

National Technical Approval/ General Construction Technique Permit

Date:

7 Dec 2020

Reference:

III 54-1.42.3-7/20

Approval number:

Z-42.3-383

Validity:

from: 1 January 2021

until: 1 January 2026

Applicant:

Minova CarboTech GmbH
Bamlerstraße 5d
45141 Essen

Subject of approval:

Short liner with the designation “CarboLith Spot Repair System” for the rehabilitation of damaged underground drains with nominal sizes of DN 100 to DN 500

The aforementioned subject of approval is herewith granted a national technical approval/General Construction Technique Permit.

This National Technical Approval/General Construction Technique Permit contains 16 pages and eight annexes.

I GENERAL PROVISIONS

- 1 This National Technical Approval/General Construction Technique Permit is proof of the fitness for use and applicability of the aforementioned subject of approval in accordance with the Building Codes of the German federal states.
- 2 This National Technical Approval/General Construction Technique Permit does not replace the statutory permissions, approvals and certificates for the execution of building projects.
- 3 This National Technical Approval/General Construction Technique Permit is granted without prejudice to third party rights, in particular private property rights.
- 4 Irrespective of further provisions laid down in the “Specific Provisions” section, the manufacturer and supplier of the subject of approval shall make copies of this National Technical Approval/General Construction Technique Permit available to the users and appliers of the subject of approval and inform them that this National Technical Approval/General Construction Technique Permit must be available at the place of use. Upon request, copies of this National Technical Approval/General Construction Technique Permit shall be submitted to all authorities involved.
- 5 Reproduction of this National Technical Approval/General Construction Technique Permit shall be in full. However, partial reproduction can be made with the consent of the Deutsches Institut für Bautechnik. Texts and drawings of advertising brochures shall not contradict this National Technical Approval/General Construction Technique Permit. Translations of this National Technical Approval/General Construction Technique Permit shall include the note “Translation from the German original text not authorized by the Deutsches Institut für Bautechnik”.
- 6 This National Technical Approval/General Construction Technique Permit is not granted irrevocably. The provisions of this National Technical Approval/General Construction Technique Permit may be subsequently amended or modified, particularly if made necessary as a result of new technical developments.
- 7 This National Technical Approval/General Construction Technique Permit is based on the data/information and documents provided by the applicant. Any changes with regard to these data/information are not covered by this National Technical Approval/General Construction Technique Permit and shall be immediately made known to the Deutsches Institut für Bautechnik.
- 8 This General Construction Technique Permit (*allgemeine Bauartgenehmigung*) is deemed to be a national technical approval for the construction technique (*bauaufsichtliche Zulassung für die Bauart*).

II SPECIFIC PROVISIONS

1 Subject of approval and field of application

This National Technical Approval/General Construction Technique Permit applies to the production and use of short liners with the designation “CarboLith Spot Repair System” (Annex 1) with the corresponding four three-component silicate isocyanate resin systems designated “CarboLith PL”, “CarboLith PL 2K Summer”, “CarboLith PL 2K Winter” and “CarboLith PL 2K Fast”, for the repair and rehabilitation of damaged underground drains with circular cross sections of the nominal sizes DN 100 to DN 500.

This National Technical Approval/General Construction Technique Permit applies to the rehabilitation of drains designed for the drainage of wastewater according to DIN 1986-3¹.

The short liners can be used for the rehabilitation of drainage pipes made of concrete, reinforced concrete, vitrified clay, asbestos-free fibre cement, cast iron, GFRP and PVC-U, provided that the cross section of the drainage pipe to be rehabilitated satisfies the method-related requirements and structural requirements.

The short liners can be used for the repair and rehabilitation of cracks (e.g. radial and longitudinal cracks as well as combinations of radial and longitudinal cracks) and leaking pipe joints provided that the host pipe-ground system still has sufficient load-bearing capacity (e.g. longitudinal cracks with a small extent of pipe deformation and verified functional lateral bedding, if necessary checked through long-term observation and/or soil boring).

Damaged drainage pipes are rehabilitated with a short liner by moving a resin-impregnated glass fibre mat – consisting of randomly oriented fibre composites – to the pipe’s damage location using an inflatable packer. By inflating the packer, the mat is then pressed against the pipe wall. The packer is left in this position until curing is nearly finished.

2 Provisions for the construction product

2.1 Properties and composition

2.1.1 Materials used for the components

2.1.1.1 Glass fibre material (Annex 1)

Only E-CR glass fibre mats and E-CR randomly oriented glass fibre mats in accordance with DIN 1259-1² and DIN 61853-1³ and DIN 61853-2⁴ as well as DIN 61854-1⁵ and in compliance with the formulations deposited with the Deutsches Institut für Bautechnik shall be used as a substrate material for the resin system.

The glass fibre mats consist of three layers, two fabric layers offset by 90° and a randomly oriented fibre layer, which are sewn together.

1	DIN 1986-3	Drainage systems on private ground – Part 3: Specifications for service and maintenance; issue: 2004-11
2	DIN 1259-1	Glass – Part 1: Terminology for glass types and groups; issue: 2001-09
3	DIN 61853-1	Textile glass; textile glass mats for plastics reinforcement; technical delivery conditions; issue: 1987-04
4	DIN 61853-2	Textile glass; textile glass mats for plastics reinforcement; classification and application; issue: 1987-04
5	DIN 61854-1	Textile glass; woven glass fabrics for plastics reinforcement; woven glass filament fabric and woven roving; technical delivery conditions; issue: 1987-04

The glass fibre mats have the following properties, among others, prior to processing (Annex 1):

1. Glass fibre mat for two-layer short liner:

Basis weight:	≈1,400 g/m ² ± 4%
Thickness:	approx. 1.8 mm
Width:	approx. 1,300 mm

2. Glass fibre mat for three-layer short liner:

Basis weight:	≈1,100 g/m ² ± 4%
Thickness:	approx. 1.2 mm
Width:	approx. 1,300 mm

2.1.1.2 Resin components

The three-component silicate isocyanate resin systems "CarboLith PL" and "CarboLith PL 2K Summer", "CarboLith PL 2K Winter" and "CarboLith PL 2K Fast" each consist of the components A (resin), B (curing agent) and C (catalyst). The compositions of these components shall correspond to the formulations deposited with the Deutsches Institut für Bautechnik.

• Component A (resin):

The resin has the following properties, among others, prior to processing:

- Density based on
DIN EN ISO 1183-1⁶ at ± 25° C 1.490 g/cm³ ± 10%
- Viscosity in accordance with
DIN EN ISO 3219⁷ at ± 25° C 270 mPa x s ± 30 mPa x s ^{A)}
- pH value: 12.5
- colour: colourless

• Component B (curing agent):

The curing agent has the following properties, among others, prior to processing:

- Density based on
DIN EN ISO 1183-1⁶ at ± 25° C 1.130 g/cm³ ± 10%
- Viscosity based on
DIN EN ISO 3219⁷ at ± 25° C 150 mPa x s ± 20 mPa x s ^{A)}
- colour: black-brown

• Component C (catalyst):

The catalyst has the following properties, among others, prior to processing:

- Density based on
DIN EN ISO 1183-1⁶ at ± 25° C 1.120 g/cm³ ± 10%
- Viscosity based on
DIN EN ISO 3219⁷ at ± 25° C 40 mPa x s ± 5 mPa x s ^{A)}

⁶ DIN EN ISO 1183-1 Plastics – Methods for determining the density of non-cellular plastics – Part 1: Immersion method, liquid pycnometer method and titration method (ISO 1183-1:2012); German version EN ISO 1183-1:2012; issue 2013-04

⁷ DIN EN ISO 3219 Plastics – Polymers/resins in liquid state or as emulsions or dispersions – Determination of viscosity using a rotational viscometer with defined shear rate (ISO 3219:1993); German version EN ISO 3219:1994; issue: 1994-10

^{A)} Cone-plate system (diameter 6 cm, cone with 2° angle), shear rate 128 rpm to 256 rpm

- pH value: 12.5
- colour: light brown
-
- Factory addition of component C (catalyst) to component A (resin) of the “CarboLith PL” resin system:
 - “CarboLith PL”: 0%
 - “CarboLith PL 2K Summer”: 1%
 - “CarboLith PI 2K Winter”: 3%
 - “CarboLith PL 2K Fast”: 5%

The silicate isocyanate resin systems shall correspond to the IR spectra deposited with the Deutsches Institut für Bautechnik. The applicant of this National Technical Approval/General Construction Technique Permit shall also submit the IR spectra to the external surveillance body.

2.1.2 Environmental safety

The construction products meet the requirements of the “Principles for assessing the effects of construction products on soil and groundwater” (version: 2011; *Schriften des deutschen Instituts für Bautechnik*). This statement only applies if the Special Provisions of this National Technical Approval/General Construction Technique Permit are complied with.

The reservation of authorisation, particularly in water protection areas, by the competent water authority remains unaffected.

2.1.3 Physical characteristics of the silicate isocyanate resin mixture

The cured resin mixture composed of components A, B and C has the following characteristics:

- Density: $\approx 1.270 \text{ g/cm}^3$
- Tensile strength based on DIN EN ISO 527-2⁸ $\geq 11 \text{ N/mm}^2$
- Modulus of elasticity in tension based on DIN EN ISO 527-2⁸ $\geq 90 \text{ N/mm}^2$
- Compressive strength based on DIN EN ISO 604⁹ $\geq 35 \text{ N/mm}^2$
- Modulus of elasticity in compression based on DIN EN ISO 604⁹ $\geq 500 \text{ N/mm}^2$
- Shrinkage based on ISO 2577¹⁰ $\leq 0.1 \%$
- Shore D hardness in accordance with DIN 53505¹¹ > 60
- Bending strength at 2% strain in accordance with DIN EN ISO 178¹² $> 9 \text{ N/mm}^2$

2.2 Production, packaging, transport, storage and marking

2.2.1 Production of short liner

In the sub-supplier’s manufacturing plant, the glass fibre mats shall be produced with the minimum wall thickness specified in sections 2.1.1.1 and 3.1.2.1. The applicant shall ensure that the sub-supplier adheres to the glass fibre mat specifications.

- | | | |
|----|------------------|--|
| 8 | DIN EN ISO 527-2 | Plastics – Determination of tensile properties – Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2:1993 including Corr. 1:1994); German version EN ISO 527-2:1996; issue: 1996-07 |
| 9 | DIN EN ISO 604 | Plastics – Determination of compressive properties (ISO 604:2002; German version EN ISO 604:2003; issue: 2003-12 |
| 10 | ISO 2577 | Plastics – Thermosetting moulding materials – Determination of shrinkage; issue: 2007-12 |
| 11 | DIN 53505 | Testing of rubber and elastomers – Hardness testing using the Shore A or Shore D scale; issue: 2000-08 |
| 12 | DIN EN ISO 178 | Plastics – Determination of flexural properties (ISO 178:2019); German version EN ISO 178:2019; issue: 2019-08 |

Production of the resin system and components A, B and C is carried out according to the formulations deposited with the Deutsches Institut für Bautechnik at the Minova Ekochem S.A. manufacturing plant in Poland.

Within the scope of goods inspection, at least the following properties of the resin components A, B and C shall be verified:

Resin properties:

- Density
- Viscosity

2.2.2 Packaging, transport, storage

The applicant shall ensure that the glass fibre mats supplied by the sub-supplier are stored on the applicant's premises or on the premises of the executing party such that the mats are not damaged.

The applicant shall ensure that the components of the "CarboLith PL", "CarboLith PL 2K Summer", "CarboLith PL 2K Winter" and "CarboLith PL 2K Fast" for resin impregnation at the respective construction site are stored separately in suitable airtight containers on the premises of the applicant or of the executing party until further use. The temperature shall be maintained between +10° and + 30° C. The storage time is approximately six months after delivery and shall not be exceeded. The containers shall be protected from direct sunlight. The containers shall be designed such that the resin components A, B and C are stored in separate containers.

The components required for the rehabilitation work shall be removed from the storage containers in the required amounts and transported in suitable separate airtight containers to the respective place of use. At the place of use, the containers shall be protected from the weather. The glass fibre mats shall be transported in suitable containers to prevent damage.

If containers are filled with resin components by the executing party, the applicant shall ensure that the components are only transferred to suitable transport containers (e.g. plastic canisters).

The relevant accident prevention provisions and the information given in the applicant's procedural manual shall be observed during storage and transport.

2.2.3 Marking

The glass fibre mats and the respective transport containers for resin components A, B and C shall be marked with the national conformity mark (*Ü-Zeichen*) including the approval number Z-42.3-383, in accordance with the Conformity Marking Ordinances (*Übereinstimmungszeichen-Verordnungen*) of the federal states. The mark shall only be applied if the requirements for attestation of conformity are met.

The manufacturer shall mark the containers, packaging, instruction leaflet and delivery note with the hazard symbols and H- and P-sentences in accordance with the Ordinance of Hazardous Substances and the EU Regulation No. 1907/2006 (REACH) as well as the respective currently valid version of CLP Regulation (EC) 1272/2008¹³. Packaging shall be marked in accordance with the regulations of ADR¹⁴, as amended from time to time.

¹³ 1272/2008 Regulation (EC) No. 1272/2008 on classification, labelling and packaging of substances and mixtures

¹⁴ ADR European Agreement concerning the international carriage of dangerous goods by road (*Accord européen relatif au transport international des marchandises Dangereuses par Route*)

Additionally, the following information shall be given on the containers used for transporting the glass fibre mats:

- Designations of the glass fibre mats 1,400 g/m² or 1,100 g/m²
- Length and width
- Batch number

Additionally, the transport containers for resins, curing agents and other additives shall be marked with at least the following information:

- Component designation A (resin), B (curing agent), C (catalyst)
- Temperature range for processing +5° C to + 25° C
- Container content (volume or weight)
- Batch number

2.3. Attestation of conformity

2.3.2 General

The attestation of conformity of the construction products with the provisions of this National Technical Approval/General Construction Technique Permit shall be issued for each manufacturing plant in the form of a declaration of conformity based on factory production control and a certificate of conformity issued by an accredited certification body as well as regular external surveillance including initial type testing of the construction products by a recognised inspection body, in accordance with the following provisions.

The manufacturer of the construction products shall involve an accredited certification body to issue the certificate of conformity and a recognised inspection body to perform external surveillance including product inspection.

The declaration of conformity shall be given by the manufacturer by affixing the national conformity mark (*Ü-Zeichen*) to the construction products with reference to the intended use.

The certification body shall submit a copy of the certificate of conformity issued by the same to the Deutsches Institut für Bautechnik.

A copy of the initial type-testing report shall also be submitted to the Deutsches Institut für Bautechnik.

2.3.2 Factory production control

A factory production control system shall be set up and implemented in each manufacturing plant. Factory production control entails the permanent internal control of production exercised by the manufacturer in order to ensure that the construction products produced by him are in conformity with the provisions of this National Technical Approval/General Construction Technique Permit.

Factory production control shall include at least the measures listed below.

- Specification and verification of the starting material

The applicant shall ensure that the properties required in accordance with section 2.1.1 are complied with for each delivery of the components of the glass fibre mats, resin, curing agent and other additives.

For this, the applicant shall ensure that each sub-supplier of the raw materials for the resin components submits the relevant "type 2.2" test reports and the manufacturing plants of the respective sub-suppliers of the glass fibre mats submit "type 2.1" declarations of compliance with the order based on DIN EN 10204¹⁵.

¹⁵ DIN EN 10204 Metallic products – Types of inspection documents; German version EN 10204:2004; issue: 2005-01

Within the scope of goods outward inspection, additional checks of the properties specified in sections 2.1.1.1 and 2.1.1.2 shall be carried out for each batch to ensure their compliance with the formulations deposited with the Deutsches Institut für Bautechnik.

In addition, the bending stress and the Shore D hardness shall be checked on at least three test specimens taken from the ready-to-use resin mixture in accordance with section 2.1.3.

The shrinkage specified in section 2.1.3 shall be checked as per ISO 2577¹⁰ on at least three test specimens per batch or in accordance with DIN 16946-1¹⁶ via determination of mass loss. Testing shall be carried out on specimens after conditioning for 24 hours at +23° C ±2° C. A metal specimen mould that can be disassembled is recommended for production of the test specimens.

- Checks and tests to be carried out during manufacture

The requirements of section 2.2.1 shall be checked.

- Checking of containers:

For each resin batch the marking requirements specified in section 2.2.3 shall be checked.

The results of factory production control shall be recorded and evaluated. The records shall at least include the following information:

- Designation of the construction product or starting materials and constituents
- Type of check or test
- Date of manufacture and testing of the construction product or starting materials and constituents
- Results of checks and tests as well as, if applicable, comparison with requirements
- Signature of the person responsible for factory production control.

The records shall be kept for at least five years and shall be submitted to the inspection body responsible for external surveillance. Upon request, these records shall be submitted to the Deutsches Institut für Bautechnik and the competent supreme building control authority.

In case of unsatisfactory test results, the manufacturer shall take immediate measures to eliminate the deficiency. Construction products that do not comply with the requirements shall be handled in such a way that they cannot be mistaken for products complying with the requirements. After elimination of the deficiency the relevant test shall be immediately repeated as far as is technically possible and necessary to verify that the deficiency has been eliminated.

2.3.3 External surveillance

At each manufacturing plant, the plant and factory production control shall be inspected regularly, at least once every six months, by means of external surveillance.

Initial type testing of the construction products shall be carried out within the scope of external surveillance. Factory production control shall be carried out within the scope of the external surveillance audit by means of spot checks. The requirements of sections 2.1.1 and 2.2.3 shall be checked in the process.

Additionally, spot checks for compliance with the requirements pertaining to production specified in section 2.2.1 shall be carried out. These checks shall also include checks of the cure behaviour, density of components A, B and C in accordance with section 2.1.1.2, storage stability and basis weight of the short liners as well as the IR spectra.

Sampling and testing shall be the responsibility of the recognised inspection body. During external surveillance, the “type 2.1” declarations of compliance with the order and the “type 2.2” test reports on the basis of DIN EN 10204¹⁵ shall also be checked.

¹⁶ DIN 16946-1 Cured casting resins; testing; issue:1989-03

The results of certification and external surveillance shall be kept for at least five years. Upon request, they shall be submitted by the certification or inspection body to the Deutsches Institut für Bautechnik and the competent supreme building control authority.

3 Provisions for the use of the subject of approval

3.1 Design and dimensioning

3.1.1 Design

The required piping data (e.g. piping layout, depth, service connection positions, manhole depths, groundwater, pipe joints, hydraulic conditions, inspection chambers and cleaning intervals) shall be checked. Any available video recordings shall be analysed with regard to the application. The accuracy of the information provided shall be checked on site. The conditions of the existing sewer for drainage from the property shall be assessed for determining the applicability of the rehabilitation process.

The hydraulic performance of the drainage pipes shall not be impaired through the insertion of a short liner. The corresponding verification shall be provided where necessary.

3.1.2 Dimensioning

3.1.2.1 Wall thickness and structure

Due to system constraints, the resin-impregnated short liners used for rehabilitation have a minimum wall thickness of 3 mm after insertion and curing, irrespective of their nominal sizes. The wall structure of the short liner shall be composed of an outer and an inner randomly oriented fibre layer with a woven glass fibre layer in between (Annex 2, Fig. Y).

3.1.2.2 Physical characteristics of the cured short liner

After curing, the glass fibre mats (laminates) impregnated with the resin system shall have the following characteristics:

- Density based on DIN EN ISO 1183-1⁶ $\approx 1.424 \text{ g/m}^3$
- Ignition residue based on DIN EN ISO 1172¹⁷ $\geq 50\%$
- Circumferential modulus of elasticity based on DIN EN 1228¹⁸ $\geq 4,500 \text{ N/mm}^2$
- Flexural modulus based on DIN EN ISO 178¹² $\geq 4,500 \text{ N/mm}^2$
- Bending strength σ_{fB} based on DIN EN ISO 178¹² $\geq 100 \text{ N/mm}^2$

3.2 Execution

3.2.1 General

Damaged drainage pipes are rehabilitated with a short liner by moving a resin-impregnated glass fibre mat – consisting of randomly oriented fibre composites – to the pipe's damage location using an inflatable packer. By inflating the packer, the mat is then pressed against the pipe wall. The packer is left in this position until curing is nearly finished.

¹⁷ DIN EN ISO 1172 Textile-glass-reinforced plastics – Prepregs, moulding compounds and laminates – Determination of the textile-glass and mineral-filler content; calcination methods (ISO 1172:1996); German version EN ISO 1172:1998; issue 1998-12

¹⁸ DIN EN 1228 Plastics piping systems – Glass-fibre reinforced thermosetting plastics (GRP) pipes – Determination of initial specific ring stiffness; German version EN 1228:1996; issue: 1996-08

The “CarboLith Spot Repair System” can be used in the following cases:

- a) From the start to the end point
- b) Starting at the start point in a sewer of a defined length, without the need for an additional manhole opening
- c) Lateral connections, starting at the start point to the connection point on the main sewer.

The start or end point can be a manhole, an inspection or cleaning chamber or an opened pipe section.

A bend of up to 45° can be rehabilitated with a flexible packer.

Should wrinkles form they may not be larger than the size specified in DIN EN ISO 11296-4¹⁹.

The applicant shall make available to the executing party a manual containing a description of the individual steps for execution of the particular rehabilitation process.

The applicant shall also ensure that the executing persons have been sufficiently familiarised with the method. Adequate technical knowledge of the executing company can be documented e.g. using the respective quality mark as issued by the Güteschutz Kanalbau e.V.²⁰

3.2.2 Equipment and facilities

Minimum component, equipment, and facility requirements for the execution of the rehabilitation process:

- Sewer cleaning equipment
- Water holding devices
- Sewer inspection equipment (DWA-M 149-2²¹)
- Rehabilitation equipment:
 - Glass fibre mats 1,400 g/m² and/or 1,100 g/m² for the nominal sizes of the pipes to be rehabilitated
 - Containers with the resin systems “CarboLith PL” and/or “CarboLith PI 2K Summer” and/or “CarboLith PL 2K Winter” and/or “CarboLith PL 2K Fast”
 - Dispensing equipment for filling with resin components
 - Mixing containers with mixing tool (stirrer)
 - Weather-protected impregnation station
 - Work / construction sheets
 - Pipe rehabilitation equipment for the appropriate nominal sizes (inflatable packer and/or flexible packer) and accessories
 - Release agents (Vaseline, beeswax or similar) and PE sheets (stretch film) for the packer
 - Camera, control unit with monitor
 - Locking air pusher rods for packer positioning

¹⁹ DIN EN ISO 11296-4 Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks – Part 4: Lining with cured-in-place pipes (ISO 11296-4:2018); German version EN ISO 11296-4:2018; issue: 2018-09

²⁰ Güteschutz Kanalbau e.V.; Linzer Str. 21, Bad Honnef, Germany, Telephone: (02224) 9384-0; Fax: (02224) 9384-84

²¹ DWA-M 149-2 German Association for Water, Wastewater and Waste (Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V., DWA) – Advisory Leaflet 149: Conditions and Assessment of Drain and Sewer Systems Outside Buildings – Part 2: Visual inspection coding system; issue: 2013-12

- Securing and pull-in ropes
- Air hoses for connection to the packer with pressure monitoring device
- Compressor, air hoses, pressure regulator
- Inflatable pipe plugs or blocking discs (suitable for the respective nominal size)
- Water supply
- Power supply
- Container for residual material
- Temperature sensors
- Temperature monitoring and recording unit
- Small tools such as air cutting tool
- Air drill
- Hand tools such as scissors, trowel, distribution rollers etc.
- Staff rooms and sanitation facilities (where required)

If electronic devices such as video cameras (or remote-controlled pipe crawlers) need to be inserted into the pipe to be rehabilitated, they shall have properties in accordance with the VDE provisions.

3.2.3 Execution of rehabilitation work

3.2.3.1 Preparatory measures

Prior to carrying out the repair or rehabilitation work it shall be ensured that the host pipe is not in service; if necessary, inflatable pipe plugs and flow diverters shall be inserted.

In preparation for the repair or rehabilitation work the reach including the associated service laterals shall be taken out of service. Subsequently the reach shall be cleaned using high-pressure water jetting. For smooth-walled internal surfaces of the damaged pipe and for pipes with deposits (so-called sewer slime) that cannot be removed through high-pressure water jetting to the extent necessary for the procedure to be carried out, surface ablation (removal of the sewer slime) should be carried out according to the existing damage pattern. Obstacles to drainage shall be removed.

The internal pipe surfaces in the regions of the pipe plugging equipment shall be smooth.

In the cleaned pipe section, the damage positions and the service lateral positions shall be determined.

The ambient temperature shall be measured prior to commencement of the work. Evaluation shall be made as to whether the required temperature limits can be adhered to.

The accident prevention provisions applicable to the repair or rehabilitation procedure shall be complied with.

Devices for the repair or rehabilitation procedure which shall be inserted into the pipe sections to be rehabilitated may be used only if it has been ensured in advance by testing that no inflammable gases are present in the pipe sections.

For this, the appropriate sections of the following standards shall be observed:

- GUV-R 126²² (formerly GUV 17.6)
- DWA-M 149-2²¹
- DWA-A 199-1 and DWA-A 199-2²³

The accuracy of the information specified in section 3.1.1 shall be checked on site. To this end, the pipe section to be rehabilitated shall be sufficiently cleaned with usual high-pressure jetting units so that the damage is clearly visible on the monitor during visual inspection in accordance with the advisory leaflet DWA-M 149-2²¹.

The relevant accident prevention provisions shall also be observed when climbing into a manhole of the sewer to be rehabilitated as well as during all steps of the repair or rehabilitation process.

Formatting of the glass fibre mats as described in section 3.2.3.3, resin mixing as described in section 3.2.3.4 and resin impregnation as described in section 3.2.3.5 shall be carried out in a weatherproof enclosure (e.g. in the rehabilitation vehicle) on a flat surface free from all types of contaminants.

The pot life in accordance with Annex 5 shall be adjusted for the respective rehabilitation work by means of resin mixing as described in section 3.2.3.4 such that the short liner is in full contact with the surface of the drainage pipe section to be rehabilitated within this time, i.e. without commencement of curing.

The steps required for process execution shall be recorded on log sheets for each impregnating and rehabilitation procedure.

3.2.3.2 Incoming inspection of the process components on site

The containers used for transporting the process components shall be inspected to ensure that the markings specified in section 2.2.3 are present. The cut lengths of the glass fibre mats required for the respective object to be rehabilitated shall be measured again prior to impregnation or saturation with resin. A check shall be carried out to ensure that the required storage temperature of +10° C to +30° C for the resin and curing agent is maintained prior to impregnation.

3.2.3.3 Formatting the glass fibre mats (Annex 1)

The rolled-up glass fibre mat shall be cut off on site on a work table situated inside a weatherproof or climate-controlled room or in the rehabilitation vehicle to a length of approx. 0.6 m to maximally 3.0 m (dependent on the planned rehabilitation length as defined in Annexes 6 and 7, short liner side C in accordance with Annex 2, Fig. F and Annex 3, Figs. A and G) multiplied by 3.5 times the diameter (Annexes 6 and 7, glass fibre side B according to Annexes 2 and 3, Fig. A), but with an overlap length of at least 10 cm (Annex 2, Fig. F and Annex 3, Fig G). It shall be ensured that the glass fibre mats are cut such that the start and end regions of the later short liner extend at least 5 cm beyond the damaged area of the pipe to be rehabilitated.

- | | | |
|----|-------------|--|
| 22 | GUV-R 126 | Safety regulations for working in confined spaces in sewage treatment plants (formerly GUV 17.6); issue: 2008-09 |
| 23 | DWA-A 199-1 | German Association for Water, Wastewater and Waste (<i>Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V., DWA</i>) – Work sheet 199: Service instructions for the personnel of wastewater systems, – Part 1: Operating instructions for the personnel of sewerage systems and stormwater treatment systems; issue: 2011-11 |
| | DWAA 199-2 | German Association for Water, Wastewater and Waste (<i>Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V., DWA</i>) – Work sheet 199: Service instructions for the personnel of wastewater systems, – Part 2: Operating instructions for the personnel of sewerage systems and stormwater treatment systems; issue: 2020-04 |

3.2.3.4 Resin mixing

The resin amounts necessary for each application case shall be determined based on the information given in Annexes 6 and 7.

The resin system "CarboLith PL" is composed of the resin component A, the curing agent component B and the catalyst component C. One hundred parts by volume of component A shall be mixed with two hundred parts by volume of component B as well as 1, 3 or 5 parts by volume (Annex 5) of component C. Component C shall first be mixed with component A and component B shall then be added to the resin mixture comprising A and C. The resin amounts necessary for each application case shall be determined based on the information given in Annexes 6 and 7. For installation of short liners requiring a longer or shorter insertion time, components A, B and C shall be mixed in a mixing container using a stirrer (e.g. electrically operated) so as to achieve a bubble-free resin mixture of homogenous colour. For use of a "seamless liner" a fixed insertion time is specified.

The resin systems "CarboLith PL 2K Summer", "CarboLith PL 2K Winter" and "CarboLith PL 2K fast" are fixed-composition resin systems with a 1% (Summer), 3% (Winter) or 5% (Fast) (see section 2.1.1.2) addition of the C component (catalyst) to the A component (resin). The insertion times given in Annex 5 shall be observed.

Mixing of the resin system and temperature conditions shall be recorded in a log as described in section 3.2.3.1. In addition, a retention sample shall be taken from each resin mixture at the construction site and the curing behaviour shall be investigated on this sample.

3.2.3.5 Resin impregnation Annexes 2 and 3

After the resin has been mixed it shall be uniformly applied with a suitable rubber spreader onto the spread-out glass fibre mat, for a two-layer short liner (first layer) on the top randomly oriented fibre side, using crosswise strokes (Annex 2, Figs. A and B). The glass fibre mat shall then be turned over (Annex 2, Fig. C) and the fabric side now facing up shall likewise be coated with the resin in the fibre direction (Annex 2, Fig. D) until no more resin is absorbed.

Then approx. one-third of the glass fibre mat shall be folded over once (Annex 2, Fig. E) and the second third shall then be folded over (Annex 2, Fig. F) with an overlap of approx. 10 cm and the randomly oriented fibre side now facing up shall be pressed firmly against the layer underneath with a trowel using lengthwise and crosswise motions. The layers shall be pressed together with a trowel using lengthwise and crosswise motions until the trapped air has escaped. The folded two-layer glass fibre mat shall now be turned (Annex 2, Fig. G) and the randomly oriented side shall likewise be pressed against the layer underneath with a trowel using lengthwise and crosswise motions until the trapped air has escaped.

For a three-layer short liner (Annex 3), between the steps according to Annex 3, Figs. A to D, before folding, a second pre-impregnated glass fibre mat (approx. 1/3 of the length of the first glass fibre mat, Annex 7; short liner side C according to Annex 3, Fig. A) shall be placed on the first mat (Annex 3, Fig. E). After that, the same steps as for the preparation of a two-layer short liner shall be carried out (Annex 3, Figs. F to H).

Through the previously described folding to form a two- or three-layer short liner the randomly oriented fibre non-woven fabric side of the glass fibre mat forms the side facing the sewage and the other side forms the side facing the host pipe. The woven glass fibre fabric side of the glass fibre mat hence lies between the randomly oriented fibre non-woven fabric layers (Annex 2, Fig. Y).

The curing time and the changes in temperature over time shall be recorded in the log as specified in section 3.2.3.1.

3.2.3.6 Insertion of the short liner into the drainage pipe to be rehabilitated

Insertion of the impregnated short liner shall be carried out using a packer.

The rubber body of the packer suitable for the drainage pipe to be rehabilitated shall be smeared with a release agent and covered with a protective PE film. The protective PE film serves as a separating layer for the later removal of the packer from the drainage pipe. In the selection of the packer, it shall be ensured that the outer diameter of the packer is approx. 50 mm to approx. 80 mm smaller than the inner diameter of the pipe to be rehabilitated.

The resin-impregnated glass fibre mat shall be installed on the packer such that the randomly oriented fibre side and the overlaps are visible. The glass fibre mat shall be secured against slipping forwards or backwards (Annex 4, Figs. A and B). Only packers fitted with rollers shall be used for rehabilitation. The rollers shall be arranged such that when the packer is inserted into and moved inside the drainage pipe to be rehabilitated the resin-impregnated glass fibre mat does not touch the inside wall of the pipe.

Prior to insertion of the packer into the drainage pipe to be rehabilitated an air hose shall be connected from the compressor to the packer. The packer shall be pulled in via the previously attached rope or air pusher rods to the determined damage location in the drainage pipe and positioned. Through pressurisation with compressed air the rubber body of the packer is expanded and presses the resin-impregnated glass fibre mat against the inner wall of the pipe to be rehabilitated. The pressure shall be maintained until the resin system has cured. It shall be ensured that no excess resin exits. The pressure in the packer shall then be relieved and the packer shall be pulled back to the start point.

3.2.3.7 Labelling in the manhole

The following marks shall be affixed in a durable and easily legible manner in the start and end manhole of the repair or rehabilitation procedure:

- Type of rehabilitation
- Designation of pipe section
- Nominal size
- Wall thickness of short liner
- Year of rehabilitation

3.2.3.8 Final inspection and leak testing

After the work has been completed the rehabilitated pipe section shall be visually inspected and documented. (Annex 8). It shall be ensured that all material residues have been removed and no hydraulically disadvantageous wrinkles are present.

The short liner shall be checked for leaks in accordance with DIN EN 1610²⁴ after it has cured. The rehabilitated sewer can then be put back into operation.

3.2.4 Testing of samples

3.2.4.1 Curing

At least four times a year the applicant shall produce a short liner using a support pipe (e.g. in a PVC-U pipe) at the respective construction site. At least twice a year the short-term moduli of elasticity (1-hour value, 24-hour value) shall be determined on the thus obtained ring.

²⁴ DIN EN 1610 Construction and testing of drains and sewers; German version EN 1610:2015; issue: 2015-12

Using the 1-hour value and the 24-hour value it shall be determined whether the creep tendency of $K_n \leq 9.5\%$ based on DIN EN ISO 899-2²⁵ is complied with in accordance with the following ratio:

$$K_n = \frac{E_{1h} - E_{24h}}{E_{1h}} \times 100$$

3.2.4.2 Watertightness of samples

The watertightness of the cured short liner can be tested on a circumferential short liner section (ring) or on test pieces taken from the cured short liner. The sheeting of this short liner section or of the test piece shall either be removed or perforated for testing.

Testing of test pieces can be carried out with an overpressure or an underpressure of 0.5 bar. For the underpressure test one side of the sample shall be exposed to water. At an underpressure of 0.5 bar no water may be observed to exit from the sample side not exposed to water over a test duration of 30 minutes.

In the overpressure test, a water pressure of 0.5 bar shall be applied for a duration of 30 minutes. Also, when using this method, no water may be observed to exit from the side of the sample not exposed to water.

3.2.5 Declaration of compliance for the rehabilitation work carried out

Confirmation of compliance of the executed rehabilitation work with the provisions of this National Technical Approval/General Construction Technique Permit shall be provided by the executing company by means of a declaration of compliance based on the specifications given in Tables 1 and 2. The declaration of compliance shall be accompanied by documents providing data on the characteristics of the process components in accordance with section 2.1.1 and the results of the tests specified in Tables 1 and 2.

The rehabilitation project manager or a competent representative of the manager shall be present at the construction site during execution of the rehabilitation work. The manager or representative shall ensure that the work is carried out properly in accordance with the provisions of section 3.2 and in particular carry out or organise the tests specified in Table 1 and organise the tests specified in Table 2. The number and scope of the tests defined therein are minimum requirements.

The tests on test pieces specified in Table 2 shall be performed by an inspection body approved by the building control authorities (see list of testing, inspection and certification bodies in accordance with the Building Codes of the federal states (*Landesbauordnungen*) Part V No. 9).

Once every six months samples shall be taken from a short liner from a completed rehabilitation project by the above-mentioned inspection body. This body shall also check the documentation of the tests carried out in accordance with Table 1 for the rehabilitation measure.

²⁵ DIN EN ISO 899-2 Plastics – Determination of creep behaviour – Part 2: Flexural creep by three-point loading (ISO 899-2:2003); German version EN ISO 899-2:2003; issue: 2003-10

Table 1: “Process-accompanying tests”

Subject of test	Nature of requirement	Frequency
Visual inspection of pipe	in accordance with section 3.2.3.1 and DWA-M 149-2 ²¹	prior to each rehabilitation
Visual inspection of pipe	in accordance with section 3.2.3.8 and DWA-M 149-2 ²¹	after each rehabilitation
Equipment requirements	in accordance with section 3.2.2	each construction site
Final inspection	in accordance with section 3.2.3.8	
Labelling of containers for rehabilitation components	in accordance with section 2.2.3	
Resin mixing, resin amount and cure behaviour of each short liner	mixing report in accordance with section 3.2.3.4	
Cure temperature, cure time and pressure in packer	in accordance with section 3.2.3.6	

The tests specified in Table 2 shall be organised by the rehabilitation project manager or a competent representative of the manager. For the tests specified in Table 2 samples shall be obtained from the short liner.

Table 2: “Tests on test pieces”

Subject of test	Nature of requirement	Frequency
Short-term Young’s modulus (1-hour and 24-hour values) and creep	in accordance with section 3.2.4.1	every six months of production per executing party
Physical characteristics	in accordance with section 3.1.2.2	
Watertightness of the sample	without slip sheet in accordance with section 3.2.4.2	
Wall thickness and structure	in accordance with section 3.1.2.1	
Resin identity by means of IR spectroscopy	in accordance with section 2.1.1.2	

The test results shall be recorded and evaluated. Upon request, they shall be submitted to the Deutsches Institut für Bautechnik. The number and scope of tests listed in the tables are minimum requirements.

Christina Pritzkow
Head of Section

E-CR Glasfasergewebematte

Beschreibung

Glasfasergewebematte für zweilagige Liner

Flächengewicht ca. 1400 g/m² ± 4 %

Dicke ca. 1,8 mm

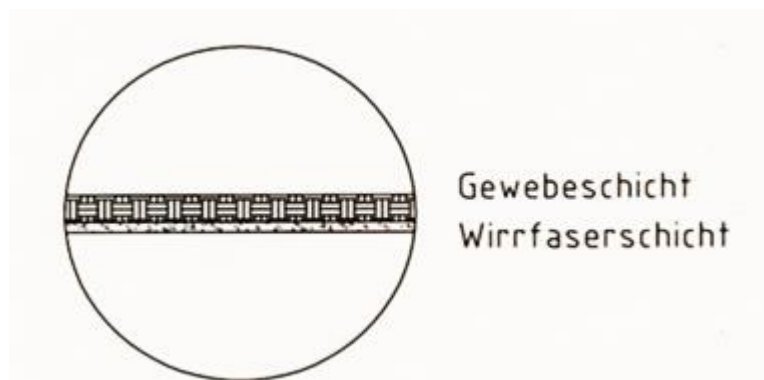
Breite (Standard) ca. 1300 mm

Glasfasergewebematte für dreilagige Liner

Flächengewicht ca. 1100 g/m² ± 4 %

Dicke ca. 1,2 mm

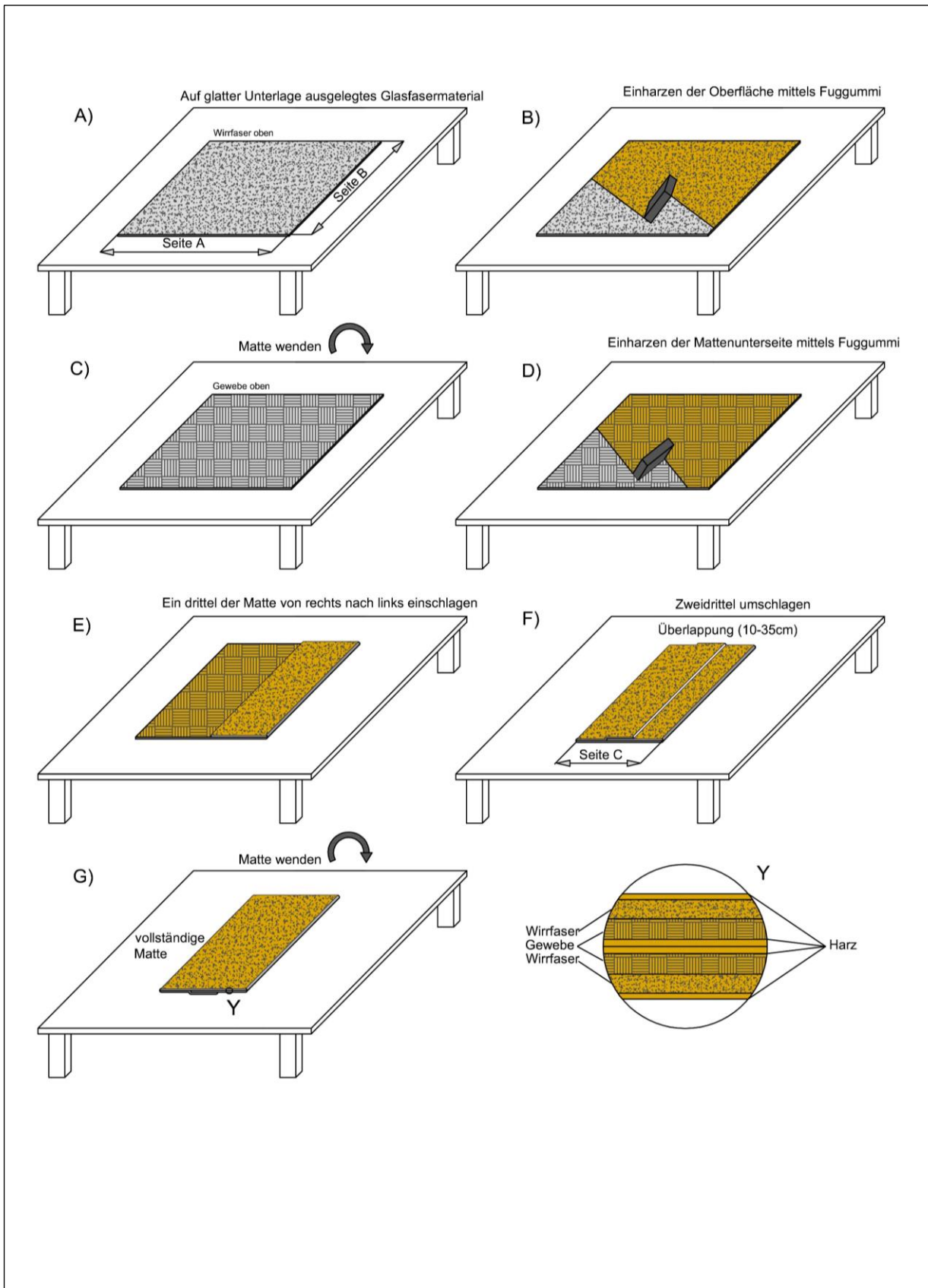
Breite (Standard) ca. 1300 mm



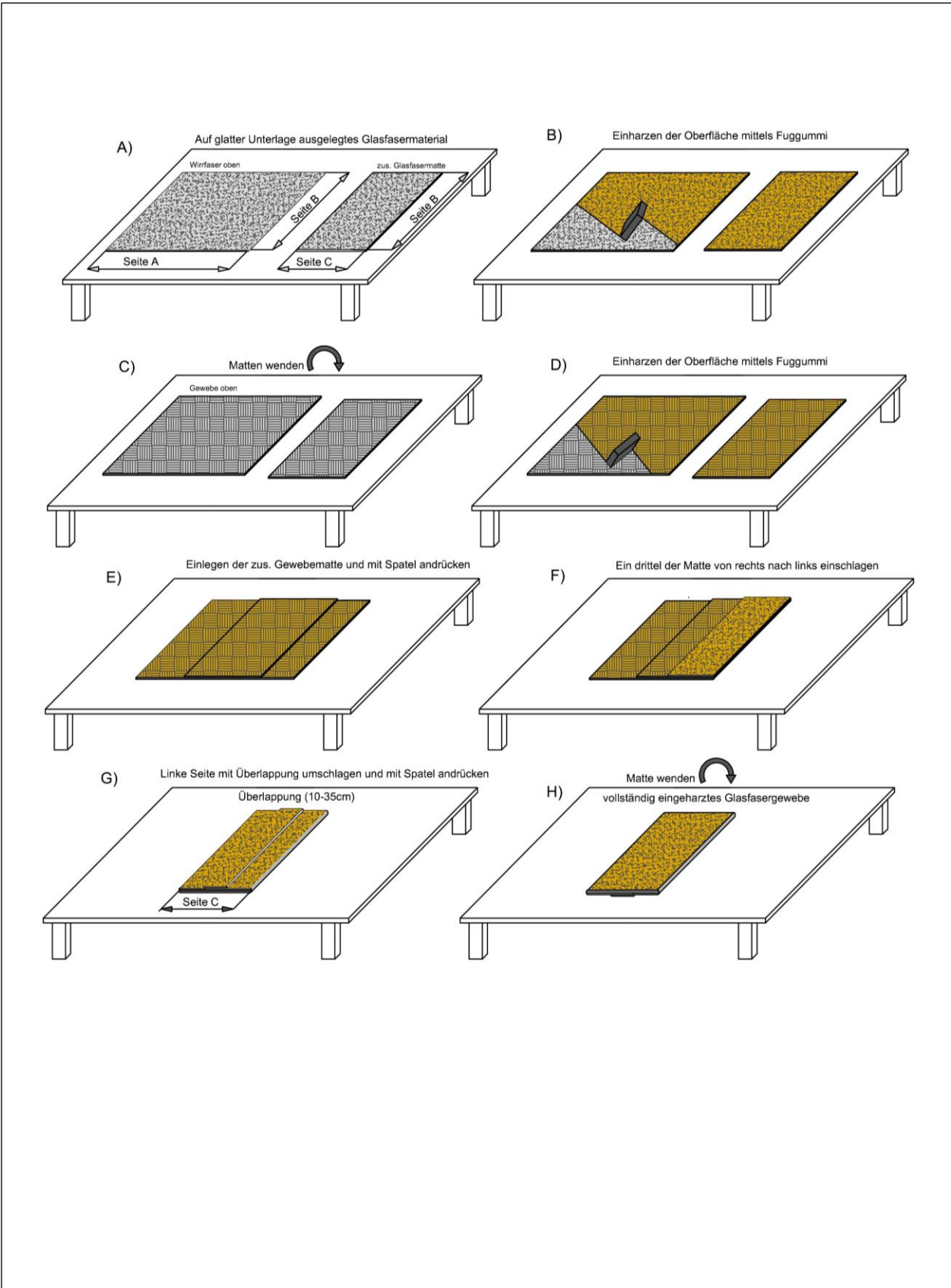
Kurzliner mit der Bezeichnung "CarboLith Spot Repair System" zur Sanierung erdverlegter schadhafter Abwasserleitungen im Nennweitenbereich von DN 100 bis DN 500

Die Glasfasermatte

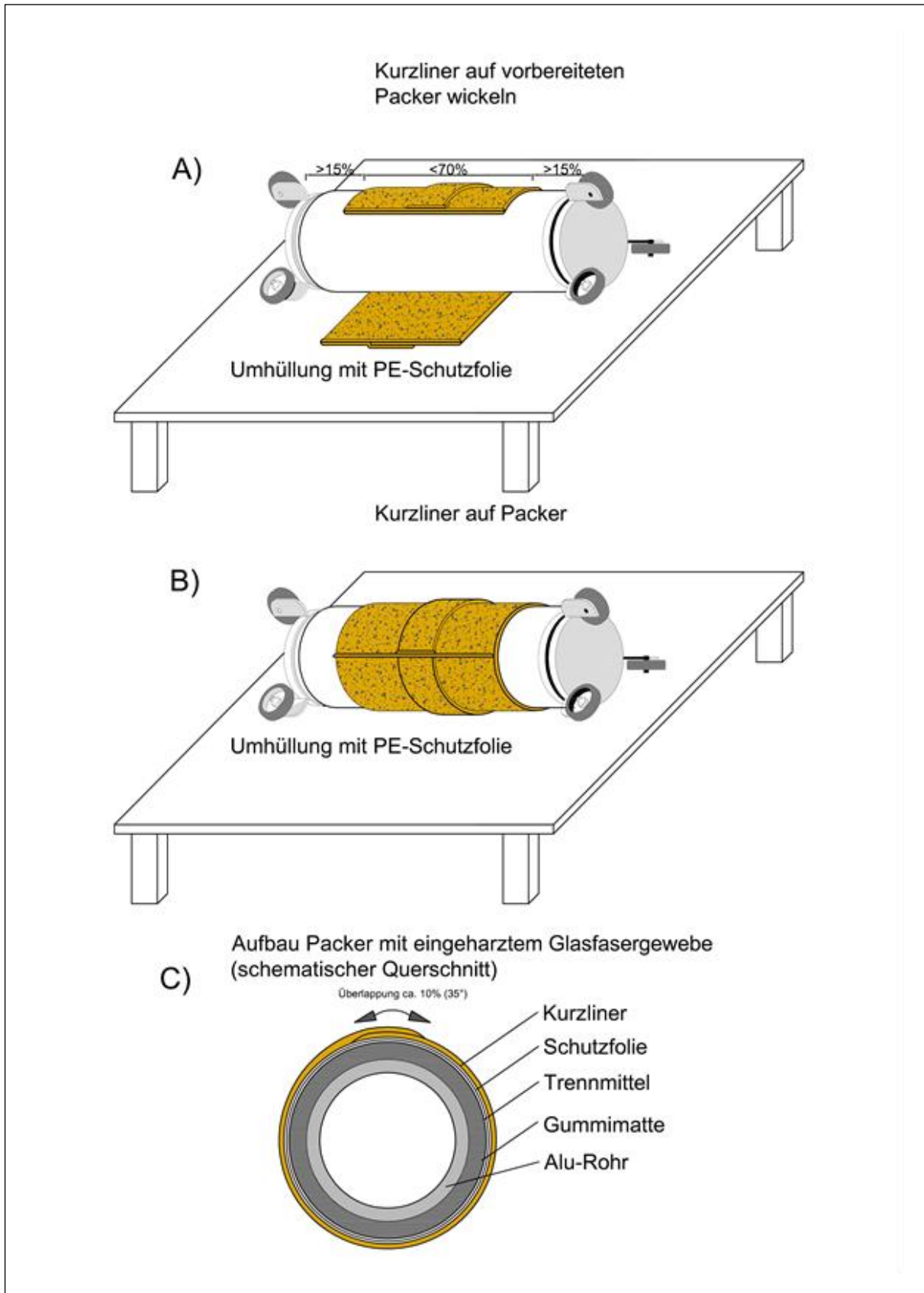
Anlage 1



<p>Kurzliner mit der Bezeichnung "CarboLith Spot Repair System" zur Sanierung erdverlegter schadhafter Abwasserleitungen im Nennweitenbereich von DN 100 bis DN 500</p>	<p>Anlage 2</p>
<p>Tränken und Falten der Glasfasermatte, 2 lagig</p>	



<p>Kurzliner mit der Bezeichnung "CarboLith Spot Repair System" zur Sanierung erdverlegter schadhafter Abwasserleitungen im Nennweitenbereich von DN 100 bis DN 500</p>	<p>Anlage 3</p>
<p>Tränken und Falten der Glasfasermatte, 3 lagig</p>	



Kurzliner mit der Bezeichnung "CarboLith Spot Repair System" zur Sanierung erdverlegter schadhafter Abwasserleitungen im Nennweitenbereich von DN 100 bis DN 500

Aufbringen der Glasfasermatte

Anlage 4

Produkttemperatur 10°C.

Zugabe C-Komponente bezogen auf A-Komponente	5,00 %	4,50 %	4,00 %	3,00 %			
Topfzeit (Verstreichbarkeit)	8'	9'	10'	12'			
Einbringzeit	15'	15'	20'	25'			
Entschalungszeit	50'	55'	60'	90'			

Produkttemperatur 15°C.

Zugabe C-Komponente bezogen auf A-Komponente			4,00 %	3,00 %	2,50 %	2,00 %	
Topfzeit (Verstreichbarkeit)			8'	9'	11'	12'	
Einbringzeit			10'	20'	20'	25'	
Entschalungszeit			50'	60'	75'	90'	

Produkttemperatur 20°C.

Zugabe C-Komponente bezogen auf A-Komponente				3,00 %	2,50 %	2,00 %	
Topfzeit (Verstreichbarkeit)				8'	9'	10'	
Einbringzeit				10'	15'	20'	
Entschalungszeit				55'	55'	60'	

Produkttemperatur 25°C.

Zugabe C-Komponente bezogen auf A-Komponente						2,00 %	1,00 %
Topfzeit (Verstreichbarkeit)						8'	10'
Einbringzeit						15'	20'
Entschalungszeit						50'	60'

Die Zugabe der C-Komponente bezieht sich in Volumenprozent auf die A-Komponente. In begründeten Fällen (siehe Handbuch) kann man von den Vorgaben abweichen.

Die C-Komponente muss homogen in die A-Komponente eingerührt werden. Alle Zeitangaben in Minuten ab Mischbeginn mit der B-Komponente. Die Mischzeit von 2 Minuten ist unbedingt einzuhalten. Die Mischung muss schlierenfrei und homogen sein.

Die angegebenen Zeiten sind Laborwerte mit einer Streuung von $\pm 15\%$. Sie können sich bei der Anwendung durch Wärmetausch zwischen Harz und Untergrund, so wie Oberflächenbeschaffenheit und anderen Faktoren beeinflusst werden.

Kurzliner mit der Bezeichnung "CarboLith Spot Repair System" zur Sanierung erdverlegter schadhafter Abwasserleitungen im Nennweitenbereich von DN 100 bis DN 500	Anlage 5
Dosierung der C-Komponente im System CarboLith PL	

Rohrdurchmesser [mm]	Schadenslänge [m]	Zuschnittlänge Glasfaser Seite A [m]	Zuschnittbreite Glasfaser Seite B [m]	Länge Kurzliner Seite C [m]	Harzmengenbedarf für zweilagige Matte in Volumen [Liter] 1400 g/m ² ± 4%
100	0,2	1,30	0,41	0,6	0,9
100	0,8	2,50	0,41	1,2	1,9
100	1,4	3,70	0,41	1,8	2,8
100	2,0	4,90	0,41	2,4	3,7
100	2,6	6,10	0,41	3,0	4,7
125	0,2	1,30	0,49	0,6	1,1
125	0,8	2,50	0,49	1,2	2,2
125	1,4	3,70	0,49	1,8	3,3
125	2,0	4,90	0,49	2,4	4,4
125	2,6	6,10	0,49	3,0	4,6
150	0,2	1,30	0,57	0,6	1,3
150	0,8	2,50	0,57	1,2	2,6
150	1,4	3,70	0,57	1,8	3,9
150	2,0	4,90	0,57	2,4	5,2
150	2,6	6,10	0,57	3,0	6,4
200	0,2	1,30	0,73	0,6	1,6
200	0,8	2,50	0,73	1,2	3,3
200	1,4	3,70	0,73	1,8	4,9
200	2,0	4,90	0,73	2,4	6,6
200	2,6	6,10	0,73	3,0	8,2
250	0,2	1,30	0,89	0,6	2,0
250	0,8	2,50	0,89	1,2	4,0
250	1,4	3,70	0,89	1,8	6,0
250	2,0	4,90	0,89	2,4	8,0
250	2,6	6,10	0,89	3,0	10,0
300	0,2	1,30	1,05	0,6	2,4
300	0,8	2,50	1,05	1,2	4,7
300	1,4	3,70	1,05	1,8	7,1
300	2,0	4,90	1,05	2,4	9,5
300	2,6	6,10	1,05	3,0	11,8
400	0,2	1,30	1,40	0,6	3,2
400	0,8	2,50	1,40	1,2	6,3
400	1,4	3,70	1,40	1,8	9,5
400	2,0	4,90	1,40	2,4	12,6
400	2,6	6,10	1,40	3,0	15,8
500	0,2	1,30	1,75	0,6	4,0
500	0,8	2,50	1,75	1,2	7,9
500	1,4	3,70	1,75	1,8	11,8
500	2,0	4,90	1,75	2,4	15,8
500	2,6	6,10	1,75	3,0	19,7

Kurzliner mit der Bezeichnung "CarboLith Spot Repair System" zur Sanierung erdverlegter schadhafter Abwasserleitungen im Nennweitenbereich von DN 100 bis DN 500 Harzmengenbedarf für zweilagige Anordnung der Glasfasermatten	Anlage 6

Rohrdurchmesser [mm]	Schadenslänge [m]	Zuschnittlänge Glasfaser Seite A [m]	Zuschnittbreite Glasfaser Seite B [m]	Zuschnittlänge Mittellage [m]	Zuschnittbreite Mittellage [m]	Länge Kurzliner Seite C [m]	Harzmengenbedarf für dreilagige Matte in Volumen [Liter]	
							1100 g/m ² ± 4%	1400 g/m ² ± 4%
100	0,2	1,30	0,41	0,60	0,41	0,6	1,1	1,4
100	0,8	2,50	0,41	1,20	0,41	1,2	2,2	2,8
100	1,4	3,70	0,41	1,80	0,41	1,8	3,3	4,2
100	2,0	4,90	0,41	2,40	0,41	2,4	4,4	5,6
100	2,6	6,10	0,41	3,00	0,41	3,0	5,5	7,0
125	0,2	1,30	0,49	0,60	0,49	0,6	1,3	1,7
125	0,8	2,50	0,49	1,20	0,49	1,2	2,6	3,3
125	1,4	3,70	0,49	1,80	0,49	1,8	3,9	5,0
125	2,0	4,90	0,49	2,40	0,49	2,4	5,3	6,7
125	2,6	6,10	0,49	3,00	0,49	3,0	6,6	8,3
150	0,2	1,30	0,57	0,60	0,57	0,6	1,5	1,9
150	0,8	2,50	0,57	1,20	0,57	1,2	3,0	3,9
150	1,4	3,70	0,57	1,80	0,57	1,8	4,6	5,8
150	2,0	4,90	0,57	2,40	0,57	2,4	6,1	7,7
150	2,6	6,10	0,57	3,00	0,57	3,0	7,6	9,7
200	0,2	1,30	0,73	0,60	0,73	0,6	1,9	2,5
200	0,8	2,50	0,73	1,20	0,73	1,2	3,9	4,9
200	1,4	3,70	0,73	1,80	0,73	1,8	5,8	7,4
200	2,0	4,90	0,73	2,40	0,73	2,4	7,8	9,9
200	2,6	6,10	0,73	3,00	0,73	3,0	9,7	12,3
250	0,2	1,30	0,89	0,60	0,89	0,6	2,4	3,0
250	0,8	2,50	0,89	1,20	0,89	1,2	4,7	6,0
250	1,4	3,70	0,89	1,80	0,89	1,8	7,1	9,0
250	2,0	4,90	0,89	2,40	0,89	2,4	9,4	12,0
250	2,6	6,10	0,89	3,00	0,89	3,0	11,8	15,0
300	0,2	1,30	1,05	0,60	1,05	0,6	2,8	3,6
300	0,8	2,50	1,05	1,20	1,05	1,2	5,6	7,1
300	1,4	3,70	1,05	1,80	1,05	1,8	8,4	10,7
300	2,0	4,90	1,05	2,40	1,05	2,4	11,2	14,2
300	2,6	6,10	1,05	3,00	1,05	3,0	14,0	17,8
400	0,2	1,30	1,40	0,60	1,40	0,6	3,7	4,7
400	0,8	2,50	1,40	1,20	1,40	1,2	7,5	9,5
400	1,4	3,70	1,40	1,80	1,40	1,8	11,2	14,2
400	2,0	4,90	1,40	2,40	1,40	2,4	14,9	19,0
400	2,6	6,10	1,40	3,00	1,40	3,0	18,7	23,7
500	0,2	1,30	1,75	0,60	1,75	0,6	4,7	5,9
500	0,8	2,50	1,75	1,20	1,75	1,2	9,3	11,8
500	1,4	3,70	1,75	1,80	1,75	1,8	14,0	17,8
500	2,0	4,90	1,75	2,40	1,75	2,4	18,7	23,7
500	2,6	6,10	1,75	3,00	1,75	3,0	23,3	29,6

Kurzliner mit der Bezeichnung "CarboLith Spot Repair System" zur Sanierung erdverlegter schadhafter Abwasserleitungen im Nennweitenbereich von DN 100 bis DN 500	Anlage 7

Reparaturprotokoll der Baumaßnahme _____

Blatt _____ von _____

Auftraggeber		Auftragnehmer	
Ort		Ort	
Straße		Straße	
Kontaktperson		Kontaktperson	
Telefon		Telefon	
Baumaßnahme			
Ort		Straße	
von Schacht		bis Schacht	
Haltung		Rohrmaterial	
Kanalrohr-Nennweite		Position/Reparaturlage	
Datenträger (CD/Stick/Memory card)		Fotos	

Wetter

Wetterbeschreibung _____

Trockenwetter: ja nein
 Regen: ja nein
 Temperatur außen ____ °C im Kanal: ____ °C

Voraussetzungen

Genehmigung eingeholt: ja nein
 Wasserhaltung eingerichtet: ja nein
 StVO-Absicherung: ja nein
 Reparaturbereich vorbereitet: HD-Reinigung mechanisch Roboter
 Hochdruckreinigung – ja am: _____ Fräsen/Schleifen
 TV-Inspektions/Querschnittskontrolle ja nein

Verwendetes Material

CarboLith PL - A: Chargen-Nr. _____ Rückstellmuster
 Wasserhaltung eingerichtet: ja nein
 StVO-Absicherung: ja nein
 Reparaturbereich vorbereitet: HD-Reinigung mechanisch Roboter
 Hochdruckreinigung – ja am: _____
 TV-Inspektions/Querschnittskontrolle ja nein

Verwendete Materialmengen

Harzbedarf CarboLith PL: Soll ____ kg (gemäß Anlagen DIBt-Zul.) Ist ____ kg (Gesamtvolumen)
 Produkttemperatur: Soll 15-25 °C Ist ____ °C
 Mischpumpenverhältnis Soll: A= 1 B = 2 C= ____ % von A (gemäß Anlage DIBt-Zulassung)
 Mischpumpenverhältnis Ist: A= ____ (Vol) B = ____ (Vol) C= ____ Zugabe in % von A
 Mischbeginn ____ Uhr Ende Tränkvorgang ____ Uhr
 Mischzeit Soll: 2 Minuten Ist: ____ Minuten
 Temperatur außen ____ °C im Kanal: ____ °C

Aufstelldruck und Aushärtezeit des Blähpackers

Packer Aufblähen: ____ Uhr Packer Entspannen: ____ Uhr
 Verarbeitungszeit: Max ____ Minuten Eingehalten ja nein
 Aushärtezeit Soll: 50 - 90 Min. Ist ____ Min
 Aufstelldruck des Packers: Soll: 1-2 bar Ist: ____ bar
 TV-Endabnahme: ja nein

Datum: _____ Unterschrift: _____ Operateur: _____

Kurzliner mit der Bezeichnung "CarboLith Spot Repair System" zur Sanierung erdverlegter schadhafter Abwasserleitungen im Nennweitenbereich von DN 100 bis DN 500

Reparaturprotokoll

Anlage 8