons.

They must be skilled workers for pipe, sewer and industrial service or meet the following minimum requirements or must have had the following training:

- Qualification for work in the sewer system
- ATV-DVWK training course in cleaning of sewers
- Worksheet ATV-M143, Part 2, Annex 2
- Rules for accident prevention (like UVV, GUV in Germany)
- First aid measures
- Traffic code

Above mentioned guidance and training courses shall be documented by appropriate proof and repeated in appropriate intervals as prescribed by law.

The installer is responsible for performing training courses or checking the qualification of the personnel.

For lining jobs with the epros®DrainPacker process, the operatives must be familiarized with the materials to be used in this method. This requires instruction by **Trelleborg Pipe Seals Duisburg GmbH**. Said familiarization will be confirmed by a personal certificate handed over to each of the participants. The instruction must be repeated every two years.

V Standard equipment

Description	Pictures of the product (subject to change)
epros®FlexPacker **– can be folded up to 90° –** DN 100 – DN 1200 (can always be used for a size range, e.g. DN 150 - DN 250) Max. repair length – depending on packer design – from 560 to 4630 mm	
epros®LongPacker **– very flexible and supple –** DN 200 to DN 1200 Max. repair length – depending on packer design – from 200 to 4565 mm	
epros®ShortPacker **– rigid for special uses with higher service flow rates –** DN 100 to DN 700 Max. repair length – depending on packer design – from 605 to 670 mm	
epros®LCRPacker **– very flexible and supple –** DN 35 to DN 200 Max. repair length – depending on packer design – from 210 to 4710 mm	
epros®FlexAdapter	

Manual of Procedure

Description	Pictures of the product (subject to change)
Compressed-air hose	
Air push rods with safety coupler and lock Alternatively 1.5 m or 3.0 m	
Filler fitting	
epros®FibreGlassMats CRF(+) 1050 g/m² CRF(+) 1400 g/m²	 
Resin & hardener	
Stretch foil roll 50 cm wide / 3 m long 23 µm layer thickness	

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Manual of Procedure

Description	Pictures of the product (subject to change)
Edding 3000 felt-tip pen	
Folding meter-rule	
Special binding wire on reel	
Special scissors for fibreglass matting with protective cap	
Filling knife, 250 mm	
Disposable gloves	

Description	Pictures of the product (subject to change)
Measuring cup, 1 Liter (2 units)	
Measuring cup, 2 Liters (2 units)	
Adhesive fabric tape (1 roll)	
Pneumatic drill	
Stirrer, 60 mm	

Manual of Procedure

Description	Pictures of the product (subject to change)
Side nippers	
Disposable coverall	

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VI Appendix

Single Documents

Safety Data Sheets

epros®FibreGlassMat CRF (+) 1050 g/m²
epros®FibreGlassMat CRF (+) 1400 g/m²
epros®Resin type W
epros®Resin type W01
epros®Resin type S
epros®Hardener for resin types W, W01, S, L30E1 and L30E3

Technical Data Sheets

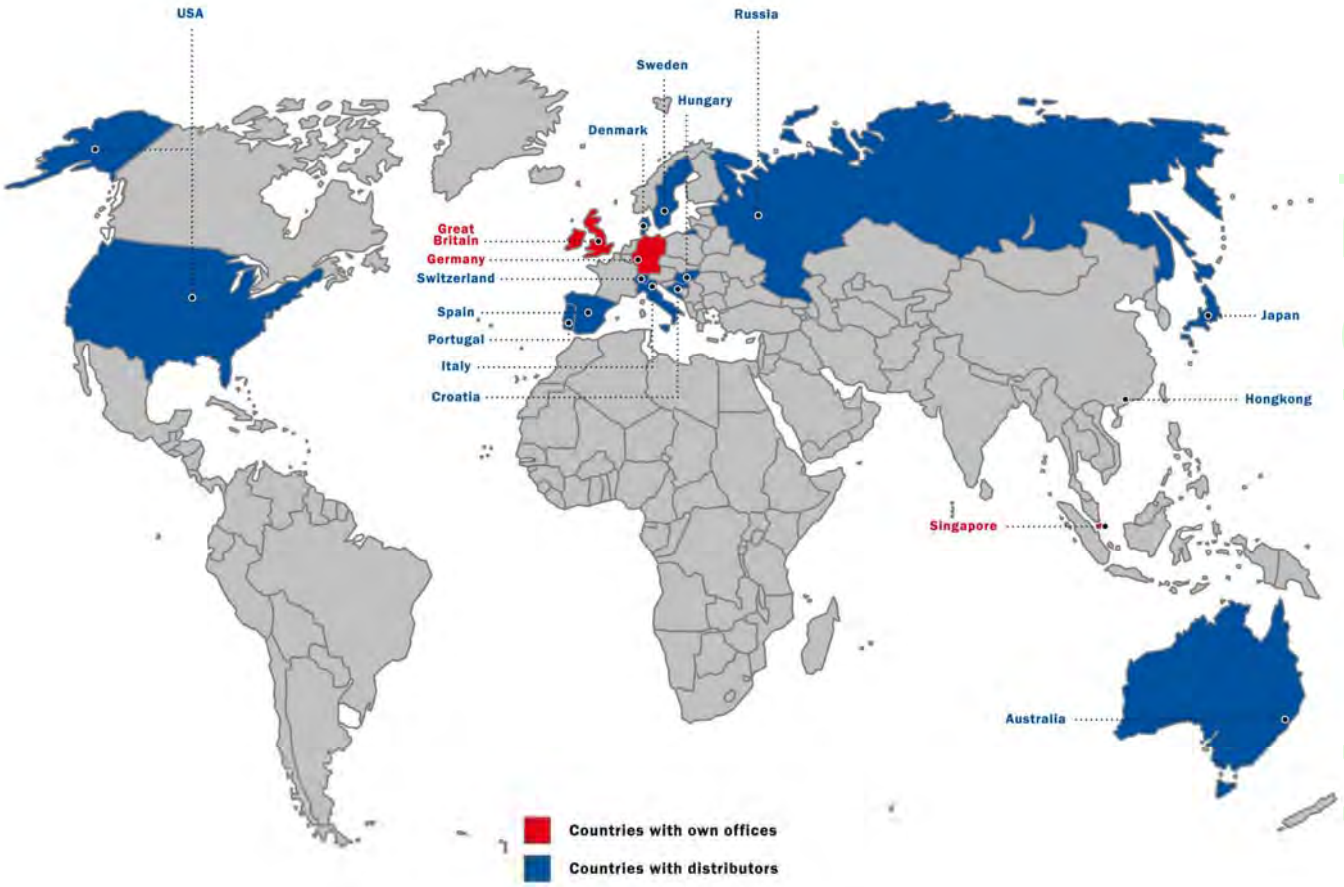
epros®FibreGlassMat CRF (+) 1050 g/m²
epros®FibreGlassMat CRF (+) 1400 g/m²

Reports

Site Visit

Preparation & Installation Report

Leakage Test



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