

Company profile

- 1. Organisation***
- 2. Services provided***
- 3. Quality assurance***
- 4. Company history***
- 5. Experience / key personal / trade associations***

***Your partner
for no-dig sewer repair
and renovation systems***



1.1 Contacts

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2.0 Services

2.1 Condition Anlyase of channel and pipes lines

Channel television	IBAK-Radias / Sirius Color-camera 450 m cable to 3.5 tonnes Vehicle Application area: D100 - 1250mm Additional equipment: <ul style="list-style-type: none">- For egg-shaped channels- For pictures of profiles track- Evaluation with the company WinCan CD Lap AG IBAK-Triton / Sirius-Color-camera with 450m cable Application area: D100 - 1000mm Evaluation with the company WinCan CD Lap AG IBAK-Ceres Color-camera with 100m cable Application area: D60-150mm Evaluation with the company WinCan CD Lap AG
Investigation team	for walk-channels, program evaluation on Win Can
Pipeline pressure testing	device and test socket according to SIA standards
Places	of channels, pipes and manholes with tracking device up to 15m depth
Consultancy / Projects	Building <ul style="list-style-type: none">- Condition Survey- Renovation projects- Cost estimates Advice for: <ul style="list-style-type: none">- Maintenance and Renovation

2.2 Repair and renovation of sewers and pipes

Repair methods

- 2.2.11 Primo robot system
- 2.2.12 * Flexiliner P (partial relining)
- 2.2.13 * Flexiliner S (short relining)
- 2.2.14 Lateral-Packer
- Renovation of supports

Injection and sealing methods

- 2.2.21 *PEKA-Tech injection system (3M-PUR)

Structural repairs

- 2.2.31 ZM injection
- 2.2.32 PEKA-Tech injection system

Renovation methods

*Relining methods

- 2.2.41 Long pipe/pipeline – PEKA-Plast system
- 2.2.42 Short pipe – PEKA-Plast system

*Pipe relining methods

- 2.2.51 Flexiliner II (pipe relining) diameter 200 – 1200 mm
- 2.2.52 Flexiliner H (pipe relining) diameter 80 – 300 mm

Renewal

- 2.2.61 *Installation method – PEKA-Plast system

***company's own licence**



2.2.11 Primo Robot System

Procedure

Procedure Category Maintenance / Repair Procedures

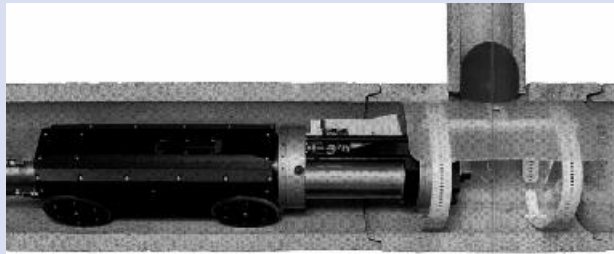
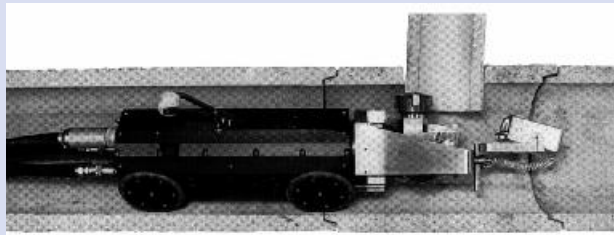
Note General information concerning relining procedures is available in section 4.2.1 of IP Construction¹, Maintenance of Inaccessible Channels.

Producer PMO Dübendorf
KRT Engineering + Handel AG Sempach

Supplier KRT Kanal-Service AG

Brief description The robots are put into the pipe section via an inspection shaft and guided to the damage site by an operator in the control vehicle using the remote camera. The damage is repaired by means of various devices capable of carrying out a variety of tasks such as grinding, drilling, injecting, filling and smoothing and sanding. The placing of rubber seals for the repair of lateral connections is also possible.

Schematic diagram



Materials 2 Component epoxy resin adhesive 96101/96107/96110

Standards Not standardized in Switzerland

First application World wide / Switzerland 1994

Area of Application

Nature of Damage Pipe cross-section:
- Root penetration
- Build up of deposits and foreign bodies

Pipe walls:
- Axial and radial cracks
- Flaking and holes
- Build up of fragments

<i>Nature of damage</i>	<i>Sleeve joints:</i> <ul style="list-style-type: none">- Leaks- Outflow <i>Lateral connections:</i> <ul style="list-style-type: none">- Protruding connections- Defects in the connection area- Closing and plugging of redundant connections- Reconnection during the relining procedure
<i>Restrictions</i>	<i>Limitations only in the case of:</i> <ul style="list-style-type: none">- Pipe wall corrosion- Broken or collapsed pipes- Positional shifting
<i>Pipe materials</i>	<i>All types, restrictions for plastics</i>
<i>Cross-Sections</i>	<i>Circular / Oval</i>
<i>Dimensions</i>	<i>Circular NW 150 mm to NW 800 mm</i> <i>Oval 300/450 mm, 400/600 mm</i>
<i>Maximum Range</i>	<i>Up to about 80 m', using cable extending kit of about 40 m'</i>
<i>Curves – U-Bends</i>	<i>Limitations to use</i>

Preparatory Work

<i>Excavations</i>	<i>Not usually necessary. Access via inspection shafts</i>
<i>Pipe Cross-Section</i>	<i>High pressure cleaning</i>
<i>Lateral Connections</i>	<i>No prior measures required</i>
<i>Ground Water</i>	<i>Plugging may be required according to the nature of the damage</i>
<i>Water Treatment</i>	<i>When working in the area of the water flow and for large volumes of water use of by-pass pumps for waste water may be necessary</i>

Final Tasks

<i>Inspection Shafts</i>	<i>No measures necessary</i>
<i>Lateral Connections</i>	<i>No measures necessary</i>
<i>Subsequent Treatment</i>	<i>High pressure cleaning</i>
<i>Acceptance</i>	<i>Inspection with pipe remote cameras</i> <i>Sealing test using air in accordance with SIA 190</i>

Remarks *No reduction in cross-section*
Inflow repair using sealing system

Status *August 2001*

Procedure **2.2.12 Flexiliner P (partial relining)**

Type of Procedure *renewal, cleaning, pipe relining*

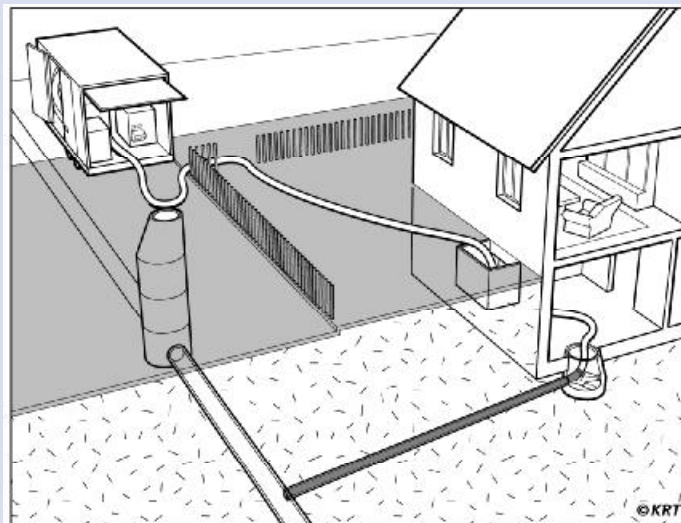
Notice *general information on the relining procedures are contained in Section 4.3.2 of the IP Construction, maintenance of non walk-in sewage systems*

License *KRT Engineering + Handel AG, Sempach*

Bidder *KRT Kanal-Service AG*

Brief Description *A hose impregnated with epoxy resin or glass fibre matting is put onto a rubber packer and inserted into the pipe section to be renovated with the help of a winch. By adding hot water to the packer circulation system, the hose is pressed against the pipe wall. After ending the hardening (30'-180'), depending on the type of resin, the pressure is reduced and withdrawn from the pipe.*

Schematic Diagram



Materials *Base material: fibre glass matting 1100 – 3600 gr/m² or synthetic fleece 4.5 - 9.0 mm
Resin: epoxy resin system
Layer thickness: 4.5 - 9 mm*

Standards *Not standardized in Switzerland*

*D: ATV Instruction Sheet M 143 Part 3: Relining (draft)
ATV Worksheet A 127 (statics)*

First Application *Worldwide / Switzerland 1992*

Procedure **2.2.13 Flexiliner S (short relining)**

Type of Procedure maintenance and repair procedures

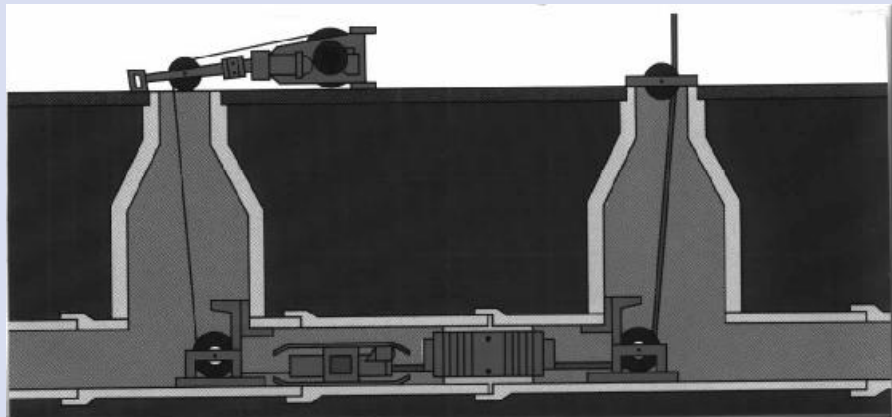
Notice general information on the relining procedures are contained in Section 4.2.1 of the IP Construction, maintenance of non walk-in sewage systems

License KRT Engineering + Handel AG, Sempach

Bidder KRT Kanal-Service AG

Brief Description An impregnated inner sleeve made of glass fibre matting of restricted length is mounted on a special packer and, with the help of a winch, positioned over the damaged point. By sending hot water into the packer, the fibre glass hose is pressed against the pipe wall, whereby the excess epoxy resin penetrates into cracks and hollow areas. After the end of the hardening process, the packer is ventilated and taken out of the pipe.

Schematic Diagram



Materials Base material: ready-to-use sleeve made of fibre glass matting V 2400
Resin: diverse epoxy resin systems
Layer thickness: 3 - 5 mm

Standards Not standardized in Switzerland

First Application Worldwide / Switzerland 1992

Area of Application

<i>Damage Aspects</i>	<i>Locally restricted damage areas such as:</i> <ul style="list-style-type: none">- <i>Open or damaged sleeves</i>- <i>Root intrusion</i>- <i>Cracks, flaking and fragmentation in the pipe wall</i>
<i>Restrictions</i>	<ul style="list-style-type: none">- <i>Pipe rupture or collapse</i>- <i>Deviation in position</i>- <i>Excessive deformation in flexible pipe</i>- <i>Corroded pipe continuously</i>
<i>Pipe Material</i>	<i>All materials</i>
<i>Cross-Section Forms</i>	<i>Circular profiles</i>
<i>Dimensions</i>	<i>Circular profiles NW 100 mm to NW 1000 mm</i>
<i>Maximum Range</i>	<i>up to about 100 m</i>
<i>Curves / U Bends</i>	<i>limitedly applicable</i>

Preparatory Work

<i>Excavations</i>	<i>not usually required; access via inspection shafts</i>
<i>Pipe Cross-Section</i>	<i>high pressure cleaning, creation of the original cross-section by boring or cutting</i>
<i>Lateral Connections</i>	<i>cut back protruding connections</i>
<i>Groundwater</i>	<i>no measures necessary, strong infiltration to be sealed by injections</i>
<i>Draining of Water</i>	<i>pumping out of wastewater usually not necessary</i>

Final Tasks

<i>Inspection Shafts</i>	<i>no measures necessary</i>
<i>Lateral Connections</i>	<i>no measures necessary</i>
<i>Treatment</i>	<i>no measures necessary</i>
<i>Acceptance</i>	<i>inspection with pipe remote camera. Tightness test as per SIA V 190</i>

Remarks

- *minimum cross-section reduction*
- *length of sleeves:*
 - standard = 0.4 m*
 - special = any lengths (up to about 5 m)*
- *hardening in operational state: 0.5 to 1 hour*

- *examples with NW 100 mm to 800 mm in Switzerland and Germany from 1994 as Shortliner, in France from 1994 as Flexojoint*

Status	<i>January 2000</i>
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2.2.14 Lateralpacker System

Procedure

Type of Procedure *maintenance, repair / injection procedure*

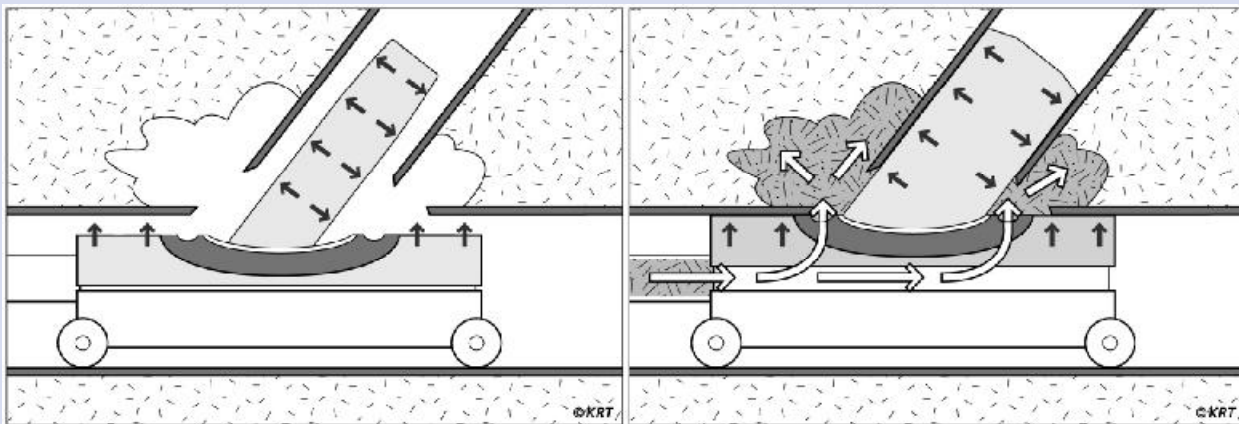
Licensor / Manufacturer packer: *Umwelttechnik Strobel GmbH Max Eyth-Strasse 3
D-72505 Krauchenwies*

Construction: *KRT Kanalrenovationen AG*

Bidder *KRT Kanal-Service AG*

Brief Description *The connection pieces / inlets are pressed with the help of a special packer, which is placed in the main pipe and in the inlet, with injection mortar. All the hollow areas are filled as a result of the high pressure and a smooth inner wall achieved by the lagging. With the special packer the imperviousness can be tested in a separate work step. An advance sealing is usually not necessary.*

Schematic Diagram



Materials *ZM injection mortar*

Standards and Guidelines *Not standardized in Switzerland
VSA guideline: maintenance of sewage systems, Annex 5*

First Applications *Worldwide 1996 Facilities in use: 22
Switzerland 1999 Facility in use: 1*

Area of Application

<i>Damage Aspects</i>	<i>chipped and otherwise damaged connection pieces and inlets</i>
<i>Restrictions</i>	<i>reservations for statically badly damaged pipes</i>
<i>Sewage Pipe Material</i>	<i>all materials</i>
<i>Cross-Section Forms</i>	<i>Circular profiles</i>
<i>Dimensions</i>	<i>Circular profiles NW 200 mm to NW 600 mm</i>
<i>Maximum Range</i>	<i>up to about 70 m</i>
<i>Curves / U Bends</i>	<i>limitedly applicable</i>

Preparatory Work

<i>Excavations</i>	<i>not usually required; access via inspection shafts</i>
<i>Pipe Cross-Section</i>	<i>high pressure cleaning, creation of the original cross-section by boring or cutting</i>
<i>Lateral Connections</i>	<i>cut back protruding connections</i>
<i>Groundwater</i>	<i>no measures necessary</i>
<i>Draining of Water</i>	<i>pumping out of wastewater necessary with large amounts of water</i>
<i>Ventilation</i>	<i>as per SUVA regulations; Instructions Sheet on Industrial Safety, October 1996</i>

Final Tasks

<i>Inspection Shafts</i>	<i>no measures necessary</i>
<i>Lateral Connections</i>	<i>no measures necessary</i>
<i>Treatment</i>	<i>high pressure cleaning</i>
<i>Acceptance /- Quality Assurance</i>	<i>inspection with pipe remote camera tightness test with air as per VSA guideline</i>

Remarks *no cross-section reduction, hollow areas filled*

Status *January 2000*

2.2.21 Peka-Tech Pressing System

Procedure

Type of Procedure maintenance – injection procedure

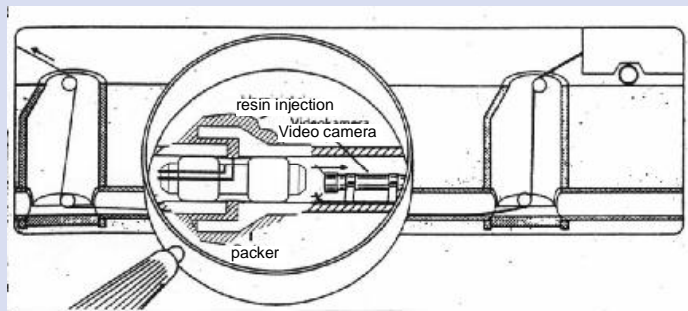
Notice general information on the relining procedures are contained in Section 4.2.3 of the IP Construction, maintenance of non walk-in sewage systems

Manufacturer KRT Engineering + Handel AG Sempach
Buchen SIS Inc.

Bidder KRT Kanal-Service AG

Brief Description The sleeves identified by a sewage system remote control camera are pressed individually with the help of special units (packers) with air or water and thus possible pressure losses are established. In leaking sleeves, in the same workstep, a 2 component gel is pressed outward into the earth or into the surrounding material. The gel polymerises and forms outside the pipe a water-impervious layer. Thereafter the imperviousness is tested again.

Schematic Diagram



Materials 2 component polyurethane resin on an acrylic basis consisting of:
- PUR prepolymer
- Water
- Additives

Standards Not standardized in Switzerland

First Applications Worldwide 1960 USA
Switzerland 1985

Area of Application

Damage Aspects Locally restricted leak points in particular in the sleeve area (infiltration, exfiltration)

Restrictions procedure only conditionally applicable for:
- longitudinal cracks
- very rough or uneven pipe walls
- statically damaged pipes

Damage Aspects sleeves:
- leakiness
- ruptures

lateral connections:
- protruding connections
- defects in connection area
- closing and filling in dead connections
- reconnecting in cases of relining procedures

Restrictions procedures only conditionally applicable for:
- corroded pipe walls
- ruptures or collapses
- deviations in position

Raw Materials all materials, restrictions for plastics

Cross-Section Forms circular profiles

Dimensions circular profiles NW 200 mm to NW 800 mm
egg-shaped 400/600

Maximum Range up to about 160 m

Curves / U Bends limitedly applicable

Preparatory Work

Excavations not usually required; access via inspection shafts

Pipe Cross-Section high pressure cleaning

Lateral Connections no measures necessary in advance

Groundwater sealing required depending on the damage aspects

Draining of Water pumping out of wastewater necessary for tasks in the vicinity of the waterflow and for large amounts of water

Final Tasks

Inspection Shafts no measures necessary

Lateral Connections no measures necessary

Treatment high pressure cleaning

Acceptance / Quality Assurance inspection with pipe remote camera
tightness test as per SIA V 190, EN 1610, M 143 part 6, VSA appendix 6

Remarks no cross-section reduction

Status January 2000

2.2.41 Pekaplast Relining System

Procedure

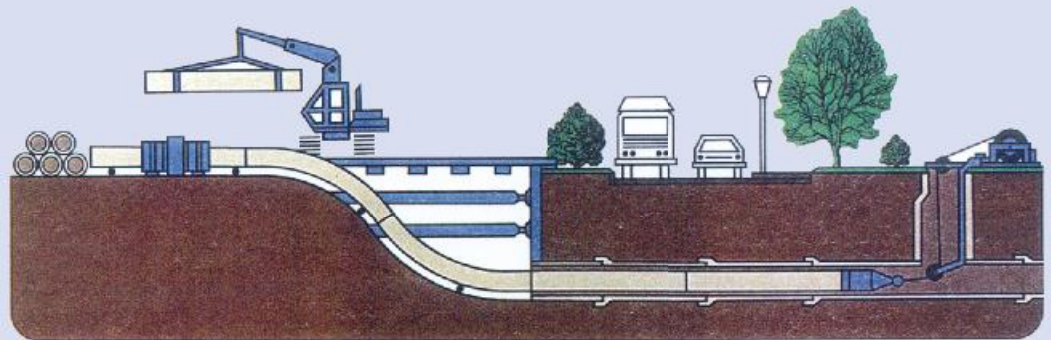
Procedure Category *Renovation/Relining Procedure*

Licencer/Producer *KRT Engineering + Handel AG, Sempach*

Supplier *KRT Kanal-Service AG*

Brief description *Flexible HDPE corrugated pipes are drawn into existing piping via an inspection shaft. The HDPE corrugated pipes are delivered in sections or rolls. Prior to insertion, sections of pipe are welded together into lengths. The ends are secured into the shafts (by packing or anchor points) and the annular gap between old and new piping must be plugged. To secure the joints, the section of the pipe in question must remain uncovered.*

Schematic diagram



Materials *HDPE Pipes corrugated*

Dimensions *External diam. / Internal diam.: 75/64 – 90/78 – 110/96 – 125/110 – 140/120 – 160/140
238/200 – 290/250 – 345/297 – 397/347*

*HDPE Pipes smoothed
Dimensions: All dimensions of individual wall thicknesses :*

Standards and Guidelines *As for rebuilding*

First application *Switzerland 1987*

Area of Application

Nature of Damage

- *Damaged surfaces or pipe walls*
- *Localised damage, such as splits, perforations, fragmenting, or open or damaged sleeve joints*

Restrictions See *Factory Instructions for HDPE Pipes*

Pipe material All materials

Cross-Section Circular profiles

Dimensions Circular profiles NW 80 mm to NW 400 mm

Maximum Range Dependant on various factors

Curves/U-Bends Dependant on various factors

Preparatory Work

Installation Installation via existing inspection shafts

Excavations Necessary in the area where joints occur

Pipe Cross-Section High pressure cleaning, restoration of the original cross-section by boring or grinding (sizing)

Lateral Connections Grind back existing connections

Ground Water Plugging of the annular space in exceptional cases

Water Treatment Resolution on a case by case basis.

Ventilation In accordance with SUVA¹ safety regulations

Final Tasks

Inspection Shafts Secure into shaft using shaft packing, or anchoring points

Lateral Connections Lateral connections should be tightly jointed with saddle pieces and constructed in the open.

Subsequent Treatment None

Acceptance Inspection with pipe remote cameras / video recording

Quality Assurance Sealing test using air in accordance with VSA guidelines

Remarks Large reduction in cross-section
Slope to be taken into consideration

Status January 2000

Procedure

2.2.42 PE Short Pipe Relining System

Procedure Category

Renovation/Relining Procedure

Licencer/Producer

KRT Engineering + Handel AG, Sempach

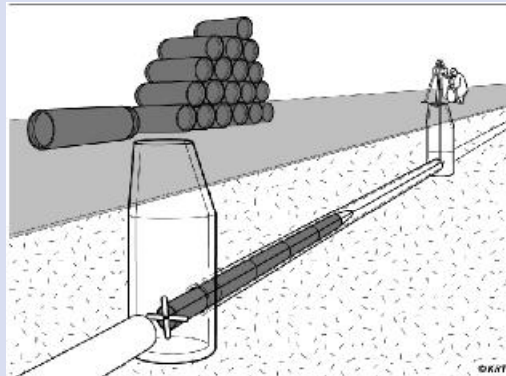
Supplier

KRT Kanal-Service AG

Brief description

Short sleeve jointed HDPE pipes are inserted or drawn into the existing pipe-work via an inspection shaft. Individual short pipes are assembled in the inspection shaft and are either inserted, bolted or welded together. The ends are secured into the shafts (by packing or anchor points) and the annular gap between old and new piping must be plugged. To secure the joints, the section of the pipe in question must remain uncovered.

Schematic Diagram



Materials

HDPE-Pipes

Material Strength: According to manufacturer (varies)

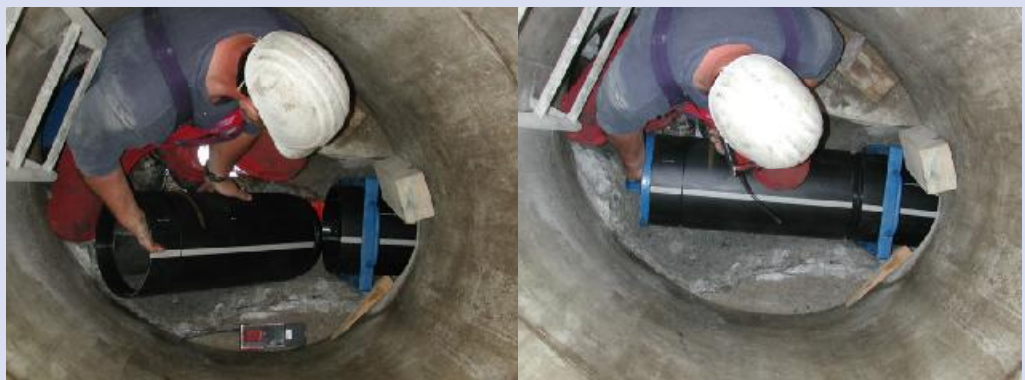
Standards and Guidelines

As for rebuilding

First application

World-wide 1984

Switzerland 1993



Area of Application

<i>Nature of Damage</i>	<i>- Damaged surfaces or pipe walls - Localised damage, such as splits, perforations, fragmenting, or open or damaged sleeve joints</i>
<i>Restrictions</i>	<i>See Factory Instructions</i>
<i>Pipe material</i>	<i>All materials</i>
<i>Cross-Section</i>	<i>Circular profiles</i>
<i>Dimensions</i>	<i>Circular profiles NW 100 mm to NW 400 mm</i>
<i>Maximum Range</i>	<i>In accordance with Factory Instructions</i>
<i>Curves/U-Bends</i>	<i>Only possible with adjacent excavation</i>

Preparatory Work

<i>Installation</i>	<i>Installation via existing inspection shafts</i>
<i>Excavations</i>	<i>Necessary in the area where joints occur</i>
<i>Pipe Cross-Section</i>	<i>High pressure cleaning, restoration of the original cross-section by boring or grinding (sizing)</i>
<i>Lateral Connections</i>	<i>Grind back existing connections</i>
<i>Ground Water</i>	<i>Penetration by ground water should be sealed off</i>
<i>Water Treatment</i>	<i>Necessary to use waste water by-pass pumps</i>
<i>Ventilation</i>	<i>In accordance with SUVA¹ safety regulations</i>

Final Tasks

<i>Inspection Shafts</i>	<i>Secure into shaft using shaft packing, or anchoring points</i>
<i>Lateral Connections</i>	<i>Lateral connections should be tightly jointed with saddle pieces and constructed in the open.</i>
<i>Subsequent Treatment</i>	<i>High pressure cleaning / Sizing</i>
<i>Acceptance</i>	<i>Inspection with pipe remote cameras / video recording</i>
<i>Quality Assurance</i>	<i>Sealing test using air in accordance with VSA guidelines</i>

Remarks

*Large reduction in cross-section
Slope to be taken into consideration*

Status

January 2000

Procedure

2.2.51 Flexiliner II (pipe relining) Typ Plus: (Inversion)

Type of Procedure

renewal, cleaning, pipe relining

Notice

general information on the relining procedures are contained in Section 4.3.2 of the IP Construction, maintenance of non walk-in sewage systems

License

KRT Engineering + Handel AG, Sempach

Bidder

KRT Kanal-Service AG

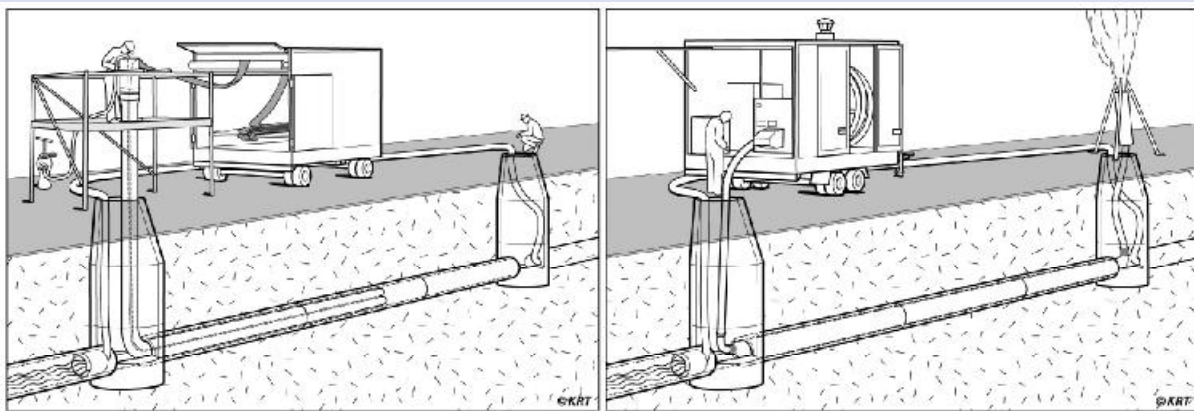
Brief Description

A flexible hose which has been saturated with epoxy resin is inserted into an existing manhole and inverted into the sewer pipe which is to be renovated using water after which it is inflated against the sewer walls using compressed air. The epoxy resin is hardened under pressure achieved by blowing in steam or heated water. Seamless sheathing of the sewer pipe which lies tightly onto the pipe without leaving a circular gap is thus ensured.

Schematic Diagram

- Insertion Phase

- Hardening Phase



Materials

Base material: ready-to use hose made of synthetic polyester fleece, if required, reinforced by glass fibre fabric

Resin: diverse epoxy resin systems

Layer thickness: 3.0 mm to 24 mm depending on pipe diameter and load

Standards

EU: DIN / EN 135566-4-2002

D: ATV Instruction Sheet M143 Part 3: Relining (draft)
ATV Worksheet A 127 (statics)

First Applications

Worldwide	1979	F (Copaflex)
Switzerland	1985	(Flexliner I)
Switzerland	1995	(Flexliner II)
	1998	(Flexliner II Plus)

Area of Application

Damage Aspects

- Open or damaged sleeves
- Cracks, flaking and light fragmentation in the pipe wall
- Corroded pipe walls

Further Applications

- Increase in performance capacity
- Increase or restoration of the static strength

Restrictions

Procedure only conditionally applicable for:

- Pipe collapse
- Deviation in position
- Excessive deformation in flexible pipes

Pipe Material

All materials

Cross-Section Forms

Circular, egg-shape and special profiles

Dimensions

Circular profiles NW 100 mm to NW 1250 mm

Maximum Range

depending on the dimensions up to about 125 m

Curves / U Bends

with reservations (wrinkling)

Preparatory Work

Excavations

not usually required; access via inspection shafts

Pipe Cross-Section

high pressure cleaning, creation of the original cross-section by boring or cutting

Lateral Connections

cut back protruding connections

Groundwater

intensive groundwater flooding to be sealed in advance

Draining of Water

pumping out of wastewater and the lateral connections required

Final Task

Inspection Shafts

transition from pipe / inspection shaft re-worked with special mortar. Tightness between pipe and relining in the transition area to be made safe with cladding

Lateral Connections

Reconnect from outside or cut the relining with sewage pipe robots from the inside. Thick wrapping of the connection pipe by commensurate measures (pressing, levelling out, shaped pieces)

Treatment

high pressure cleaning

Acceptance

inspection with pipe remote camera. Tightness test as per SIA N 190

Remarks

- reduction of cross-section according to layer thickness
- wrinkling in curves dependent on pipe diameter, radius and angle
- No cladding between relining and pipe when using an outer foil
- In France until the end of 1990 about 17.5 km so executed; in Switzerland, until the end of May 1997, about 55 km

Advantages of the System

- no excavations
- minimum traffic obstruction
- minimum cross-sectional losses
- short renewal time (1 day per sewage unit)
- improvement in pipe static
- improvement in the roughness value
- simple installation, mobile, also possible on the inside of buildings and in open terrain
- adherent connections using friction possible
- minimum installation requirements
- guaranteed service life of 50 years

Status

January 2000

Procedure

2.2.51 Flexiliner II (pipe relining) Typ Perfect: (Heeling)

Type of Procedure

renewal, cleaning, pipe relining

Notice

general information on the relining procedures are contained in Section 4.3.2 of the IP Construction, maintenance of non walk-in sewage systems

License

KRT Engineering + Handel AG, Sempach

Bidder

KRT Kanal-Service AG

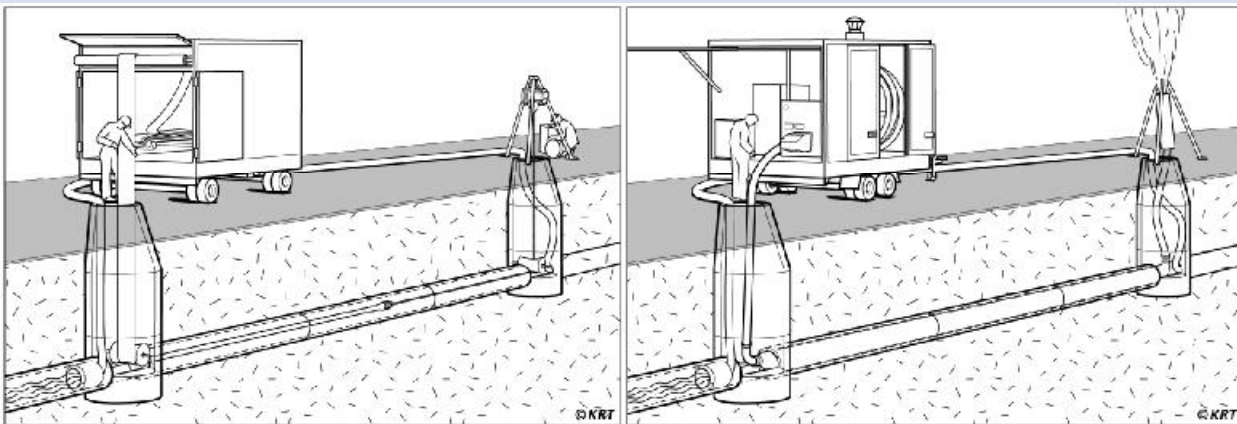
Brief Description

A flexible, tube impregnated with epoxy resin is inserted via existing inspection shafts by cable winch into the pipe section to be renovated. Then the tube is expanded using compressed air and pressed against the pipe wall. The hardening of the resin takes place under pressure by blowing in steam. A jointless cladding is created which fits tightly without annular gap to the existing pipe.

Schematic Diagram

- Insertion Phase

- Hardening Phase



Materials

Base material: ready-to use hose made of synthetic polyester fleece, if required, reinforced by glass fibre fabric

Resin: diverse epoxy resin systems

Layer thickness: 3.0 mm to 24 mm depending on pipe diameter and load

Standards

D: ATV Instruction Sheet M143 Part 3: Relining (draft)
ATV Worksheet A 127 (statics)

First Applications

Worldwide	1979 F (Copaflex)
Switzerland	1985 (flexliner I)
Switzerland	1995 (flexliner II)

Area of Application

Damage Aspects

- Open or damaged sleeves
- Cracks, flaking and light fragmentation in the pipe wall
- Corroded pipe walls

Further Applications

- Increase in performance capacity
- Increase or restoration of the static strength

Restrictions

Procedure only conditionally applicable for:

- Pipe collapse
- Deviation in position
- Excessive deformation in flexible pipes

Pipe Material

All materials

Cross-Section Forms

Circular, egg-shape and special profiles

Dimensions

Circular profiles NW 100 mm to NW 1250 mm

Maximum Range

depending on the dimensions up to about 125 m

Curves / U Bends

with reservations (wrinkling)

Preparatory Work

Excavations

not usually required; access via inspection shafts

Pipe Cross-Section

high pressure cleaning, creation of the original cross-section by boring or cutting

Lateral Connections

cut back protruding connections

Groundwater

intensive groundwater flooding to be sealed in advance

Draining of Water

pumping out of wastewater and the lateral connections required

Final Task

Inspection Shafts

transition from pipe / inspection shaft re-worked with special mortar. Tightness between pipe and relining in the transition area to be made safe with cladding

Lateral Connections

Reconnect from outside or cut the relining with sewage pipe robots from the inside. Thick wrapping of the connection pipe by commensurate measures (pressing, levelling out, shaped pieces)

Treatment

high pressure cleaning

Acceptance

inspection with pipe remote camera. Tightness test as per SIA N 190

Remarks

- reduction of cross-section according to layer thickness
- wrinkling in curves dependent on pipe diameter, radius and angle
- No cladding between relining and pipe when using an outer foil
- In France until the end of 1990 about 17.5 km so executed; in Switzerland, until the end of May 1997, about 55 km

Advantages of the System

- no excavations
- minimum traffic obstruction
- minimum cross-sectional losses
- short renewal time (1 day per sewage unit)
- improvement in pipe static
- improvement in the roughness value
- simple installation, mobile, also possible on the inside of buildings and in open terrain
- adherent connections using friction possible
- minimum installation requirements
- guaranteed service life of 50 years

Status

January 2000

Procedure **2.2.52 Flexiliner H (hose relining)**

Type of Procedure maintenance and repair / renewal and relining procedures

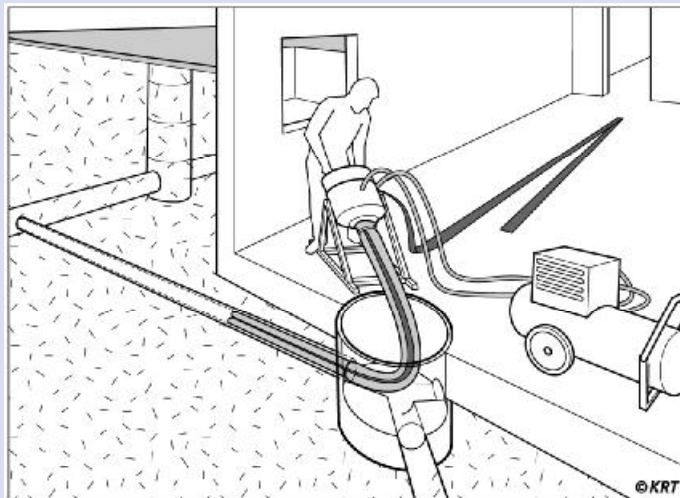
Notice general information on the relining procedures are contained in Section 4.3.2 of the IP Construction, maintenance of non walk-in sewage systems

License KRT Engineering + Handel AG, Sempach

Bidder KRT Kanal-Service AG

Brief Description A hose impregnated with epoxy resin is blown into a pipe section to be renovated using an inversion unit. By adding hot water to the circulation system, the hose is pressed against the pipe wall. After the hardening phase has ended (30' – 180'), depending on the type of resin, the pressure is drained out.

Schematic Diagram



Materials
Base material: synthetic polyester 3 – 6 mm or polyester textile hose
Resin: epoxy resin system
Layer thickness: 3 - 6 mm

Standards Not standardised in Switzerland

D: ATV Instruction Sheet M143 Part 3: Relining (draft)
ATV Worksheet A 127 (statics)

First Application Worldwide / Switzerland 1992

Area of Application

<i>Damage Aspects</i>	<i>Locally restricted damage areas such as:</i> <ul style="list-style-type: none">- Open or damaged sleeves- Root intrusion- Cracks, flaking and fragmentation in the pipe wall- Corroded pipe wall- Lack of pipe static
<i>Restrictions</i>	<ul style="list-style-type: none">- Pipe collapse- Deviation in position

Excessive deformation in flexible pipe

<i>Pipe Material</i>	<i>All materials</i>
<i>Cross-Section Forms</i>	<i>Circular profiles</i>
<i>Dimensions</i>	<i>Circular profiles NW 100 mm to NW 300 mm</i>
<i>Maximum Range</i>	<i>up to about 50 m</i>
<i>Curves / U Bends</i>	<i>applicable</i>

Preparatory Work

<i>Excavations</i>	<i>not usually required; access via inspection shafts</i>
<i>Pipe Cross-Section</i>	<i>high pressure cleaning, creation of the original cross-section by boring or cutting</i>
<i>Lateral Connections</i>	<i>cut back protruding connections</i>
<i>Groundwater</i>	<i>no measures necessary, strong infiltration to be sealed by injections</i>
<i>Draining of Water</i>	<i>pumping out of wastewater usually not necessary</i>

Final Tasks

<i>Inspection Shafts</i>	<i>no measures necessary</i>
<i>Lateral Connections</i>	<i>no measures necessary</i>
<i>Treatment</i>	<i>no measures necessary</i>
<i>Acceptance</i>	<i>inspection with pipe remote camera. Tightness test as per SIA V 190</i>

Remarks	<ul style="list-style-type: none">- minimum cross-section reduction- good curve response
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Status	<i>January 2000</i>
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2.2.61 PEKAPLAST – System

Procedure:

Process group:

*Installation procedure
The procedure used for renovation (full or partial lining) in man-entry pipelines and constructions.*

Operating Range:

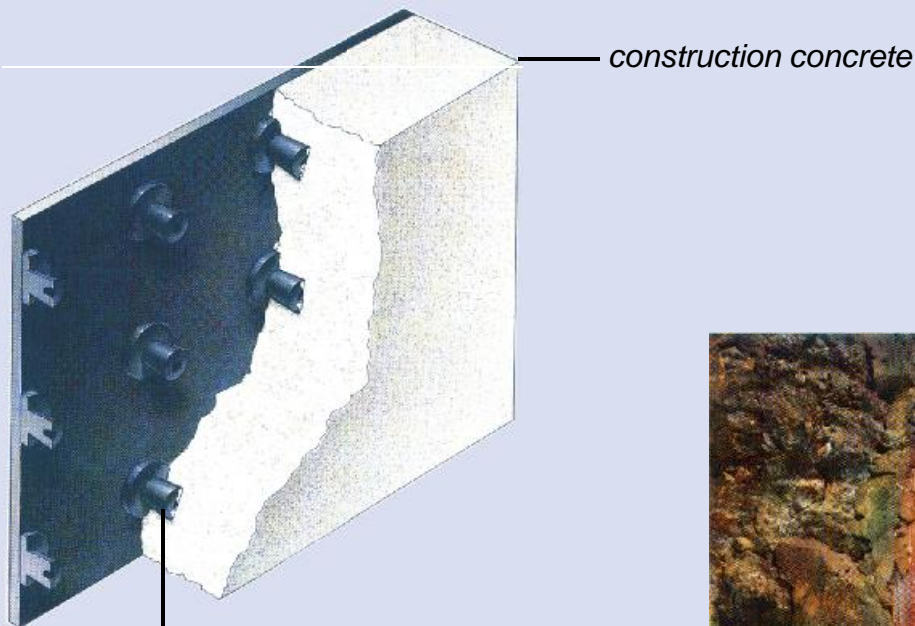
*Diameters from 600 mm upwards
Cross-sectional shapes, circular, ovoid and special profiles*

Material:

*Polyethylen (PE-HD) normal use
Polypropylen PP or Polypropylene
Polyvinylidenflouride PVDV for special purposes
The sheets are fitted with a definite number of conical anchor stubs.*

Implementation:

The individual sheet elements are inserted as liner sections into the pipeline being renovated from an existing manhole or from another open entry point and joined together. The circular space left between the new lining and the original pipe wall is filled using a special quick setting liquid cement. After hardening the joints of the liner are welded tight using an extruder thus providing a complete new water-tight pipe within the older sewer line. The seams are checked per radio-electrical means after completion of the work. When necessary a pressure test using water can be made.

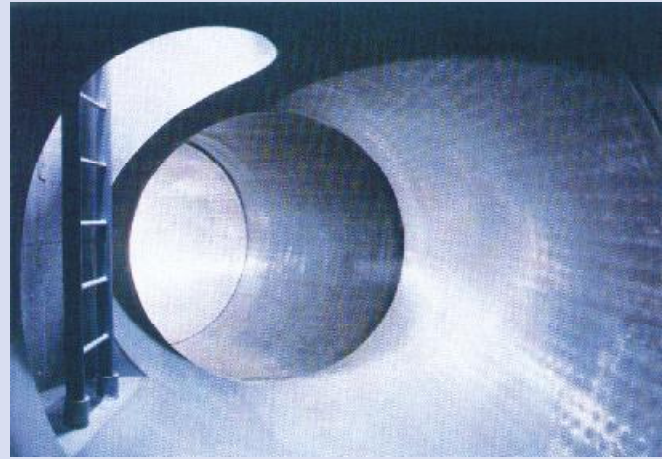


*mechanical anchoring
using anchoring stubs*



KRT Group

- *gas and water tightness of the sealed system*
- *equal mechanical attaching of the inner pipe to the original carrier pipe*
- *no differential expansion caused by different expansion coefficients of concrete and plastics*
- *Corrosion and chemical resistance of the lined sewer, against concentrated acids and alkaline liquids within the scope of the extensive resistance lists which are available.*
- *Reliability through extensive experience of lining operations in acidic protection in an environment where strong mechanical, thermal, and chemical demands are present.*
- *Higher flow speeds, reduced sedimentation resulting in less decomposition and accumulation of H₂S are the result of the smooth anti-adhesive surface of the lining.*
- *Rodent hostile environment*
- *Repetitive repairs possible*
- *High level of hit toughness high loading*
- *Strong close fitting jointing with the concrete pipe which cannot be undone.*



2.3 Manufacture of sewer repair and renovation systems

Repair methods

Primo robot system (partner of the company PMO)

- *Flexiliner P (partial relining)*
- *Flexiliner S (short relining)*
- *Support renovation system*

Injection and sealing methods

PEKA-Tech injection system (3M-PUR)

Structural repair methods

ZM injection

PEKA-Tech injection system

Renovation methods

Pipe relining methods

Flexiliner II (pipe relining) diameter 200 – 1200 mm

Flexiliner H (pipe relining) diameter 80 – 300 mm



3.0 QA (quality assurance) at KRT

QM system according to ISO 9001:2000

- 3.10 Our procedure**
- 3.110 Our company profile**
(see section 4.0 Company history)
- 3.120 Program and policies**
- 3.130 Concept and company policy**
(quality / security / environment)
- 3.140 Organisation / responsibilities** *(separate document available on demand)*
- 3.150 General procedures** *(separate document available on demand)*
- 3.160 Data summary** *(separate document available on demand)*
- 3.170 Our management system,
organisation, validity and implementation**



3.120 Company program and policies

3.121 Initial situation

Branch: Sewer renovation for private persons and public authorities

- > *KRT is fully integrated and established in the market.*
- > *KRT is well known in the branch.*
- > *KRT is innovative and continues to search for new markets.*
- > *KRT continues to search for new technical advances.*
- > *KRT has a very good infrastructure*
- > *KRT has state-of-the-art technology*
- > *KRT has well-trained and highly skilled employees both in the field and in the office.*

Swiss markets

- > *Bern, Basel, Zurich, Sempach, Pontresina*
- > *Architects, plumbers, public authorities, property managers, private house owners*

International markets

- > *Europe: France, Germany, United Kingdom, Italy, Portugal, Spain*
Middle East: UAE (United Arab Emirates)
Asia: China, India
- > *Agents, subsidiary companies, public authorities*

3.120 Company program and policies

3.122 Position in the market

- > *KRT is well-positioned in the market and has a large number of regular customers.*
- > *The company attaches a great deal of importance to highly skilled personnel who can work in a team. This means that KRT is in a position to offer the best possible price/performance ratio. In the market this is recognised and rewarded. HIGH STANDARD WORK ALSO HAS ITS VALUE.*
- > *KRT will not do a job at any price and has a reputation for quality. Working together with KRT means **quality, trust and partnership**.*
- > *KRT provides its customers with excellent consultation and services, with uncomplicated operation. These are appreciated by customers and they create a climate of trust.*
- > *KRT keeps to its promised deadlines and employs the best possible equipment and materials and provides efficient and clean operations.*
- > *Thanks to its well-organised team, KRT is able to short-cut complicated communication paths and react quickly to provide professional services.*
- > *Due to the foresight and efforts of its CEO, Hansruedi Petermann, KRT is active outside Switzerland. Hansruedi Petermann communicates with the company's competitors and observes the market closely in order to keep a few steps ahead.*
- > **KRT's policy is to avoid low price solutions. The company policy is to cooperate with its customers and to consider them as partners. This is valid both in Switzerland and abroad.**

3.120 Company program and policies

3.123 Company goals

- > *We intend to continue the build-up of our market position at home and abroad.*
- > *In the home market it is necessary to maintain our market share and to add to it.*
- > *We have to take other regions of Switzerland into consideration and to develop them with carefully prepared campaigns.*
- > *We should continue to extend our markets abroad. We need to find new partners. However, we should concentrate more on trade with products as well as with services.*
- > *We intend to continue our expansion – while still taking employees and infrastructure fully into consideration.*
- > *Partnerships and mergers with competitors could be considered in order to make full use of market potential and synergy (cost reduction). However, in all cases KRT keeps full control.*
- > *KRT's big advantage is its healthy base and thanks to its flexibility combined with steady growth, the basic structure has been maintained. This situation is vital in order to hold its position in the market successfully.*

3.130 Company concept and policy (quality / security / environment)

- *We intend to remain as an independent company.*
- *We shall maintain our leading position with innovation and technology and all our efforts are aimed at keeping this position.*
- *We stand for flexibility, transparency, and speed.*
- *We encourage a high level of responsibility with individuals and management. This provides us with the basis to further develop and improve the company.*
- *We apply actively our practical management system, which we continuously check and improve for efficiency and effectiveness.*
- *We cooperate closely with our customers as partners and provide technical consultancy. This permits us to maintain customer satisfaction at a high level and even to improve it.*
- *We keep our quality at a high level and improve it continuously with the help of cooperation with selected suppliers and partners.*
- *We employ qualified personnel and, with the aid of continuous further training, we meet our own high expectations.*
- *We ensure a high level of safety for our employees and third parties.*
- *We ensure that all our services are environmentally friendly.*

Our guiding principles

Independence at work, openness and honesty in relations, mutual respect, appreciation of a job well done and openness form the basis of our cooperation. In one word "trust".

In this connection: a spoken promise has the same value as a written one.

3.140 Organisation / Responsibility

Main Courses - Detail Courses	Position	Responsible Person	Working Instruments (Detail Regular)
1. Direction	-	H.R. Petermann	MHB 0 Grundlagen
Administration Official (KRT Kanalsanierungstechnik AG)	VR	H.R. Petermann	VR-Basics
1.1 General Management / Quality Responsible (KRT Kanalsanierungstechnik AG)	GL / QB*	H.R. Petermann	MHB 1, F-File GL
2. Improvement (KVP)	-	-	-
2.1 Project Management / Entwicklungen	PJM	H.R. Petermann	MHB 2, File GL
2.2 Error Management	FM	S. Cahenzli	MHB 2, A-File QM
2.3 Improvement Management	VM	S. Cahenzli	MHB 2, A-File QM
3. Performance	-	-	-
3.1 Business Sector 1 Engineering and Trade	GB1	H.R. Petermann	MHB 3.0.1 / F-File GB1
3.2 Business Sector 2 Pipe Renovation	GB2	H.R. Petermann	MHB 3.0.2 / F-File GB2
Location Küssnacht am Rigi (KRT Kanalsanierungstechnik AG)	GF2-KN	H.R. Petermann	MHB 3.0.2 / NB Branch
Branch Luzern / Sempach (KRT Kanal-Service GmbH)	GF2-LU	S. Cahenzli	MHB 3.0.2 / F-File Luzern
Branch Zürich (KRT Kanal-Service GmbH)	GF2-ZH	S. Cahenzli	MHB 3.0.2 / NB Branch
Branch Pontresina (KRT Kanalsanierungstechnik AG)	GF2-PA	H.R. Petermann	MHB 3.0.2 / F-Ordner NB Branch
Branch Leopoldshafen (KRT Kanalsanierungstechnik AG)	GF2-LH	H.R. Petermann	MHB 3.0.2 / F-Ordner NB Branch
Location Basel (KRT Kanalsanierungstechnik GmbH)	GF2-BA	P. Kraus	MHB 3.0.2 / F-File Basel
Location Bern (KRT Kanal-Service GmbH)	GF2-BE	H.R. Petermann	MHB 3.0.2 / F-File Bern
4. Services	-	-	-
4.1 Controlling- Financing- und Accounting	CFR	O. Wespi	MHB 4.1 / A-File CFR
4.2 Personnel Matters	PWE	H.R. Petermann	MHB 4.2 / A-File PWE
4.3 Secretary	SEK	G. Affentranger	MHB 4.3 / A-File SEK
4.4 Marketing	MK	H.R. Petermann	MHB 4.4 / A-File MK
4.5 Logistics	LOG	P. Markzoll	MHB 4.5 / A-File LOG
4.6 Informatics / EDV	EDV	O. Wespi	MHB 4.6 / A-File EDV
4.7 Infrastructure & Safety	I&S	W. Frei	MHB 4.7 / F-File I&S
4.8 Quality Management	QM	S. Cahenzli	MHB 4.8 / A-File QM

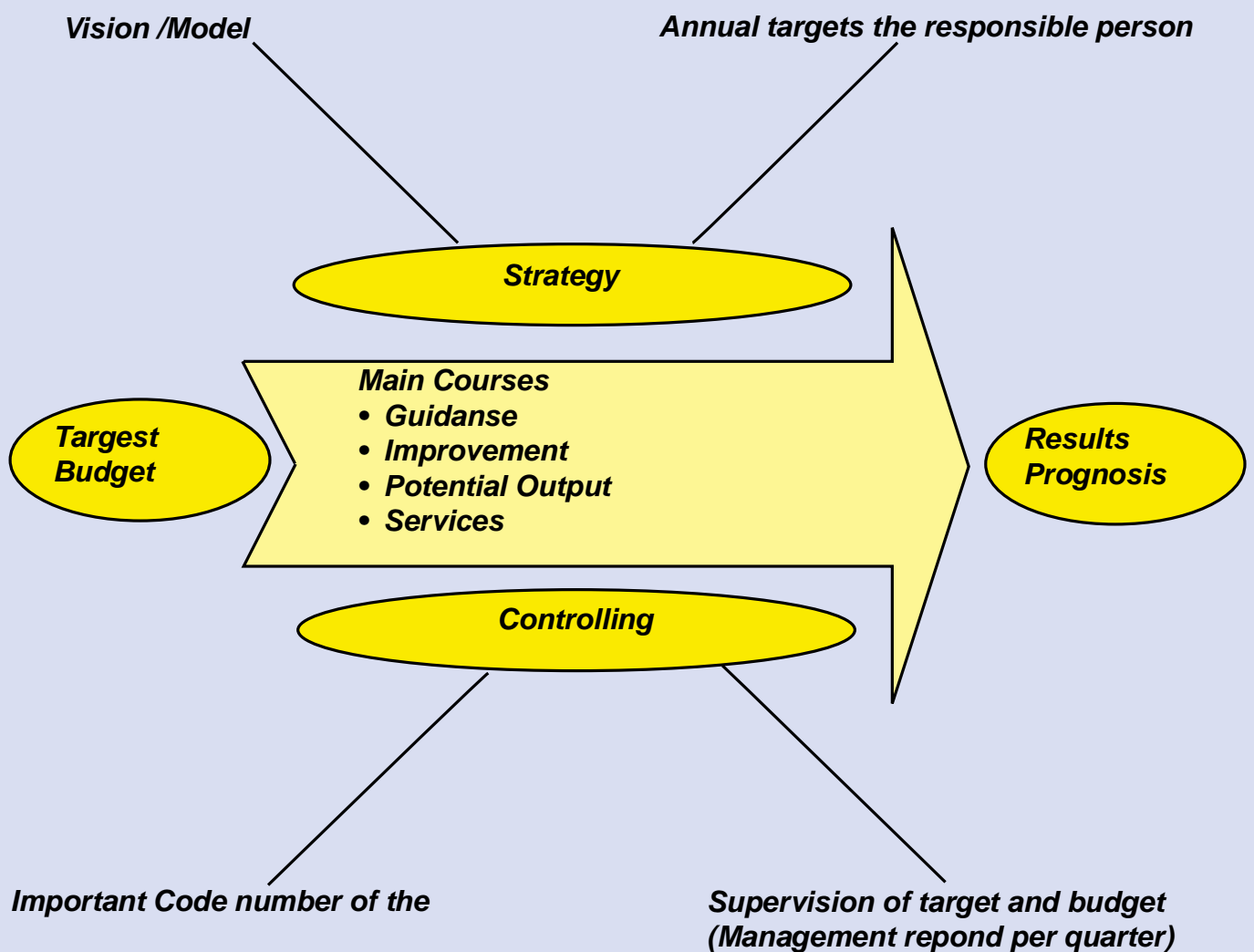
General Management

- H.R. Petermann

Leading Team

- H.R. Petermann
- S. Cahenzli
- O. Wespi

3.150 General Course Circle



3.160 Data Compiling

- 3.161.0 *Order recording data*
- 3.161.1 *Customer statements*
- 3.161.2 *Object data*
- 3.161.3 *Calculation basis*
- 3.161.4 *Executing companies / subcontractors*
- 3.161.5 *Execution dates*
- 3.161.6 *Description of works*
- 3.161.7 *Checklist installation*
- 3.161.8 *Checklist documents*
- 3.161.9 *Checklist AVOR*
- 3.161.10 *Checklist material ordering*
- 3.161.11 *Checklist sleeve joints rehabilitation*

- 3.162.0 *Excuting of preparatory works*
- 3.162.1 *Recording of condition, general*
- 3.162.2 *Data recording*
- 3.162.3 *Calibration data*
- 3.162.4 *Recording of construction KS*
- 3.162.5 *Water analysis*
- 3.162.6 *Building ground*
- 3.162.7 *Lateral construction*
- 3.162.8 *Installation details*
- 3.162.9 *Water holding measures*
- 3.162.10 *Equipment and current requirements for Water holding*

- 3.163.0 *AVOR*
- 3.163.1 *Equipment investment*
- 3.163.2 *Personal investment*
- 3.163.3 *Detail program*

3.160 Data Compiling

- 3.164.0** *Execution / Data capture*
- 3.164.1** *External hose production*
- 3.164.2** *Internal hose production*
- 3.164.3** *Hose impregnation*
- 3.164.4** *Hose transport*
- 3.164.5** *Installation data Inliner*
- 3.164.6** *working data Robot works*
- 3.164.7** *Working data sleeve joints rehabilitation*

- 3.165.0** *Quality checking*
- 3.165.1** *Hose checking*
- 3.165.2** *Resin checking*
- 3.165.3** *Performance checking*
- 3.165.4** *Visual checking*
- 3.165.5** *Tightness test*
- 3.165.6** *Material checking*
- 3.165.7** *Checking of supplementary works*

- 3.166.0** *Data composition*
- 3.166.1** *Completeness check*
- 3.166.2** *Document compsition*

3.170 Organisation, validity and introduction of our management system

This management manual and all other documents belonging to it contain our management instruments. They are valid without reservations for the whole KRT group of companies (KRT-Kanalsanierungstechnik AG and all the KRT subsidiaries).

The management system that we employ is based on the ISO 9001 standard. However, it has been implemented according to our operational plans (see title page) Our operations and controlling (management report) are drawn up according to the European TQM model (EFQM model) and they cover all elements.

Company management implemented this management system.

Sempach 1st January 2003

*HR. Petermann
Chief Executive Officer / quality manager*

4.0 Company history

Company history

- 17.05.1989 *company founded in Bern*
- 27.06.1991 *headquarters moved to Biel*
- 01.03.1992 *the complete infrastructure of the company ARPE taken over:*
 - *workshop / Rickenbach /office in Lucerne*
 - *equipment and machines for inliner work*
 - *complete personel*
- 01.07.1996 *workshop moved to Sempach-Allmend*
- 01.08.1996 *service centre moved to: 6204 Sempach, Luzernerstrasse 19*
- 12.09.1996 *KRT Kanalsanierungs-Technik GmbH Basel founded*
- 01.01.1997 *KRT Engineering+Handel GmbH in Sempach founded*
- 01.01.1998 *branch office, Germany in 76344 Leopoldshafen*
- 08.04.1999 *new location for KRT AG in Küssnacht am Rigi*
- 04.04.2002 *Kanalsanierungstechnik GmbH founded in Bern*
- 01.05.2002 *ranch office opened in Zurich*
- 11.01.2005 *License for UAE*
- 01.01.2008 *foundet KRT Kanal-Service GmbH, Luzernerstrasse 19, 6204 Semach*
- 01.04.2009 *change the company KRT AG Küssacht, new name:*
KRT Kanalarenovationen AG, new adress: Industriestrasse 47, 6300 Zug
- 05.10.2009 *change the company KRT Kanal-Service GmbH in KRT Kanal-Service AG*

Headcount: 38 staff, stand 01.08.2010

5.0 Experience / key personal / membership of trade associations

5.10 Experience

5.101 *The relining method Flexiliner II was developed by KRT AG*

KRT AG is the owner of the licence.

Since 1987 it has been used for over 80 km of sewers

Licences for the Flexiliner system have been given to companies in Germany, France and the United Arab Emirates.

5.102 *The partial relining method Flexiliner P/S was also developed by KRT AG and launched on the market in 1992.*

5.103 *We have many years of experience in the use of sewer robots. Together with the company PMO AG in Dübendorf we have developed our own robot system. In 1994 we launched the product and also started to use it.*

5.104 *Other methods have also been developed together with other companies and used by our technicians, such as:*

- Relining method (hard relining) in pipelines and short pipes*
- Sealing method with PUR injection and injection cement*
- Renovation of supports with ZM injection*

5.0 Experience / key personal / membership of trade associations

5.20 Key personal

5.201 Chief Executive Officer Mr. Hansruedi Petermann
in the sewer renovation branch since 1985 and founder of KRT AG

5.202 Construction site supervisor Mr. Sascha Cahenzli
He has had this position at KRT AG Juli 2010

Construction site supervisor Mr. Pascal Kraus
general manager of KRT Basel GmbH since August 2010

Construction site supervisor Mr. Heinz-Dieter Wulfmeier
branch office manager at KRT AG since 1998

5.203 Manager and equipment designer Mr. Walter Frei
employed at KRT AG since 1992

5.204 Group leaders

Pipe relining / Flexiliner II: Mr. J. Haas
group leader for pipe relining since 1989
experience gained: 80,000 m

Robot operator: Mr. J. Zihlmann
employed since 1987

Pipe relining / private property area Flexiliner H: Mr H. Haas
group leader since 1995

Sewer inspection: Mr. M. Gerber
employed as KF operator since 1995

5.205 See attachment for information on remaining personal

5.0 Experience / key personal / membership of trade associations

5.3 Members of trade associations

KRT AG is a member of the following trade associations

VSA *Swiss Water Pollution Control Association,
member Hansruedi Petermann*

ATV *German Association for Water and Waste Management*

Gstt/CHstt *German Association for no-dig construction*

KSV *Sewer Renovation Association (Switzerland)
(since 2003 on the Management Committee of the KSV)*

