37TH INTERNATIONAL NO-DIG FLORENCE 2019

Fortezza da Basso • FLORENCE (Italy)

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Water main rehabilitation with inserted hoses – Considerations on design and installation

ANDREAS GROSS – Rädlinger primus line GmbH

EN ISO 11295:2017 update

- Updated version of EN ISO 11295:2017 – standard for plastic piping systems used for renovation and replacement - includes the rehabilitation with „inserted hoses“ for *pressure pipes in water and gas*

- Characteristics
  - Circular woven, textile reinforced liner with same or different inside and outside coating
  - Installation of the liner in U-shape by means of a pulling winch
  - Re-rounding of liner into circular shape using internal pressure
  - No bonding to the existing host pipe
  - The liner will maintain its round shape under depressurized conditions if not subject to external load
  - Long installation lengths of up to 2 km
  - Geometrics from 80 mm to 500 mm

- Performance
  - Full internal pressure resistance
  - Minimal reduction in volumetric capacity

GSTT Information 20-1

GSTT Information 20-1 – Rehabilitation of pressure pipes

Suitability based on failure modes of host pipe

- ✓ Incrustations
- ✓ Inside corrosion
- ✓ Leakage
- x structural stability

Change of use

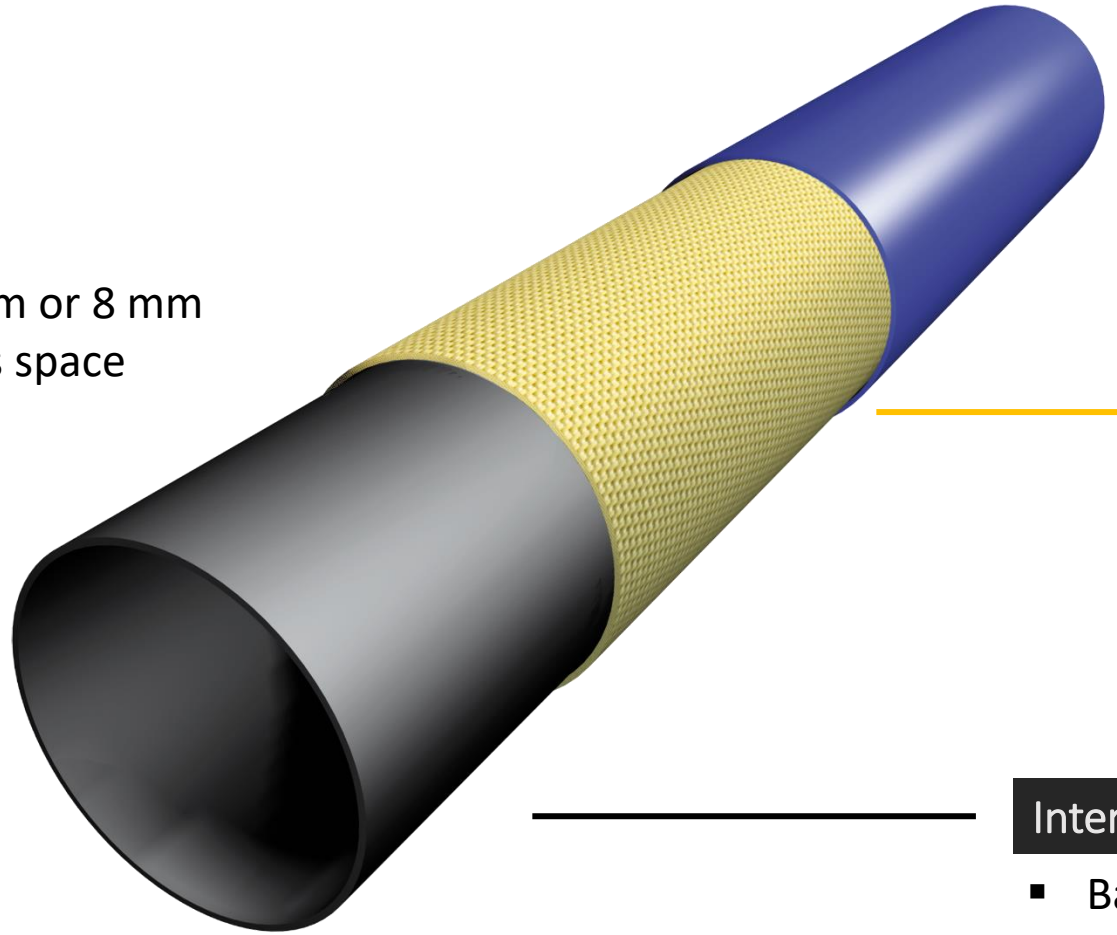
- ➢ Increase of pressure rating
- ➢ Change of transported fluid

Life span

- ➢ 50 years based on test regulation DVGW-VP 643

Primus Line – Material composition - Liner

- DN 150 – DN 500
- Wall thickness of 6 mm or 8 mm
- Installed with annulus space



External Layer

- Protection of reinforcement layer

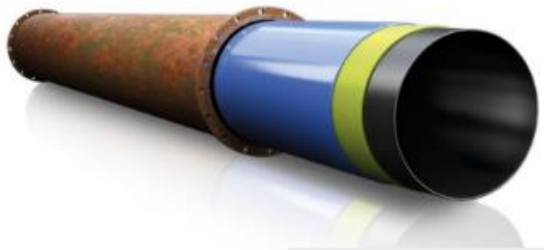
Kevlar®

- Seamless woven reinforcement fabric
  - Polyester/Kevlar
  - Kevlar
  - 2 layers of Kevlar
- Full pressure resistance

Internal Layer

- Based on PE
- Complies with KTW W 270, NSF/ANSI 61, AS/NZS 4020:2005, BS 6920, SS375:2015 and many more

Primus Line – Material composition - Liner

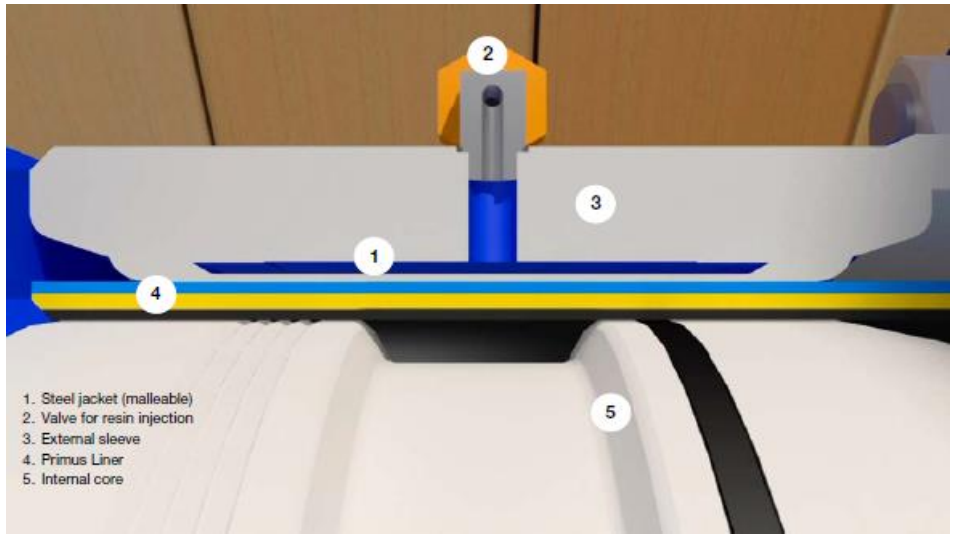


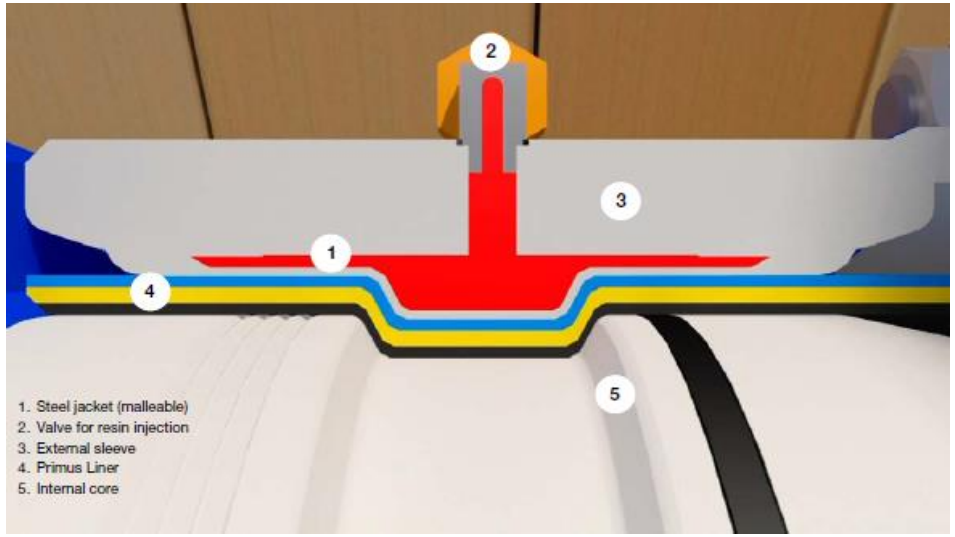
	Primus Line® low pressure single-layer hybrid design						Primus Line® medium pressure single-layer Kevlar® design						Primus Line® high pressure double-layer Kevlar® design					
	OD mm	t mm	ID mm	burst bar	MOP bar	weight kg/m	OD mm	t mm	ID mm	burst bar	MOP bar	weight kg/m	OD mm	t mm	ID mm	burst bar	MOP bar	weight kg/m
Primus Line® DN 150	134	6.0	122	63	25	2.1	134	6.0	122	140	56	2.2	-	-	-	-	-	-
Primus Line® SD 150	150	6.0	138	54	20	2.4	150	6.0	138	120	48	2.4	160	8.0	144	206	82	3.3
Primus Line® DN 200	182	6.0	170	47	18	2.9	182	6.0	170	100	40	3.0	192	8.0	176	173	69	4.0
Primus Line® SD 203	203	6.0	191	42	16	3.3	203	6.0	191	84	33	3.4	-	-	-	-	-	-
Primus Line® DN 250	237	6.0	225	38	15	3.8	237	6.0	225	75	30	4.0	250	8.0	234	128	51	5.3
Primus Line® SD 261	261	6.0	249	30	12	4.2	261	6.0	249	64	25	4.4	-	-	-	-	-	-
Primus Line® DN 300	284	6.0	272	30	12	4.6	284	6.0	272	64	25	4.8	294	8.0	278	110	44	6.4
Primus Line® DN 350	-	-	-	-	-	-	314	6.0	302	50	20	5.2	-	-	-	-	-	-
Primus Line® DN 400	-	-	-	-	-	-	354	6.0	342	46	18	6.0	364	8.0	348	82	32	8.1
Primus Line® DN 450	-	-	-	-	-	-	408	6.0	396	40	16	7.0	-	-	-	-	-	-
Primus Line® DN 500	-	-	-	-	-	-	454	6.0	442	40	16	7.7	-	-	-	-	-	-

Primus Line – Material composition - Connector

Flange coupling adaptor

Primus Line connector





Primus Line – Performance

- Testing basis VP 643, June 2004 – Flexible, fabric-reinforced plastic inliners and corresponding connectors
- Verification of long-term strength according to DIN 16887 and DIN EN ISO 9080 in a series of up to 10,000 hour tests extrapolated to 50 years derived a fabric factor of 2.0
- An additional safety factor of 1.25 is included

Example DN 200-MD

- Burst pressure 100 bar
  ⬇ /2
- Lifetime factor 50 bar
  ⬇ /1.25
- Safety factor water 40 bar

Straight pipe sections, without bends

Primus Line – Performance in bends

- The liner can be installed through (multiple) bends of up to 45 degree with r = 1.5xD
- The internal pressure is accommodated by the textile reinforcement; an annulus space remains; the pipe is designed as a new pipe inside the existing conduit
- If installed through bends the maximum allowable operating pressure is reduced since only a certain amount of fabric used; the reduction of the pressure rating of the liner depends on
  - The degree of the bend (e.g. 45 degree)
  - The bend radius (e.g. 1.5xD)
  - The nominal host pipe diameter and the installed liner system (e.g. a DN 500 liner inside a DN 600 host pipe)
- Minimum life span of 50 years

Primus Line – Performance in bends

Example: Installation of a DN 250 liner into a host pipe DN 250 with a 45 degree bend (r= 1.5xD)

	Primus Line® low pressure						Primus Line® medium pressure								Primus Line® high pressure							
	single-layer hybrid design						single-layer Kevlar® design								double-layer Kevlar® design							
Primus Line® DN 250	237	6.0	225	38	15	3.8	237	6.0	225	75	30	4.0	18	4.4	250	8.0	234	128	51	5.3	32	5.8

MAOP **8.2 bar** **16.2 bar** **27.7 bar**

- Annulus space of 8 mm, if installed through bends

Modified 45 degree bend with 2 x 22.5 degree
Distance between bends: min 1.00 m
MAOP in a 22.5 degree bend: 11.0 bar

Installation considerations

Installation – Excavation pits & manholes

Start pit

- Man-hole

- Excavation pit

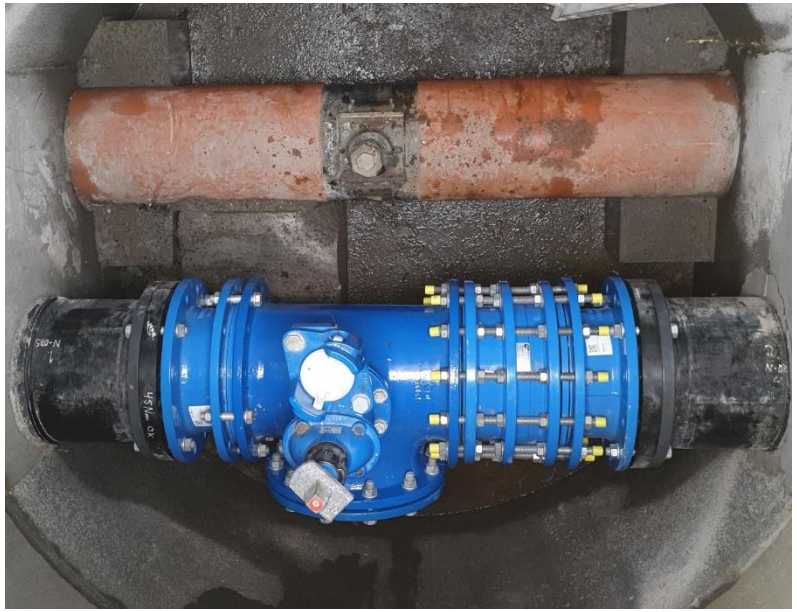
Pipe diameter	Working space
DN 150 – DN 200	min. 1.25 m
DN 250 – DN 500	min. 1.75 m

- Pipe cut in a 90 degree angle to pipe axis
- Pipe ID to be deburred and chambfered
- Use of insertion roll to protect liner

Installation – Excavation pits & manholes

Intra-pit

- Man-hole



- Excavation pit

Pipe diameter	Working space
DN 150 – DN 200	min. 1.50 m
DN 250 – DN 500	min. 2.00 m

- Pipe cut in a 90 degree angle to pipe axis
- Pipe ID to be deburred and chambfered

Installation – Excavation pits & manholes

Destination pit

- Excavation pit

Pulling force	Exit angle	Pipe diameter	Working space
< 3 tons	max. 30 degree	DN 150 – DN 200	min. 1.25 m
> 3 tons	max. 10 degree	DN 250 – DN 500	min. 1.75 m

CCTV Inspection

- First CCTV inspection prior to pipe cleaning
  - Focus on reductions in cross-section caused by protruding obstacles (weld seams, fittings, pins)
  - Bends
  - Steps
  - 360 degree inspection of pipe joints
- CCTV used as a means to create the inital rope connection between pits
- **CCTV inspection goal:** determine cleaning needs

Pipe cleaning

Goal: Create a free inside diameter

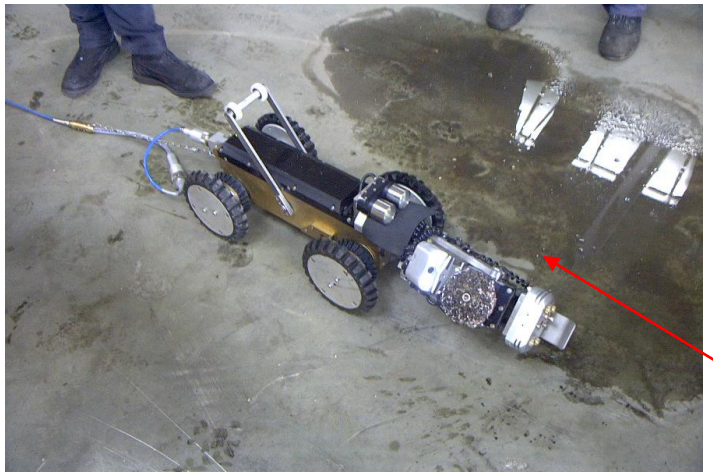
- Cleaning requirements dependent on host pipe material
- Ductile iron, cast iron, steel pipes → incrustation
- Asbestos cement, PVC, PE, GRP, cement lined pipes → lose debris
- Subsequent CCTV inspection to verify free inside diameter

Cleaning with up to 300 m/h

Pipe cleaning

Goal: Create a free inside diameter

- Welding seams in uncoated steel pipes – butt-welded steel pipes



Cutter

Liner insertion

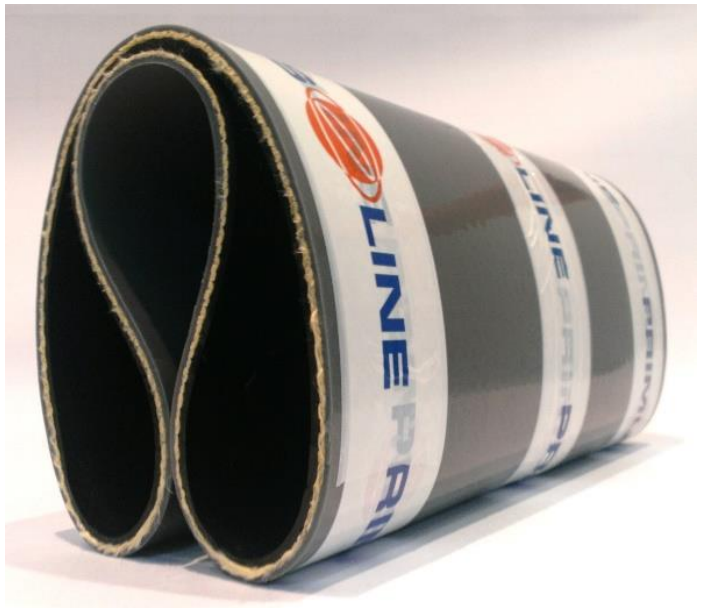
Delivered on transport reels directly to site

Diameter	Reel capacity
DN 150	up to 5,700 m
DN 500	up to 1,675 m

- Width: 1.40 m – 11.00 m
- Suitable for 20ft. and 40ft. Containers
- Smaller reels via airfreight possible

Liner insertion

Liner pre-folded in U-shape at factory



Reduce pulling forces to achieve long insertion lengths

Liner insertion

Pulling forces up to 5 tons
depending on reinforcement layer

Pulling forces up to 10 tons
depending on reinforcement layer

Liner inflation

Inflation using compressed air

- Oil-free air for potable water
- Pipe stopper to close liner
- Pipe stopper with by-pass to inflate
- No heating, steaming, curing processes

Connector installation

Connector with wall-mounting plate

Connector DN 500 with flange DN 600

Different flange standards

- Pressure testing based on pressure loss method as described in DIN EN 805
- Disinfection according to the acknowledged rules of technology for disinfecting pipes made from PE

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Thank you for your attention

Please visit our booth #9

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