DECLARATION OF PERFORMANCE

in accordance with Regulation (EU) No. 305/2011

No. 513-EX1-2

1.Unique identification code of the product-type:

EX1-2, EX2-2 epoxy resin with liner

2. Type, batch or serial number or any other element allowing identification of the construction product as required pursuant to Article 11(4):

carton bord labeled

3. Intended use or uses of the construction product, in accordance with the applicable harmonized technical specification, as foreseen by the manufacturer:

sewer pipe rehabilitation (CIPP)

4. Name, registered trade name or registered trade mark and contact address of the manufacturer as required pursuant to Article 11(5):

Sanikom d.o.o. Vrtna ulica 39, 4294 Križe SI

5. Where applicable, name and contact address of the authorised representative whose mandate covers the tasks specified in Article 12(2):

-

6. System or systems of assessment and verification of constancy of performance of the construction product as set out in Annex V:

system 3

7. Harmonized standard:

EN 11296-4:2011

Declaration of the performance of the essential characteristics of the construction product by the manufacturer on the basis of factory production control and testing laboratory.

8. Appropriate Technical Documentation and/or Specific Technical Documentation: -

9. Declared performance/s

Content of Order:	Approval tests for DIBt approval on liner samples
Test samples:	Pure resin samples resin types "EX 1-2" and "EX 2-2" Polyester mesh Liner "SX2" DN 150 and "SX4", DN 200 Various DN 200 test pieces from hardened Liner samples: - Resin type "EX 1-2" with polyester mesh Liner "SX4" - Resin type "EX 2-2" with polyester mesh Liner "SX2"
Test period:	April 2018 up to March 2020

1 Content of Order

– According to the order, tests were carried out on the submitted sample material as part of a DIBt approval.

2 Tests and results

The following sample material was delivered by the client:

Resin single components

- 14 kg base resin blue, component A, batch 019-01-2018
- 3.5 kg hardener "EX1-2", component B, batch 0034-01-2018
- 3.5 kg hardener "EX2-2", component B, batch 0246-01-2018

Polyester mesh Liner with PU coating

- "SX2", DN 150, 3.0 mm, batch 1572027
- "SX4", DN 200, 4.0 mm, batch 101095944

Various hardened pipe liner samples DN 200 with preliner installed in KG pipes

- Resin "EX1-2" with polyester mesh Liner "SX4"
- Resin "EX2-2" with polyester mesh Liner "SX2"

These samples were used for the mechanical tests on the cured resin / polyester mesh Liner assembly.

1 hardened laminate plate, approx. 20 cm x 30 cm x 0.5 cm

- Resin "EX1-2" with "SX4"
- Resin "EX2-2" with "SX2"

The samples were conditioned in the test atmosphere at least 12 hours before the tests.

2.1 Individual components before processing

2.1.1 Pure resins

2.1.1.1 Viscosity according to DIN EN ISO 3219: 1994-10

The viscosity of the liquid resin components was determined in accordance with DIN EN ISO 3219, Appendix A (coaxial cylinders).

Test parameters: Brookfield RV3 rotational viscometer

Test temperature: 23 ° C

Results:

	Speed rpm	Viscosity in mPas
Resin	25	3010
Hardener EX1-2	200	246
Hardener EX2-2	200	249

2.1.1.2 Density according DIN EN ISO 2811-2

The density of the liquid resin components was determined in accordance with DIN EN ISO 2811-2: 2011-06.

Test parameters:

Test temperature: 23 ° C

Results:

Destiny in g/cm³	
Basic Resin, component A	1,15
Hardener EX1-2, component B	1,02
Hardener EX2-2, component B	0,98

2.1.1.3 Colour

The color was apparently determined.

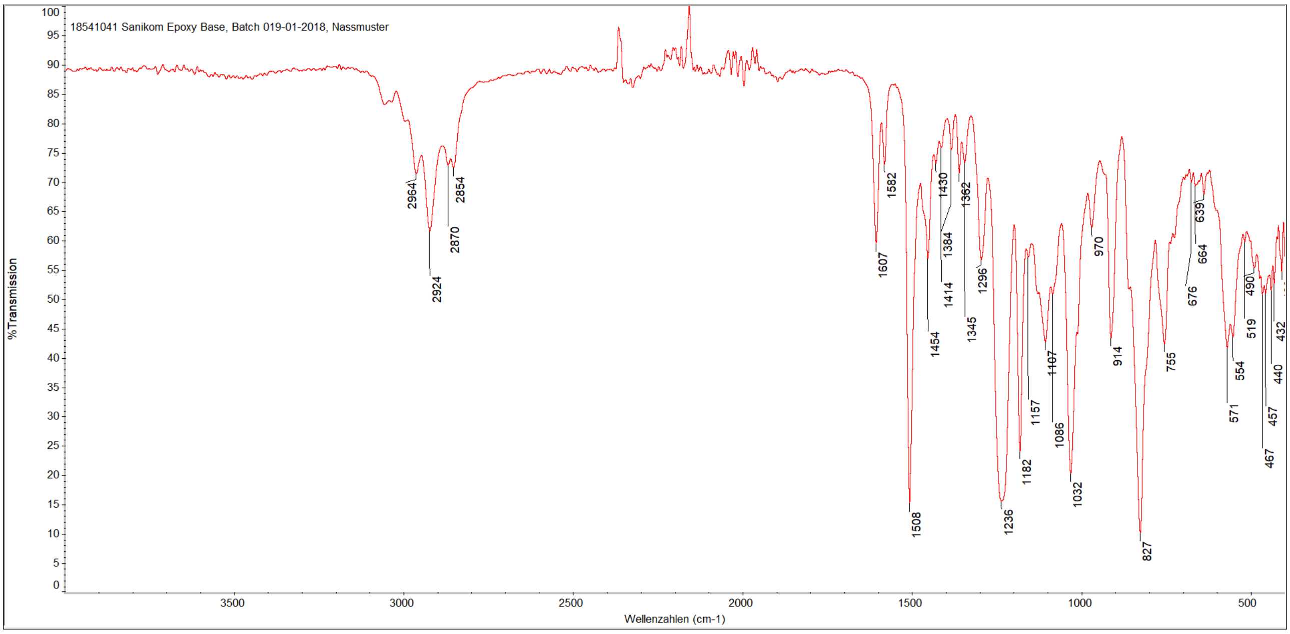
Farbe	
Basic Resin, component A	blue
Hardener EX1-2, component B	light orange
Hardener EX2-2, component B	lightorange

2.1.1.4 IR spectroscopy

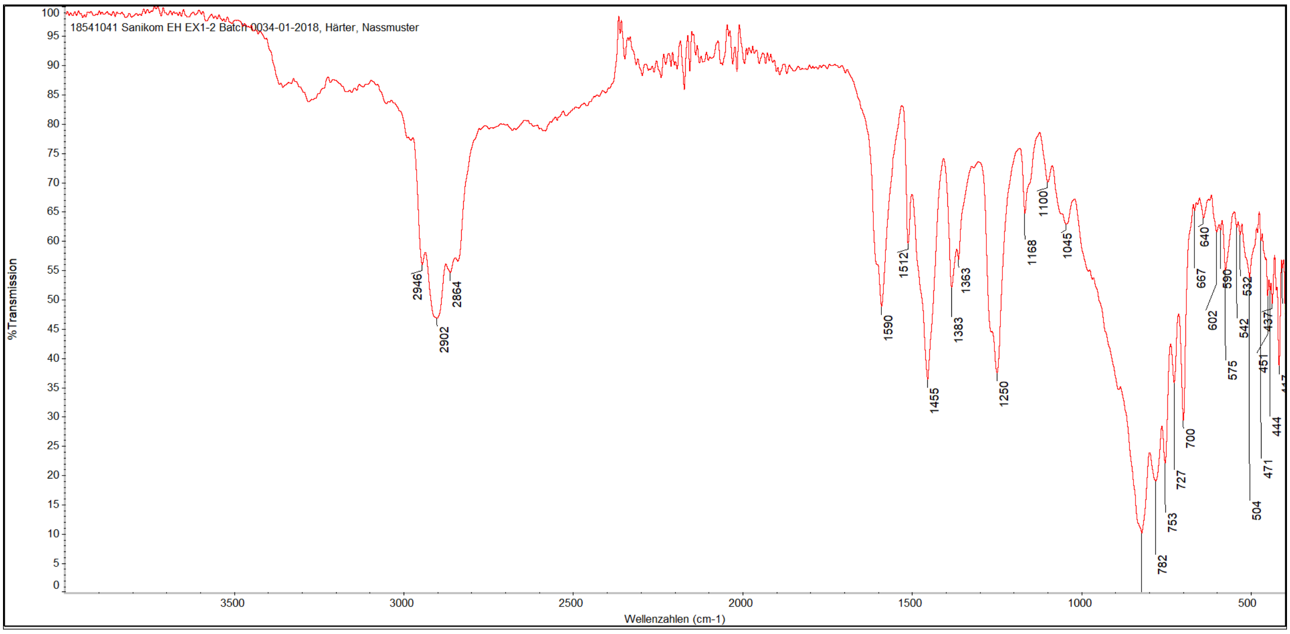
IR spectra were recorded on the individual components.

The samples were applied to the measuring window of the ATR infrared spectrometer and measured in the wavenumber range of 4000-400 cm-1.

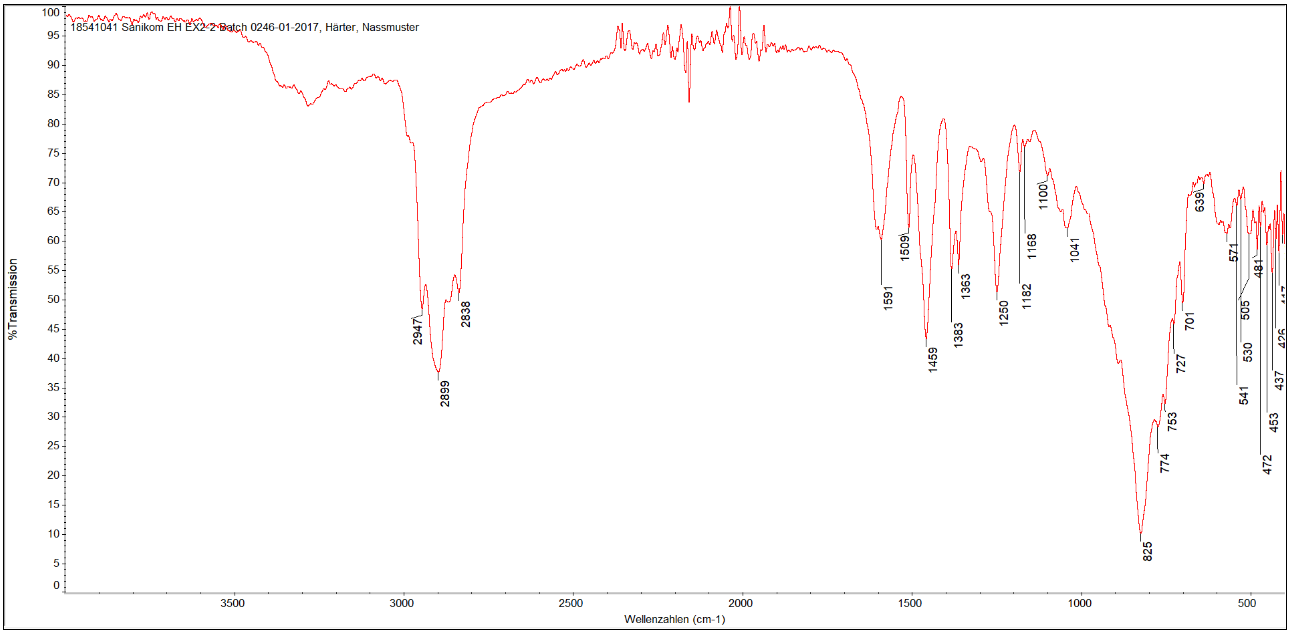
Basic Resin, component A



Hardener EX1-2, component B



Hardener EX2-2, component B



2.1.2 Polyester mesh Liner

2.1.2.1 Basis weight

The weight per unit area of the polyester mesh hoses with PU coating was tested in accordance with DIN EN ISO 9864: 2005-05, but the seam areas were not checked.

Results:

Basis weight including PU coating in g / m²		
	SX2 3,0 mm	**SX4 4,0 mm**
1	663	1027
2	656	1044
3	667	1060
average	**662**	**1044**

2.1.2.2 Maximum tensile strength and elongation based on DIN EN 29073-3

Strips were removed from the polyester mesh hoses and the maximum tensile force and the associated elongation were determined in accordance with DIN EN 29073-3: 1992-08 in the longitudinal and transverse directions.

Test parameters:

Test speed: 100 mm / min Test climate: 23 ° C / 50% RH

Results:

Maximum traction in daN/5 cm				
	SX2 3,0 mm		SX4 4,0 mm	
Sample	**along**	**across**	**along**	**across**
1	60,8	36,3	123	71,3
2	65,2	38,3	116	69,6
3	63,2	37,2	116	71,3
4	63,8	37,8	121	72,3
5	68,3	37,6	124	69,2
average	**64,3**	**37,4**	**120**	**70,7**
deviation	**3**	**0,8**	**4**	**1,3**

Maximum tensile strength expansion in %				
	SX2 3,0 mm		SX4 4,0 mm	
Sample	**along**	**across**	**along**	**across**
1	91	125	91	214
2	90	131	91	215
3	87	127	85	214
4	91	129	85	217
5	90	129	91	217
average	**90**	**128**	**89**	**215**
deviation	**2**	**2**	**3**	**1**

2.2 Cured resin

Test panels with a thickness of approx. 5 mm were produced from the pure resins under the following conditions:

Resin / Hardener	Parts by weight resin : hardener	Hardening
EX1-2	100:25	ambient curing ca. 24 h bei 23°C
EX2-2	100:25	Warm curing ca. 2 h bei 60°C

Before the test, the plates were stored in a room climate for at least three weeks.

2.2.1 Bending properties according to DIN EN ISO 178

Approx. 10 mm wide test specimens were removed from the test plates and the bending modulus, the flexural strength and the bending elongation were then applied in a 3-point bending test according to DIN EN ISO 178: 2013-09 Flexural strength determined.

Specimen dimensions:

Width: approx. 10 mm length: approx. 80 mm

Test parameters:

Support diameter: 10 mm

Test speed: 10 mm / min Test climate: 23 ° C / 50% RH

Span: 70 mm

Results:

EX1-2						
sample	**e**	**b**	**l_v**	**E_f**	**σ_{fm}**	**ε_{fm}**
	mm	**mm**	**mm**	**MPa**	**MPa**	**%**
1	5,2	10,3	70,0	3910	90,5	2,38
2	5,3	10,5	70,0	3570	93,2	2,70
3	5,4	10,4	70,0	3530	130	4,86
4	5,3	10,4	70,0	3590	128	4,34
5	5,2	10,4	70,0	3710	97,8	2,75
6	5,4	10,4	70,0	3710	139	5,67
7	5,4	10,4	70,0	3730	131	4,29
8	5,2	10,4	70,0	3690	127	4,03
9	5,4	10,4	70,0	3660	107	3,08
10	5,5	10,5	70,0	3620	124	3,95
average	**-**	**-**	**-**	**3670**	**117**	**3,80**
deviation	**-**	**-**	**-**	**107**	**17,8**	**1,06**
5% -Fraktil	**-**	**-**	**-**	**3470**	**84,1**	**1,87**

EX2-2						
sample	**e**	**b**	**l_v**	**E_f**	**σ_{fm}**	**ε_{fm}**
	mm	**mm**	**mm**	**MPa**	**MPa**	**%**
1	4,9	10,4	70,0	3390	101	3,09
2	5,1	10,5	70,0	3590	79,4	2,22
3	4,6	10,4	70,0	3510	80,9	2,29
4	4,7	10,5	70,0	3580	90,9	2,57
5	5,0	10,5	70,0	3610	80,3	2,25
6	4,7	10,4	70,0	3590	98,9	2,85
7	5,0	10,5	70,0	3430	95,7	2,90
8	4,4	10,6	70,0	3460	88,9	2,58
9	4,5	10,5	70,0	3440	66,8	1,90
10	4,8	10,5	70,0	3470	107	3,30
average	**-**	**-**	**-**	**3510**	**89,0**	**2,59**
deviation	**-**	**-**	**-**	**80**	**12,2**	**0,44**
5% -Fraktil	**-**	**-**	**-**	**3360**	**66,6**	**1,79**

2.2.2 **Tensile strength properties according to DIN EN ISO 527-2** (BS EN ISO 527 or ASTM D638)

Type 1B test specimens were milled and the tensile modulus of elasticity, tensile strength and elongation at break were determined in accordance with DIN EN ISO 527-2: 2012-06.

Test parameters:

Test speed: 5 mm / min measuring length: 50 mm

Test climate: 23 ° C / 50% RH

Results:

EX1-2					
sample	**e**	**b**	**E_t**	**σ_{tm}**	**ε_{tm}**
	mm	**mm**	**MPa**	**MPa**	**%**
1	4,0	11,0	3330	74,2	3,03
2	4,5	11,0	3490	*35,4**	*1,31**
3	4,0	11,0	3630	74,7	3,35
4	4,0	11,0	3510	67,4	2,59
5	4,3	11,0	3630	60,1	2,38
6	3,8	11,0	3050	58,4	2,39
7	5,9	11,0	3590	60,5	3,04
8	5,9	11,0	3320	80,1	4,51
9	5,9	11,0	3320	57,0	2,87
10	5,9	11,0	3410	68,4	4,14
average	**-**	**-**	**3430**	**66,8**	**3,14**
deviation	**-**	**-**	**180**	**8,3**	**0,75**
5% -Fraktil	**-**	**-**	**3100**	**51,4**	**1,75**

EX2-2					
sample	**e**	**b**	**E_t**	**σ_{tm}**	**ε_{tm}**
	mm	**mm**	**MPa**	**MPa**	**%**
1	4,2	11,0	3400	42,3	1,64
2	4,2	11,0	3490	68,2	2,85
3	4,3	11,0	3370	51,3	2,07
4	4,4	11,0	3440	70,2	3,13
5	4,2	11,0	3430	53,8	2,15
6	4,2	11,0	3440	63,9	2,66
7	4,4	11,0	3530	50,7	2,11
8	4,2	11,0	3400	55,1	2,23
9	4,3	11,0	3670	50,7	2,09
10	5,0	11,0	3470	57,2	2,86
average	**-**	**-**	**3460**	**56,3**	**2,38**
deviation	**-**	**-**	**90**	**8,7**	**0,47**
5% -Fraktil	**-**	**-**	**3300**	**40,4**	**1,52**

* Terminal break, not rated

2.2.3 Pressing properties according to DIN EN ISO 604

Test specimens were has been taking from the test plates and the pressure modulus of elasticity and the compressive strength were determined in accordance with DIN EN ISO 604: 2003-12.

Test parameters:

Test speed: 1 mm / min measuring length: 40 mm

Test climate: 23 ° C / 50% RH

EX1-2						
sample	**e**	**b**	**E_t**	**e**	**b**	**σ_{tm}**
	mm	**mm**	**MPa**	**mm**	**mm**	**MPa**
1	5,0	9,9	3730	5,4	10,0	113
2	5,3	10,1	4070	5,3	10,0	110
3	5,1	10,1	3990	5,1	9,8	113
4	4,8	10,0	4110	5,1	10,0	114
5	5,3	10,0	4130	5,0	9,9	113
6	4,8	9,7	3530	4,6	9,9	112
7	4,9	10,0	4090	4,7	9,9	109
8	4,7	9,9	3520	4,7	9,9	112
9	4,9	9,9	3430	4,7	9,9	110
10	4,9	9,9	3380	4,8	9,8	110
average	**-**	**-**	**3800**	**-**	**-**	**112**
deviation	**-**	**-**	**310**	**-**	**-**	**2**
5% -Fraktil	**-**	**-**	**3230**	**-**	**-**	**108**

EX2-2						
sample	**e**	**b**	**E_t**	**e**	**b**	**σ_{tm}**
	mm	**mm**	**MPa**	**mm**	**mm**	**MPa**
1	5,4	10,0	3720	5,2	9,9	108
2	5,1	9,9	3550	5,3	9,9	105
3	5,7	10,0	3780	5,4	9,8	109
4	5,5	10,0	4060	5,2	9,9	106
5	5,2	10,1	4230	5,3	9,9	109
6	5,2	9,9	3700	5,8	9,6	108
7	5,1	9,9	3590	5,6	10,0	106
8	5,1	9,9	3470	5,8	9,9	110
9	5,6	9,9	3320	6,0	9,8	110
10	5,6	9,9	3690	6,2	9,9	109
average	**-**	**-**	**3710**	**-**	**-**	**108**
deviation	**-**	**-**	**27**	**-**	**-**	**2,0**
5% -Fraktil	**-**	**-**	**3220**	**-**	**-**	**104**

2.2.4 Shore D-hardness according to DIN EN ISO 868: 2003-10

The Shore D-hardness was determined on the surface of the test panels.

Test parameters:

Reading time: 1 s Test climate: 23 ° C / 50% RH

Results:

Shore D/1						
	1	**2**	**3**	**4**	**5**	**average**
EX1-2	86	86	85	86	87	**86**
EX2-2	85	86	86	87	85	**86**

2.2.5 Pot life according to DIN EN ISO 10364: 2018-06 (follow-up document to DIN EN 14022: 2003-12)

The pot life was determined according to DIN EN ISO 10364, method 3 "Determination with the aid of the reaction temperature", corresponds to method 4 of DIN EN 14022.

Test parameters:

Weight: 125 g (100 g A + 25 g B) beaker: 200 ml, PP

Test temperature: 22 ° C critical temperature: 40 ° C

Result:

pot life in min	
EX1-2	34
EX2-2	108

2.2.6 Determination of density

The cut-out of the sample plates was used to determine the density in accordance with DIN EN ISO 1183-1: 2013-04.

Test parameters:

Sample size: approx. 5 cm² Medium: ethanol

Results:

density in g/cm³		
sample	**EX1-2**	**EX2-2**
1	1,167	1,158
2	1,167	1,157
3	1,167	1,157
4	1,167	1,158
5	1,167	1,158
average	**1,17**	**1,16**
deviation	**0,00**	**0,00**

2.2.7 Heat resistance HDT according to DIN EN ISO 75: 2013-08 *

10 mm wide test specimens were taken from the test plates and the flatness of the heat resistance HDT determined according to DIN EN ISO 75, method A.

Test parameters:

Heating rate: 120 K / h   Test pressure: 1.8 MPa

Test direction: flat

Results:

HDT/A in °C										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
EX1-2	64,5	68,8	68,2	67,9	68,8	67,9	67,8	68,5	67,6	67,4
EX2-2	70,9	72,4	72,0	71,2	72,2	72,3	71,3	71,8	71,5	71,9

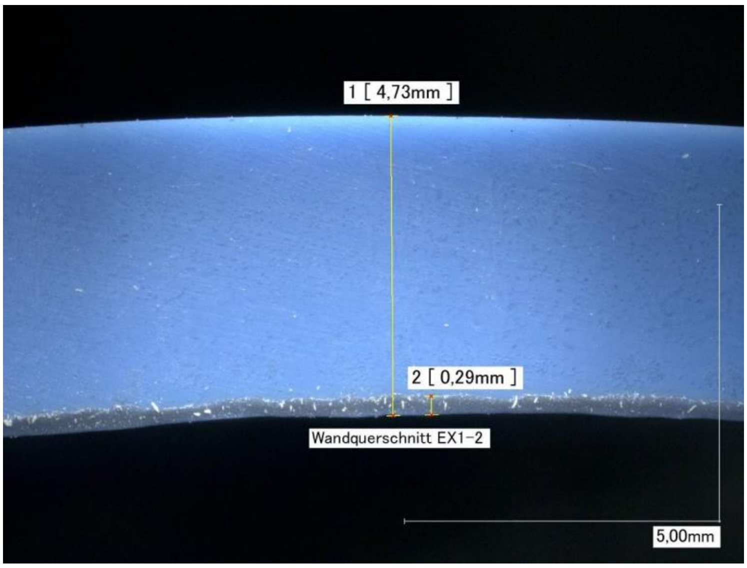
HDT/A in °C				
			EX1-2	**EX2-2**
average	-	-	**67,7**	**71,8**
deviation	-	-	**1,2**	**0,5**
5% -Fraktil	-	-	**65,5**	**70,8**

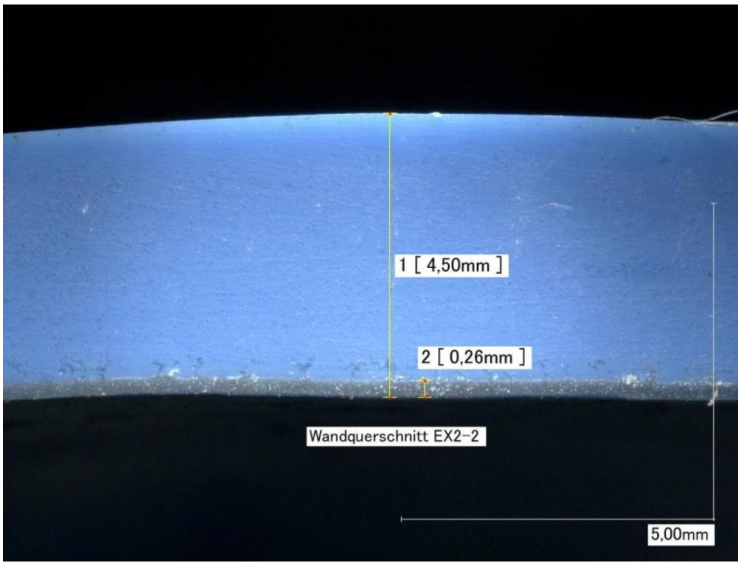
* this test was carried out subcontracted by an external test laboratory

2.3 Tests on hardened Liners

2.3.1 Liner wall construction

The wall structure of the hardened pipe liner was examined microscopically on the cut surfaces.





2.3.2 Watertightness

The water-tightness was checked on the hardened hose liner samples in accordance with DIN EN 1610, the inner coating was perforated with a cross cut to the load-bearing laminate.

Test parameters:

Test pressure: -0.5 bar Test duration: 30 min

Test medium: colored water

Results:

sample	Test point 1	Test point 2	Test point 3	Overall result
EX1-2/SX4	leakproof	leakproof	leakproof	**leakproof**
EX2-2/SX2	leakproof	leakproof	leakproof	**leakproof**

2.3.3 Determination of water absorption

The water absorption of rectangular test pieces was determined according to DIN EN ISO 62: 2008-05 over a period of 30 days. The samples were stored in distilled water at room temperature.

Test parameters:

Test specimen: rectangles, approx. 75 mm x 25 mm x 4 mm

Storage period: 30 d

Results:

EX1-2/SX4			
	water absorption after 24 h, c_{24h}	**water absorption after 7 d, c_{7d}**	**water absorption after 30 d, c_{30d}**
sample	**in %**	**in %**	**in %**
1	0,18	0,34	0,60
2	0,20	0,36	0,66
3	0,20	0,37	0,64
4	0,22	0,41	0,67
average	**0,20**	**0,37**	**0,64**
deviation	**0,02**	**0,02**	**0,03**

EX2-2/SX2			
	water absorption after 24 h, c_{24h}	**water absorption after 7 d, c_{7d}**	**water absorption after 30 d, c_{30d}**
sample	**in %**	**in %**	**in %**
1	0,21	0,39	0,68
2	0,22	0,40	0,67
3	0,23	0,42	0,70
4	0,32	0,42	0,70
average	**0,24**	**0,41**	**0,69**
deviation	**0,05**	**0,01**	**0,01**

2.3.4 Determination of density

The laminate density of the samples was determined in accordance with **DIN EN ISO 1183-1: 2013-04.** (ASTM D792)

Test parameters:

Sample size: approx. 5 cm² Medium: ethanol

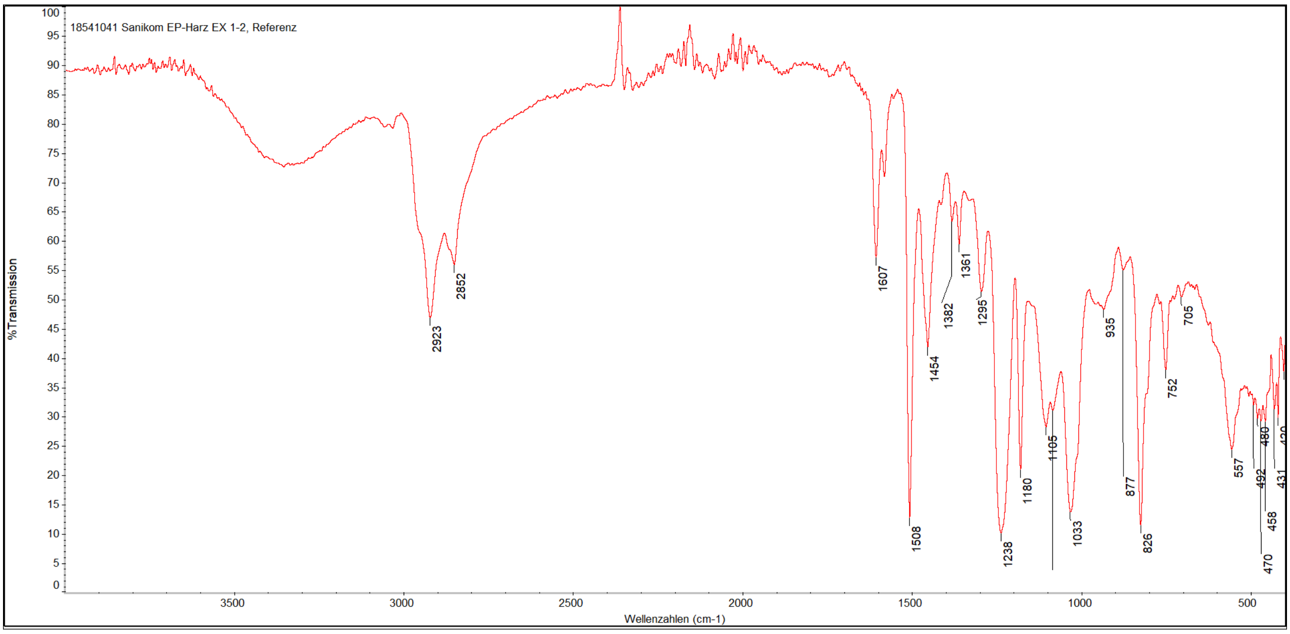
Results:

density in g/cm³		
sample	**EX1-2/SX4**	**EX2-2/SX2**
1	1,18	1,17
2	1,19	1,17
3	1,19	1,17
4	1,19	1,16
5	1,18	1,16
average	**1,19**	**1,17**
deviation	**0,01**	**0,01**

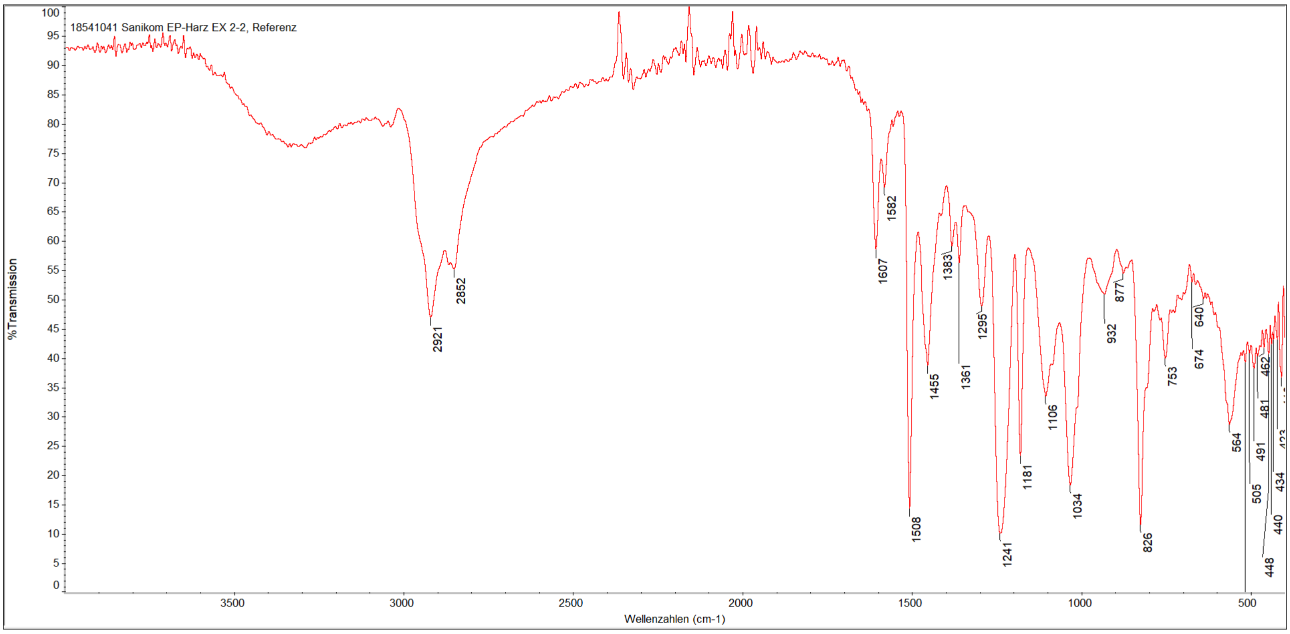
2.3.5 IR-spectroscopy

IR spectra were recorded on the cured resins.
The samples were applied to the measuring window of the ATR infrared spectrometer and measured in the wavenumber range of 4000-400 cm-1.

EX1-2/SX4



EX2-2/SX2



2.3.6 Crest pressure test

The specific initial ring stiffness S_0 according to DIN EN 1228: 1996-08 was determined on pipe sections in the crest pressure test and the circumferential modulus of elasticity was calculated from this.

Test parameters:

Support: flat plate Method: B, load type a)

Test climate: (23 ± 2) ° C / (50 ± 5)% RH

Results:

EX1-2/SX4										
resin	**Pos.**	**d_a**	**e_m**	**d_m**	**length**	**F_{2min}**	**Δd_v**	**S_0**	**S_R**	**Ering**
		mm	**mm**	**mm**	**mm**	**N**	**mm**	**N/m²**	**MPa**	**MPa**
1-A	0	190,2	3,9	186,4	301,6	243	5,6	2780	0,0222	3780
	60	190,2	3,9	186,4	301,6	218	5,6	2500	0,0200	3400
	120	190,2	3,9	186,4	301,6	262	5,6	3000	0,0240	4080
1-B	0	190,3	3,9	186,4	297,5	243	5,6	2810	0,0225	3760
	60	190,3	3,9	186,4	297,5	227	5,6	2630	0,0211	3520
	120	190,3	3,9	186,4	297,5	247	5,6	2860	0,0229	3820
1-C	0	190,3	3,9	186,4	298,1	249	5,6	2870	0,0230	3690
	60	190,3	3,9	186,4	298,1	226	5,6	2620	0,0209	3360
	120	190,3	3,9	186,4	298,1	253	5,6	2930	0,0234	3760
average								**2780**	**0,0222**	**3690**
deviation								**160**	**0,0013**	**230**
5% - Fraktil								**2480**	**0,0198**	**3260**

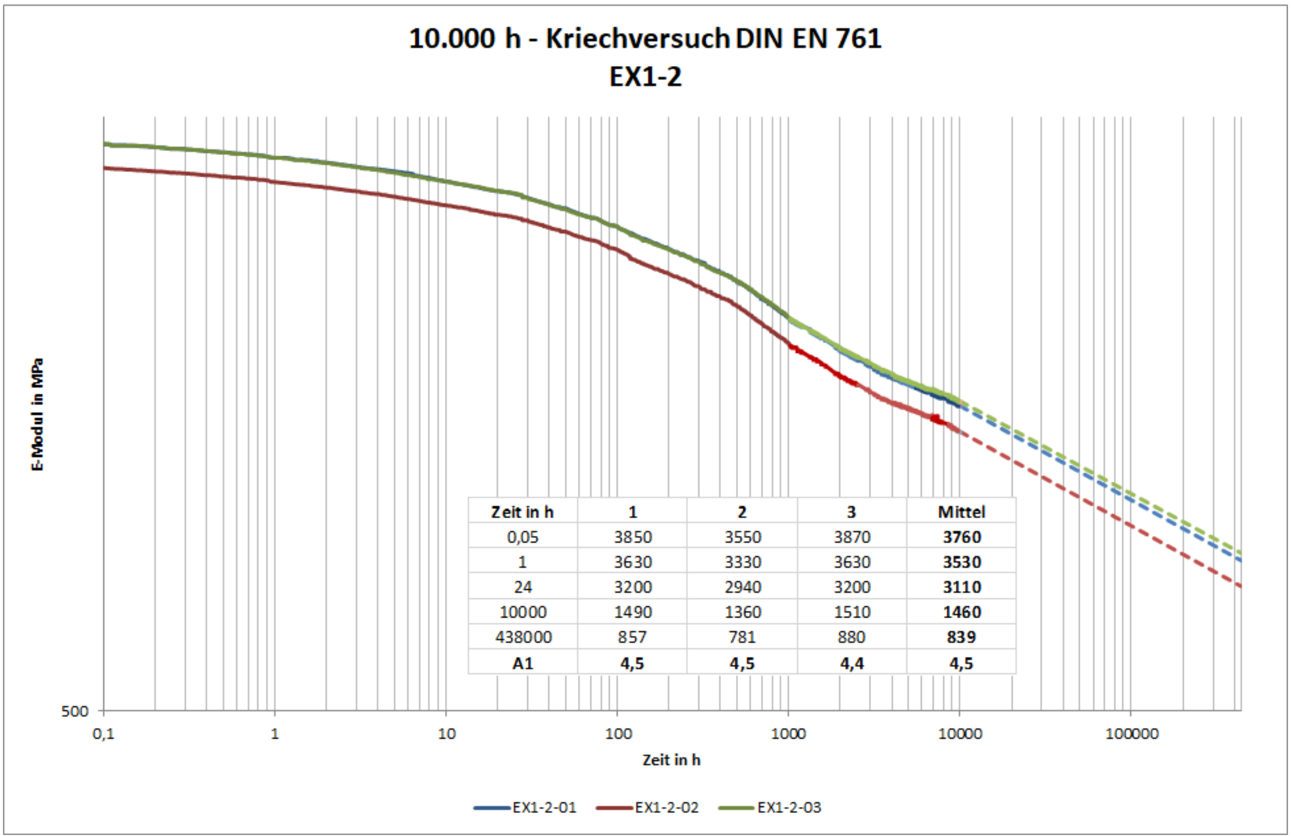
EX2-2/SX2										
resin	**Pos.**	**d_a**	**e_m**	**d_m**	**length**	**F_{2min}**	**Δd_v**	**S_0**	**S_R**	**Ering**
		mm	**mm**	**mm**	**mm**	**N**	**mm**	**N/m²**	**MPa**	**MPa**
2-A	0	189,7	3,7	185,9	300,4	206	5,6	2370	0,0190	3520
	60	189,7	3,7	186,0	300,4	197	5,6	2260	0,0181	3350
	120	189,7	3,7	186,0	300,4	194	5,6	2230	0,0179	3310
2-B	0	190,4	4,0	186,4	299,3	216	5,6	2490	0,0199	3040
	60	190,4	4,0	186,4	299,3	198	5,6	2280	0,0182	2790
	120	190,4	4,0	186,4	299,3	227	5,6	2610	0,0209	3200
2-C	0	190,4	4,2	186,2	300,5	263	5,6	3030	0,0242	3240
	60	190,4	4,2	186,2	300,5	240	5,6	2760	0,0221	2950
	120	190,4	4,2	186,2	300,5	255	5,6	2930	0,0234	3130
average								**2550**	**0,0204**	**3170**
deviation								**300**	**0,0024**	**220**
5% - Fraktil								**1990**	**0,0159**	**2760**

2.3.7 Long-term crest pressure test according to DIN EN 761 (BS EN ISO 11296-4)

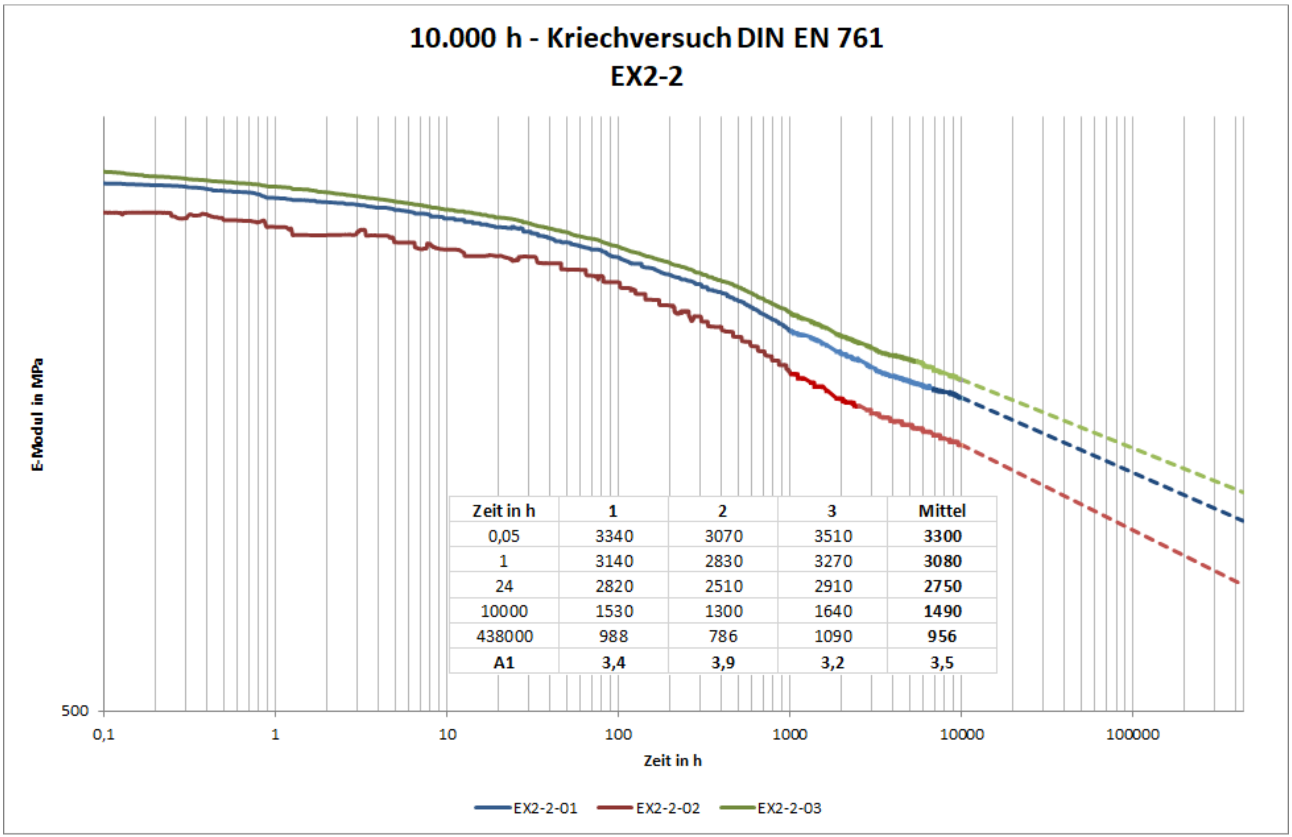
A long-term crest pressure test according to DIN EN 761: 1994-08 was carried out on three pipe sections in each case to determine the long-term reduction factor A1L.

Test climate: (23 ± 2) ° C Test duration: 10,000 h

EX1-2/SX4			
sample dimensions	**1**	**2**	**3**
average diameter **d_m in mm**	186,2	186,3	186,4
Liner thickness **s in mm**	3,8	3,8	3,8
length **l in mm**	297	299	297
test load **F in N**	143	130	137



EX2-2/SX2			
sample dimensions	**1**	**2**	**3**
average diameter **d_m in mm**	186,5	186,5	186,6
Liner thickness **s in mm**	3,9	3,9	3,9
length **l in mm**	297	300	299
test load **F in N**	126	123	124



Based on the determined 3-minute value and the estimate of the 50-year value after 10,000 hours of testing, the following reduction factors result A_{IL}:

EX1-2/SX4			
sample	**$E_{3'}$ in MPa**	**E_{50a} in MPa**	**reduction factor A_{IL}**
1	3850	857	4,5
2	3550	781	4,5
3	3870	880	4,4
average	**-**	**-**	**4,5**

EX2-2/SX2			
sample	**$E_{3'}$ in MPa**	**E_{50a} in MPa**	**reduction factor A_{IL}**
1	3340	988	3,4
2	3070	786	3,9
3	3510	1090	3,2
average	**-**	**-**	**3,5**

2.3.8 Bending modulus of elasticity and bending strength at the circular cutout (BS EN ISO 178)

Approximately 50 mm wide test specimens were taken in the circumferential direction and the flexural modulus and flexural strength determined in a 3-point bending test according to **DIN EN ISO 178: 2013-09**. The modulus of elasticity and the flexural strength were calculated analogously to **DIN EN ISO 11296-4: 2011-07**.

Specimen dimensions:

Width: 50 mm length: approx. 80 mm

Test parameters:

Support diameter: 10 mm Direction of loading: outside in pressure zone

Test speed: 10 mm / min Test climate: (23 ± 2) ° C / (50 ± 5)% RH

Results:

EX1-2/SX4						
sample	**e_{ges}**	**e_m**	**b**	**l_v**	**E_f**	**σ_{fm}**
	mm	**mm**	**mm**	**mm**	**MPa**	**MPa**
1	4,3	4,1	50,1	51,0	3570	66,3
2	4,2	4,0	50,5	51,0	3650	62,7
3	3,9	3,7	50,1	51,0	3370	65,6
4	3,8	3,6	50,4	51,0	3640	69,3
5	4,4	4,2	50,3	51,0	3480	63,7
6	4,4	4,2	50,4	51,0	3410	61,0
7	4,5	4,3	50,1	51,0	3650	63,0
8	4,5	4,3	50,4	51,0	3520	60,1
9	3,8	3,6	50,2	51,0	3600	63,8
10	3,7	3,5	50,4	51,0	3590	62,9
11	4,7	4,5	50,1	51,0	3040	49,2
12	4,7	4,5	50,4	51,0	3140	52,7
average	**4,2**	**4,0**	**-**	**-**	**3470**	**61,7**
deviation	**0,4**	**0,4**	**-**	**-**	**201**	**5,6**
5% -Fraktil	**-**	**-**	**-**	**-**	**3110**	**51,6**

EX2-2/SX2						
sample	**e_{ges}**	**e_m**	**b**	**l_v**	**E_f**	**σ_{fm}**
	mm	**mm**	**mm**	**mm**	**MPa**	**MPa**
1	4,7	4,4	50,2	51,0	3250	63,9
2	4,6	4,3	50,5	51,0	3210	63,8
3	3,9	3,6	49,9	51,0	3070	54,1
4	4,1	3,8	50,4	51,0	3060	60,0
5	4,4	4,1	50,3	51,0	3420	64,0
6	4,5	4,2	50,4	51,0	3300	65,0
7	4,3	4,0	50,3	51,0	3210	63,8
8	4,3	4,0	50,5	51,0	3260	55,4
9	3,8	3,5	50,4	51,0	2690	56,0
10	3,8	3,5	50,4	51,0	2970	59,1
11	4,4	4,1	50,3	51,0	3390	68,2
12	4,4	4,1	50,5	51,0	3310	55,3
average	**4,3**	**4,0**	**-**	**-**	**3180**	**60,7**
deviation	**0,3**	**0,3**	**-**	**-**	**204**	**4,7**
5% -Fraktil	**-**	**-**	**-**	**-**	**2820**	**52,3**

2.3.9 Flexural strength on the circular ring

The bending strength was determined on circular rings in the crest compression test.

Test parameters:

Support: flat plate test speed: 3% / min

Test climate: (23 ± 2) ° C / (50 ± 5)% RH

Results:

EX1-2/SX4						
Probe	**d_a**	**e_m**	**d_m**	**l**	**F_B**	**σ_{fB}**
	mm	**mm**	**mm**	**mm**	**N**	**MPa**
1	190,2	3,9	186,3	301,6	1090	42,8
2	190,3	3,9	186,4	297,5	1140	45,7
3	190,3	3,9	186,4	298,1	1060	42,2
4	190,1	3,8	186,3	297,2	1190	50,0
5	190,2	3,8	186,4	299,0	1120	46,8
6	190,1	3,9	186,2	297,2	1210	48,4
average						**46,0**
deviation						**3,1**
5% -Fraktil						**39,8**

EX2-2/SX2						
Probe	**d_a**	**e_m**	**d_m**	**l**	**F_B**	**σ_{fB}**
	mm	**mm**	**mm**	**mm**	**N**	**MPa**
1	189,7	3,7	186,0	300,4	930	40,7
2	190,4	4,0	186,4	299,3	1060	39,8
3	190,4	4,0	186,4	300,5	1030	38,9
4	190,3	4,0	186,3	296,7	1090	41,6
5	190,4	3,9	186,5	299,9	1200	47,6
6	190,4	4,0	186,4	299,2	959	36,2
average						**40,8**
deviation						**3,8**
5% -Fraktil						**33,1**

Determination of long-term bending strength $\sigma_{fB,\ 50a}$ on the circular ring from the short-term bending strength σ_{fB} and the reduction factor A_{1L}:

	σ_{fB}	A_{1L}	$\sigma_{fB,\ 50a}$
EX1-2/SX4	39,8	4,5	**8,8**
EX2-2/SX2	33,1	3,5	**9,5**

2.3.10 Pressing properties according to DIN EN ISO 604 (BS 2782: Part 3: Method 345A)

Test specimens were removed from the pipe sections and the pressing modulus of elasticity and the compressive strength were determined in accordance with **DIN EN ISO 604: 2003-12.** (BS 2782: Part 10: Method 1001)

Test parameters:

Test speed: 1 mm / min measuring length: 40 mm

Test climate: 23 ° C / 50% RH

results:

EX1-2/SX4						
sample	**e**	**b**	**E_t**	**e**	**b**	**σ_{tm}**
	mm	**mm**	**MPa**	**mm**	**mm**	**MPa**
1	5,3	9,9	3840	4,4	9,6	105
2	5,3	9,9	3930	3,8	9,7	102
3	5,3	9,9	3910	3,8	9,6	107
4	5,3	9,9	3830	3,8	9,7	107
5	5,2	9,8	4190	4,3	9,6	103
6	5,0	9,8	3440	4,1	9,6	105
7	5,0	9,8	3540	4,1	9,5	106
8	5,0	9,8	3720	4,6	9,6	103
9	5,0	9,8	3600	4,1	9,5	106
10	5,2	10,0	3860	4,1	9,5	106
average	**-**	**-**	**3790**	**-**	**-**	**105**
deviation	**-**	**-**	**220**	**-**	**-**	**2**
5% -Fraktil	**-**	**-**	**3390**	**-**	**-**	**101**

EX2-2/SX2						
sample	**e**	**b**	**E_t**	**e**	**b**	**σ_{tm}**
	mm	**mm**	**MPa**	**mm**	**mm**	**MPa**
1	4,8	9,8	3670	4,0	9,5	97,6
2	5,1	10,0	3760	4,1	9,6	97,6
3	5,1	9,8	3260	4,2	9,7	98,7
4	5,0	9,8	3130	4,1	9,7	98,2
5	5,1	9,8	3330	4,4	9,5	96,2
6	5,1	9,8	3210	4,2	9,7	97,2
7	4,8	9,8	3240	4,3	9,7	97,2
8	4,8	9,8	3380	4,3	9,6	99,5
9	4,7	9,8	3300	4,3	9,5	95,4
10	4,8	10,0	3410	4,1	9,7	98,0
average	**-**	**-**	**3370**	**-**	**-**	**97,6**
deviation	**-**	**-**	**20**	**-**	**-**	**1,2**
5% -Fraktil	**-**	**-**	**3000**	**-**	**-**	**95,4**

2.3.11 Shore D-hardness according to DIN EN ISO 868: 2003-10 (BS 2782: part 10: Method 1001)

The Shore D hardness was determined on the outside of the pipe liner samples.

Test parameters:

Reading time: 1 s Test climate: 23 ° C / 50% RH

results:

Shore D/1						
	1	**2**	**3**	**4**	**5**	**average**
EX1-2/SX4	87	86	86	85	86	**86**
EX2-2/SX2	86	85	85	84	85	**85**

2.3.12 Determination of the 24-hour creep tendency

Approx. 50 mm wide test specimens were taken in the circumferential direction and the 24-hour creep tendency according to DIN 16869-2 or DIN EN ISO 899-2 was determined in a 3-point bending test. The load was determined so that it corresponded to an initial vertical deformation of 3 ± 0.5%. The tendency to creep was tested depending on the age of the sample up to the age of 51 days.

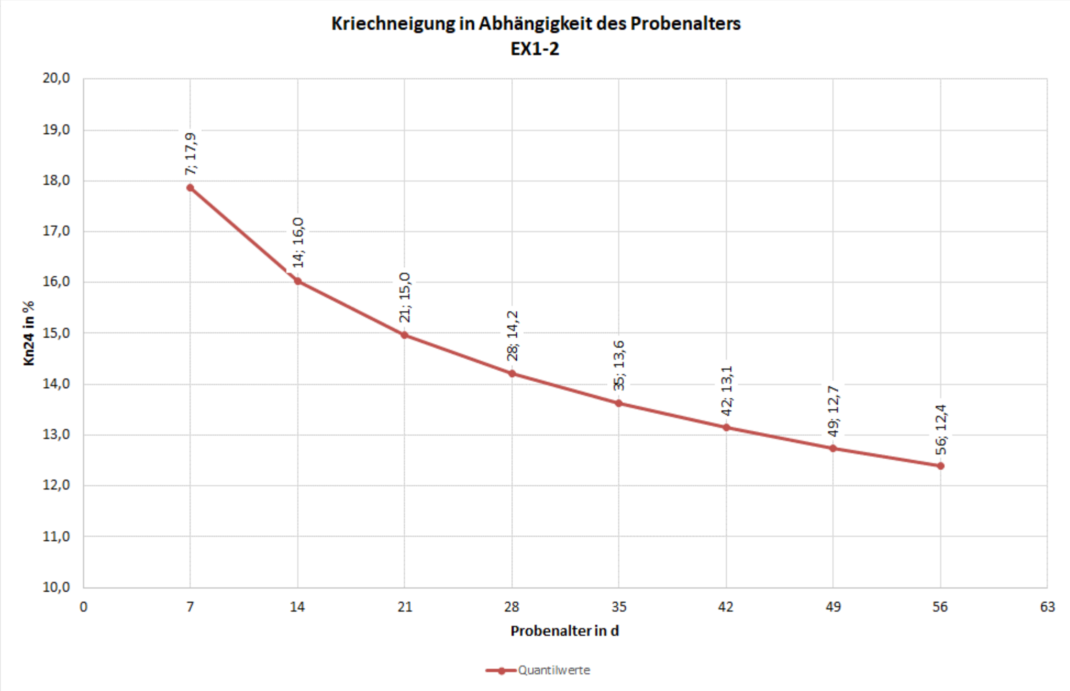
Test parameters:
Test specimen: segments taken in circumferential direction
Width: approx. 50 mm Length: approx. 80 mm
Support diameter: 10 mm Direction of loading: outside in the pressure zone
Test climate: (23 ± 2) ° C / (50 ± 5)% RH

Results:

EX1-2/SX4									
age	**sample**	**E_{1h}**	**E_{24h}**	**Kn_{24}**	**Alter**	**Probe**	**E_{1h}**	**E_{24h}**	**Kn_{24}**
d		**MPa**	**MPa**	**%**	**d**		**MPa**	**MPa**	**%**
7	K1	2600	2190	15,8	28	K3	2520	2260	10,3
7	K2	2930	2460	16,0	28	K4	2220	2010	9,5
9	K3	2580	2190	15,1	30	K5	3220	2850	11,5
9	K4	2590	2220	14,3	30	K6	2810	2510	10,7
14	K5	3100	2690	13,2	33	K1	2690	2370	11,9
14	K6	2740	2380	13,1	33	K2	2690	2350	12,6
16	K1	2790	2440	12,5	37	K3	2750	2430	11,6
16	K2	3040	2650	12,8	37	K4	2790	2470	11,5
19	K3	2680	2360	11,9	41	K5	3070	2710	11,7
19	K4	2680	2380	11,2	41	K6	2620	2330	11,1
23	K5	3320	2920	12,0	44	K1	2800	2500	10,7
23	K6	2850	2510	11,9	44	K2	2790	2470	11,5
26	K1	2850	2500	12,3	51	K5	3370	2970	11,9
26	K2	2800	2450	12,5	51	K6	2670	2370	11,2

The following values result as the upper 5% fractile:

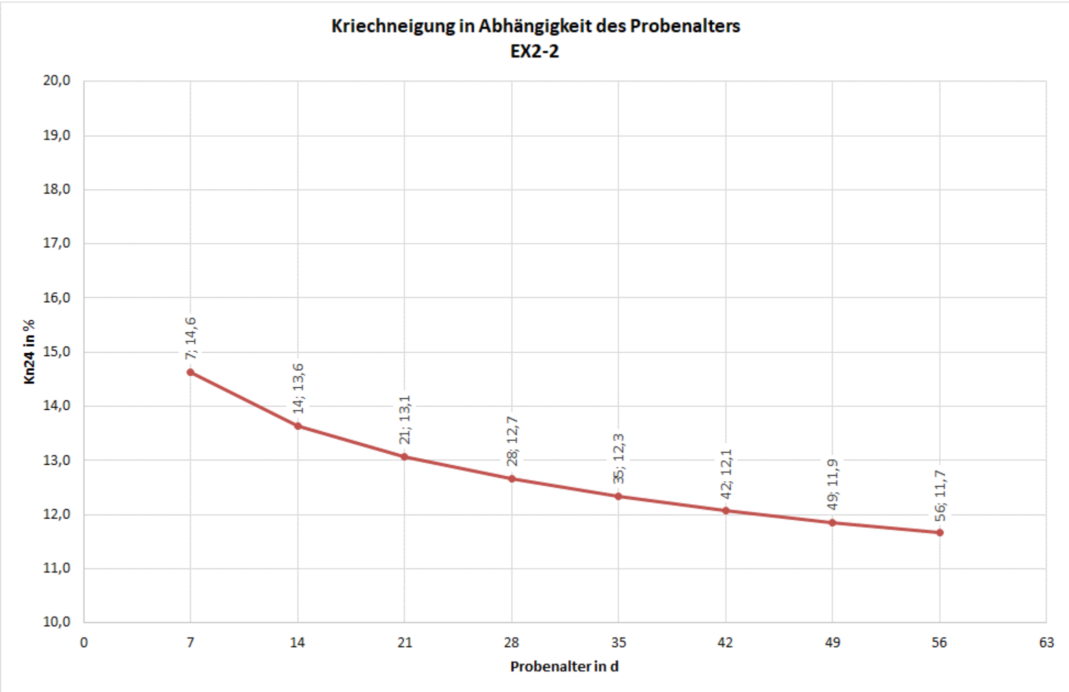
EX1-2/SX4			
sample age in d	**Kn_{24} in %**	**sample age in d**	**Kn_{24} in %**
7 d	17,9	35 d	13,6
14 d	16,0	42 d	13,1
21 d	15,0	49 d	12,7
28 d	14,2	56 d	12,4



EX2-2/SX2									
age	sample	E_{1h}	E_{24h}	Kn_{24}	Alter	sample	E_{1h}	E_{24h}	Kn_{24}
d		MPa	MPa	%	d		MPa	MPa	%
7	K1	3110	2760	11,3	28	K3	2540	2290	9,8
7	K2	2760	2440	11,6	28	K4	1940	1770	8,8
9	K3	2930	2540	13,3	30	K5	2080	1860	10,6
9	K4	2430	2110	13,2	30	K6	2640	2390	9,5
14	K5	2680	2340	12,7	33	K1	2930	2590	11,6
14	K6	2710	2410	11,1	33	K2	3120	2770	11,2
16	K1	3250	2900	10,8	37	K3	2850	2560	10,2
16	K2	2770	2470	10,8	37	K4	2460	2190	11,0
19	K3	2730	2440	10,6	41	K5	2400	2140	10,8
19	K4	2360	2110	10,6	41	K6	2780	2510	9,7
23	K5	2810	2490	11,4	44	K1	3330	3010	9,6
23	K6	2700	2430	10,0	44	K2	2760	2480	10,1
26	K1	2650	2390	9,8	51	K5	2690	2410	10,4
26	K2	2850	2540	10,9	51	K6	2860	2580	9,8

The following values result as the upper 5% fractile:

EX1-2/SX2			
sample age in d	Kn_{24} in %	sample age in d	Kn_{24} in %
7 d	14,6	35 d	12,3
14 d	13,6	42 d	12,1
21 d	13,1	49 d	11,9
28 d	12,7	56 d	11,7



2.3.13 Shear Strength, Determination of the Poisson number (cross contraction number)

(ASTM D732 or BS 2782: Part 3: Method 340B)

Rectangular samples were taken from the laminate sheets in the axial and radial directions. Strain gauges with an xy measuring grid and a grid length of 6 mm were applied in the middle on both sides.

The samples were subjected to a tensile load in the linear elastic range. The samples were loaded and unloaded with 4 cycles each and the longitudinal and transverse strains were continuously measured.

test parameters:

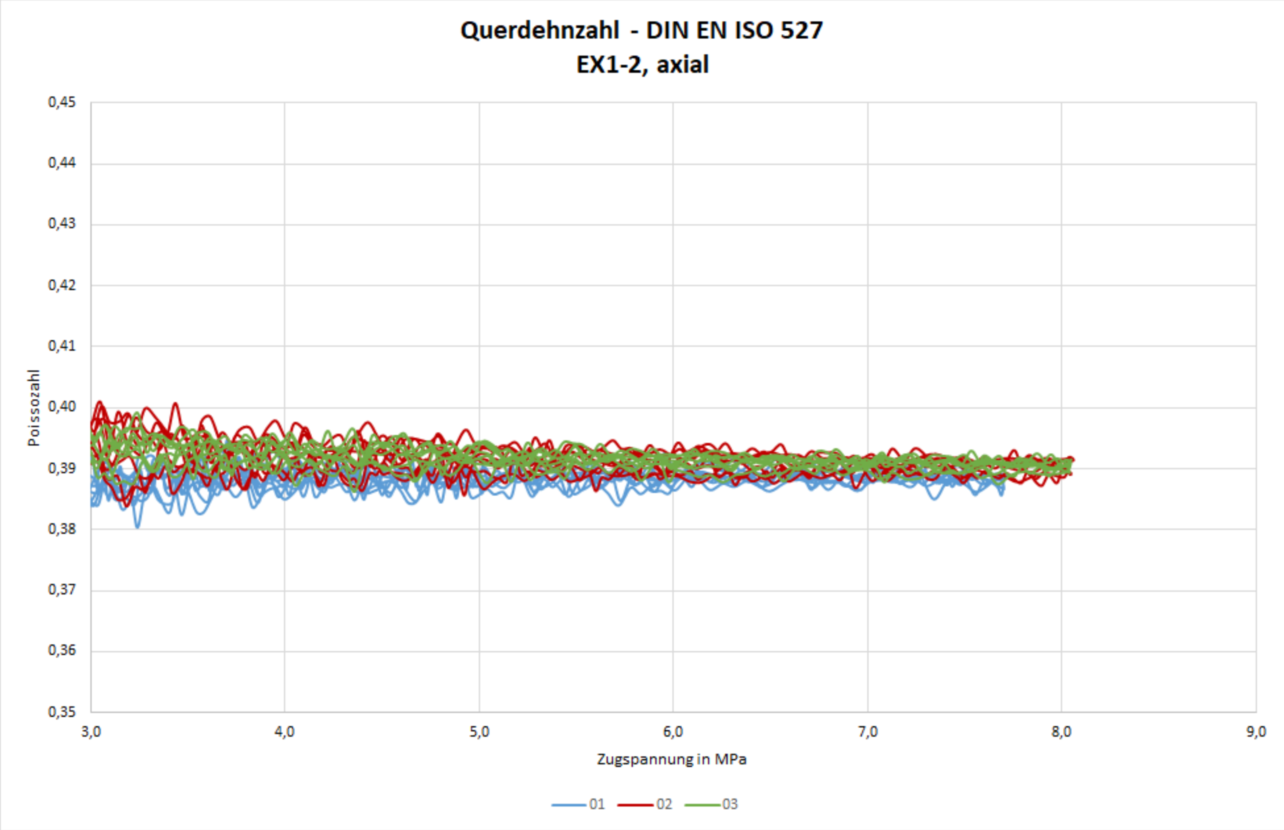
Length:	approx. 250 mm	width:	approx. 25 mm
Thickness:	approx. 5 mm	Test speed:	5 mm / min
Underload:	1 MPa	Upper load:	8 MPa
Test climate:	23 ° C / 50% RH		

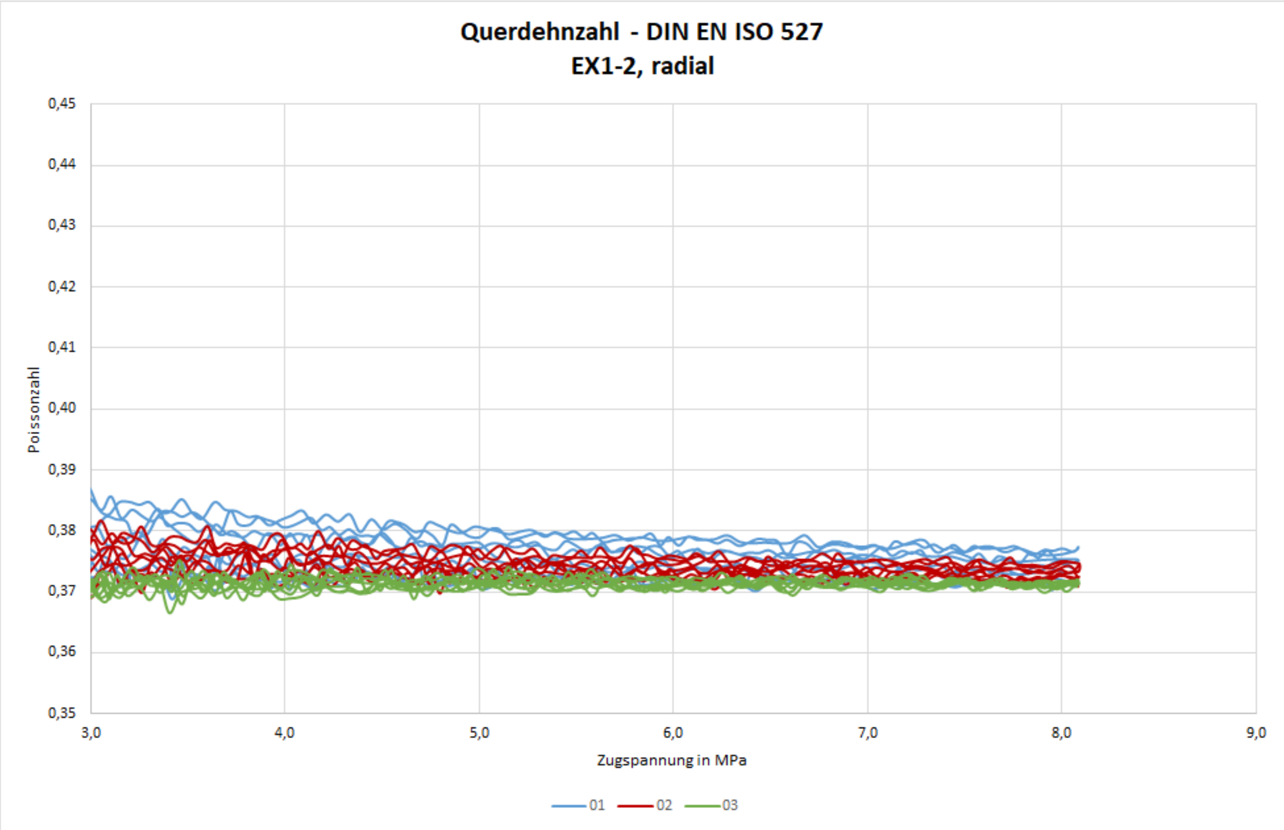
The transverse contraction number μ was calculated from the measured individual strains as follows:

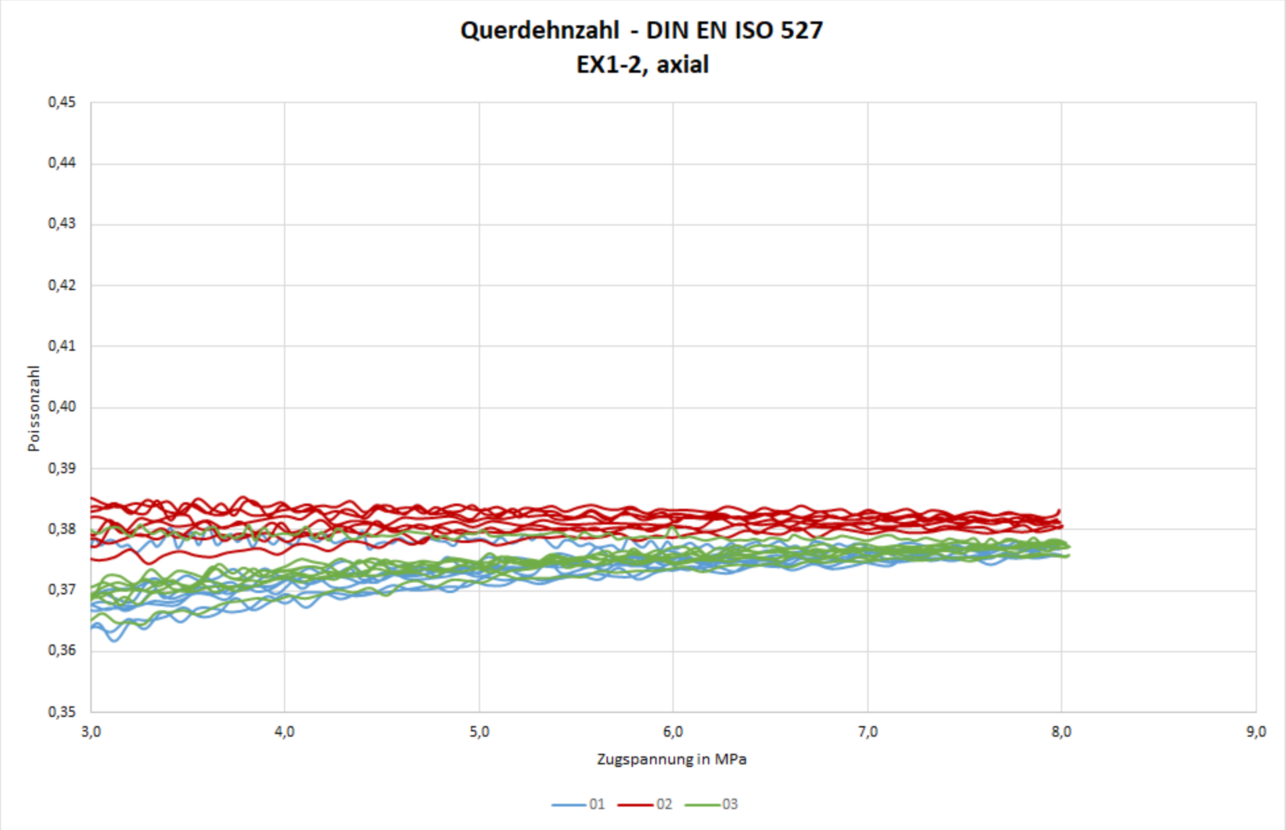
$$\mu = \frac{\varepsilon_{quer}}{\varepsilon_{längs}}$$

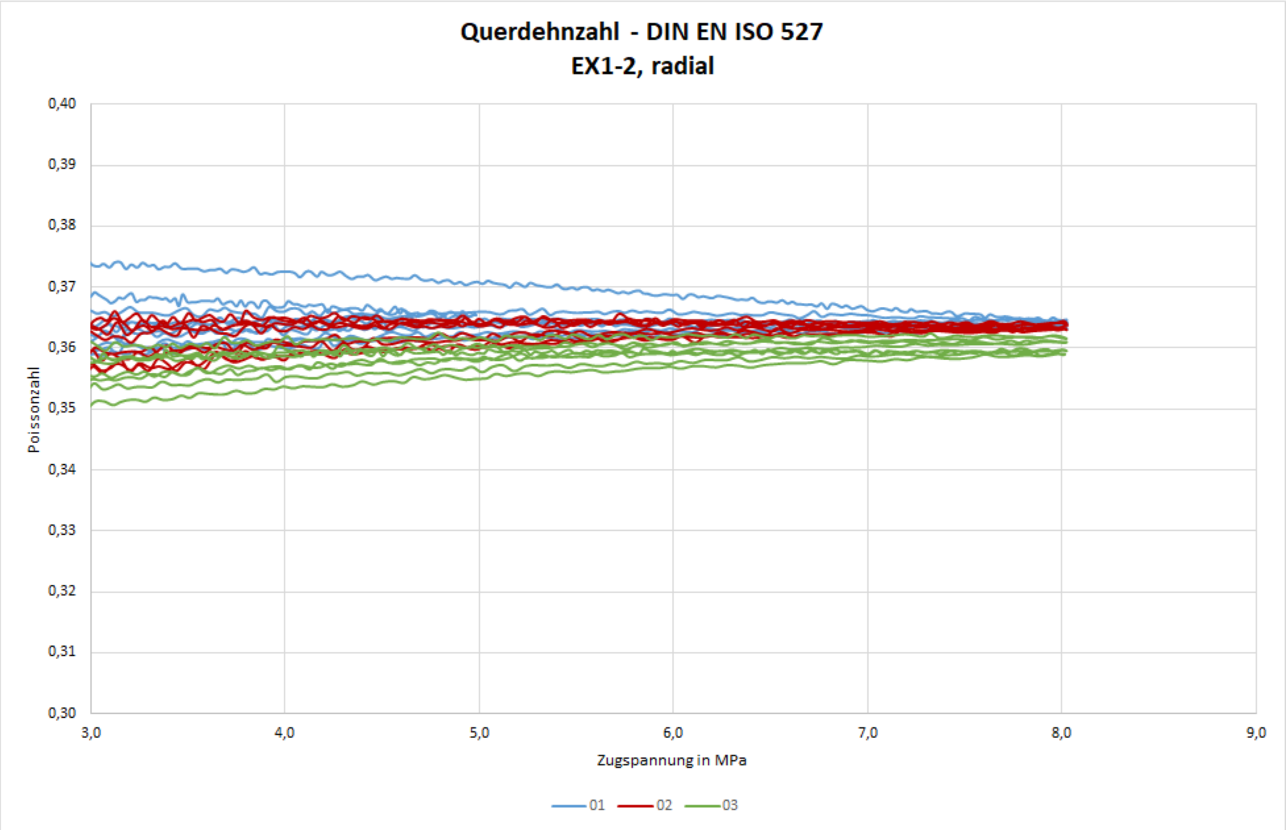
But ε_{quer} and $\varepsilon_{längs}$ referring to the orientation in the tensile test.

The following diagrams show the transverse contraction number μ compared to the tensile stress:


Querdehnzahl - DIN EN ISO 527
EX1-2, axial
Poissozahl
0,45
0,44
0,43
0,42
0,41
0,40
0,39
0,38
0,37
0,36
0,35
3,0
4,0
5,0
6,0
7,0
8,0
9,0
Zugspannung in MPa
01
02
03


Querdehnzahl - DIN EN ISO 527
EX1-2, radial
Poissonzahl
0,45
0,44
0,43
0,42
0,41
0,40
0,39
0,38
0,37
0,36
0,35
3,0
4,0
5,0
6,0
7,0
8,0
9,0
Zugspannung in MPa
01
02
03





There is a slight dependence on the voltage, which may be due to slight pre-curvature of the samples.

In the case of the overvoltage, the transverse contraction number approaches a limit value, which is given below:

resin	test direction	poisson / cross contraction number μ			
		sample 1	sample 2	sample 3	average
EX1-2/ SX4	axial	0,389	0,390	0,391	**0,39**
	radial	0,373	0,372	0,732	**0,37**
EX2-2/ SX2	axial	0,377	0,381	0,377	**0,38**
	radial	0,364	0,364	0,360	**0,36**

2.3.14 Determination of the 24-hour creep tendency Test of abrasion resistance (Darmstadt tipping channel) according to DIN EN 295-3[na]

(similar test to ASTM D4060 or ASTM D-1044-05)

The abrasion resistance up to a load cycle number of 100,000 load cycles was tested on each half-shell with a length of 1 m in accordance with DIN EN 295-3: 2012-03, item 12.

After the test, the abrasion depth was measured in the bottom line.

Test parameters:

incline: ± 22,5°

test material: round quartz gravel, d_{50} = 6 mm

quantity of test material: 4,0 kg

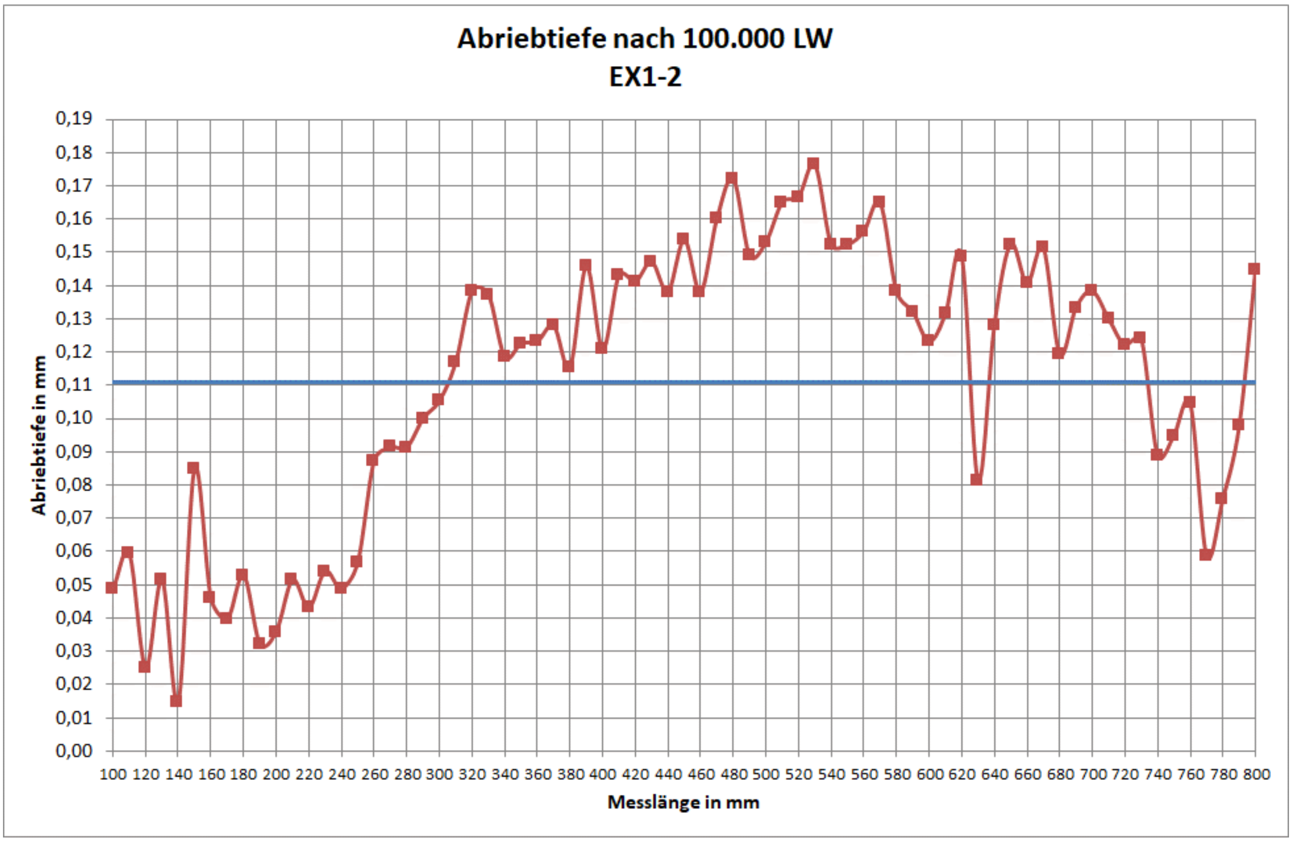
Tipping frequency: 20 min^{-1}

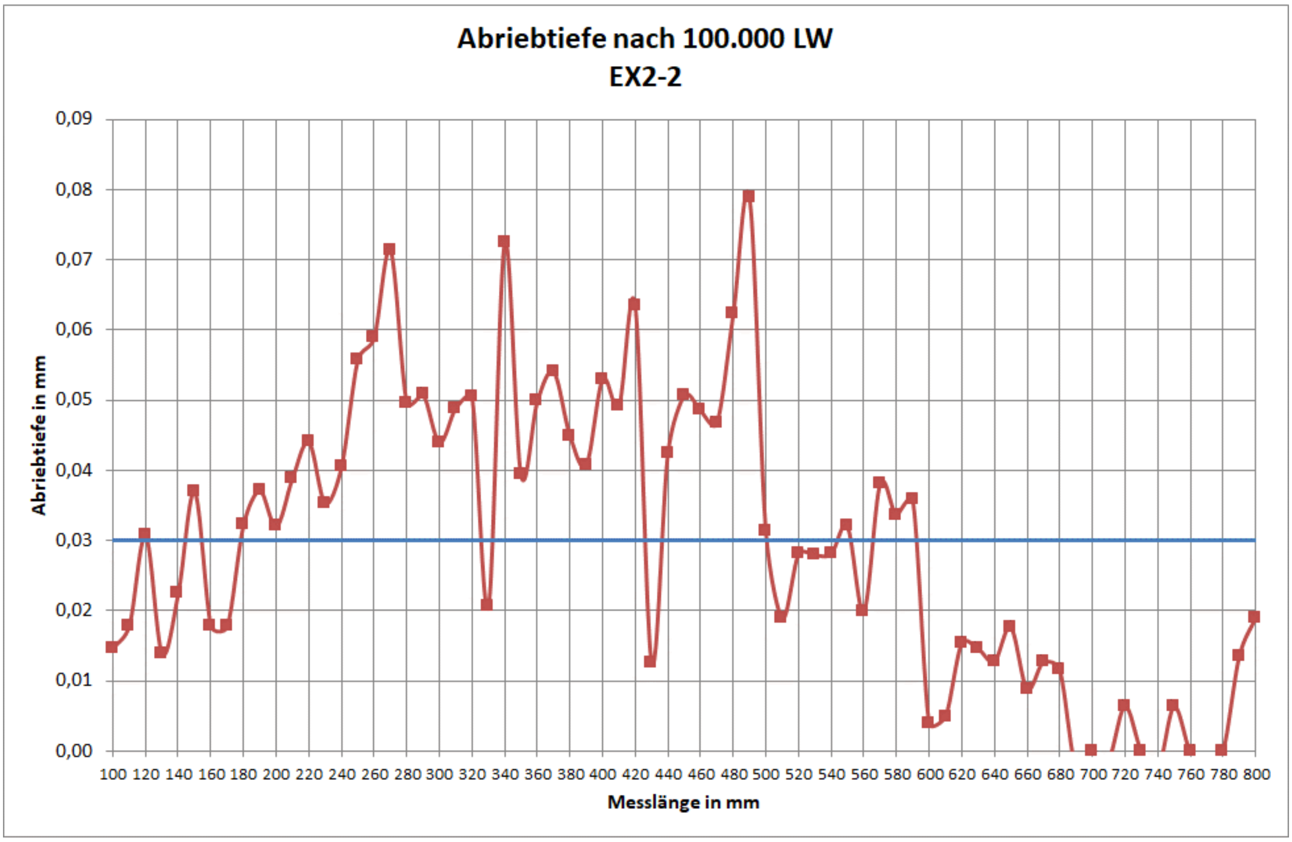
test temperature: (23±2)°C

results:

	average abrasion depth in mm
EX 1-2/SX4	**0,11**
EX 2-2/SX2	**0,03**

No damage to the coating or the load-bearing wall structure was found.





2.3.15 Testing the high-pressure cleaning resistance according to DIN 19523

The test for high-pressure flushing resistance (material test) has been passed, see separate test report G 30 450 from iro GmbH, Oldenburg.

The test for high-pressure flushing resistance (practical test) has been passed, see separate test report PT 18541041-HD from Polytest Ingenieure GmbH.

2.3.16 Chemical resistance test

Test specimens were removed from the tube liners and stored in sulfuric acid (H2SO4 10%), in sodium hydroxide solution (NaOH 1%) and in 5% aqueous solution of a peroxide-containing commercial sanitary cleaner at room temperature over a period of 28 days. The inside coating remained untreated.

After storage, the change in mass was measured and the tensile properties and impact strength were checked.

2.3.16.1 Mass change

Test specimen: squares with an edge length of 40 mm

Results:

acid H_2SO_4						
	EX1-2/SX4			**EX2-2/SX2**		
sample	m_{vor} in g	m_{nach} in g	change in %	m_{vor} in g	m_{nach} in g	change in %
1	6,7769	6,8277	+0,75	6,6960	6,7764	+1,20
2	8,4019	8,4541	+0,62	8,5816	8,6681	+1,01
3	8,2857	8,3398	+0,65	8,7360	8,8267	+1,04
4	7,1348	7,1840	+0,69	7,3656	7,4500	+1,15
average	**-**	**-**	**+0,68**	**-**	**-**	**+1,10**

lye NaOH						
	EX1-2/SX4			**EX2-2/SX2**		
sample	m_{vor} in g	m_{nach} in g	change in %	m_{vor} in g	m_{nach} in g	change in %
1	6,8057	6,8272	+0,32	7,7733	7,7946	+0,27
2	8,3163	8,3451	+0,35	8,6616	8,6971	+0,41
3	8,3300	8,3621	+0,39	7,8632	7,8885	+0,32
4	7,1851	7,2108	+0,36	7,3126	7,3440	+0,43
average	**-**	**-**	**+0,35**	**-**	**-**	**+0,36**

sanitary cleaner containing peroxide (5%)						
	EX1-2/SX4			EX2-2/SX2		
sample	m_{vor} in g	m_{nach} in g	change in %	m_{vor} in g	m_{nach} in g	change in %
1	7,4885	7,5212	+0,44	6,7969	6,8334	+0,54
2	7,9836	8,0163	+0,41	8,4619	8,4990	+0,44
3	8,1022	8,1345	+0,40	8,6166	8,6539	+0,43
4	8,1545	8,1873	+0,40	7,9398	7,9776	+0,48
average	**-**	**-**	**+0,41**	**-**	**-**	**+0,47**

Apparently no changes or damage could be found on the samples.

2.3.16.2 tension strength and elongation at break

The tensile strength and elongation at break were determined on untreated comparative samples and the media-stored samples in accordance with DIN EN ISO 527-4.

Test parameters:

Test specimen: strip samples with parallel sides, axial

Width: approx. 15 mm length: approx. 200 mm

Test speed: 5 mm / min Test climate: 23 ° C / 50% RH

Measuring length: 50 mm

Results:

EX1-2/SX4				
before storege				
sample no.	**weidth b in mm**	**thickness s in mm**	**tension strength σ_r in MPa**	**elongation at break ε_r in %**
1	14,6	4,2	34,4	1,46
2	15,1	4,4	43,3	2,14
3	15,0	4,4	46,1	1,70
4	14,9	3,6	37,7	1,39
5	15,0	4,5	44,9	1,96
average	**-**	**-**	**41,3**	**1,73**
deviation	**-**	**-**	**5,0**	**0,32**
5% -Fraktil	**-**	**-**	**30,6**	**1,05**

after acid storage H_2SO_4				
1	15,0	4,2	46,3	1,96
2	15,1	4,2	44,4	1,86
3	14,8	3,8	30,8	0,90
4	14,7	3,7	31,7	1,10
*5**	*14,7*	*3,7*	*24,1*	*1,06*
average	**-**	**-**	**38,3**	**1,46**
st.deviation	**-**	**-**	**8,2**	**0,5**

after storage NaOH				
sample no.	weidth b in mm	thickness s in mm	tension strength σ_r in MPa	elongation at break ε_r in %
1	14,7	3,7	33,3	1,16
2	14,7	3,7	30,6	0,90
3	15,1	4,2	49,0	2,02
4	14,8	3,8	31,3	1,07
5	15,2	4,2	49,6	2,27
average	**-**	**-**	**38,8**	**1,48**
standard deviation	**-**	**-**	**9,7**	**0,62**
EX1-2/SX4				
after storage in sanitary cleaner containing peroxide				
*1**	*15,0*	*3,7*	*20,4*	*0,70*
2	15,0	4,2	42,1	1,83
3	14,8	3,9	39,7	1,15
4	14,8	3,7	30,2	1,50
5	14,7	3,8	37,4	1,43
average	**-**	**-**	**37,4**	**1,48**
standard deviation	**-**	**-**	**5,1**	**0,28**

* Terminal break, sample not evaluated

EX1-2/SX4	Änderung in %	
	tension strength σ_r	elongation at break ε_r
acid H_2SO_4	-7,2	-15,9
lye NaOH	-6,1	-14,2
sanitary cleaner containing peroxide	-9,5	-14,6

EX2-2/SX2				
before storage				
sample no.	weidth b in mm	thickness s in mm	tension strength σ_r in MPa	elongation at break ε_r in %
1	15,0	3,7	30,2	1,40
2	15,0	4,2	38,6	1,59
3	15,0	4,2	33,6	1,71
4	15,0	4,2	41,2	1,54
5	15,0	3,7	33,2	1,00
average	**-**	**-**	**35,4**	**1,40**
standard deviation	**-**	**-**	**4,4**	**0,27**
5% -Fraktil	**-**	**-**	**25,9**	**0,87**

after acid storage H_2SO_4				
1	14,8	3,7	28,4	0,82
2	15,1	4,0	39,1	1,29
3	14,7	3,7	30,8	1,02
*4**	*14,9*	*3,9*	*19,8*	*0,79*
5	14,9	3,8	36,0	1,46
average	**-**	**-**	**33,6**	**1,15**
standard deviation	**-**	**-**	**4,9**	**0,28**
after storage in lye NaOH				
sample no.	**weidth b in mm**	**thickness s in mm**	**tension strength σ_r in MPa**	**elongation at break ε_r in %**
1	15,1	4,0	33,2	1,34
2	15,0	4,2	48,3	1,95
3	15,1	4,0	37,4	1,28
4	14,7	3,9	27,1	1,22
5	15,1	4,1	40,7	1,43
average	**-**	**-**	**37,3**	**1,44**
standard deviation	**-**	**-**	**8,0**	**0,29**
EX2-2/SX2				
after storage in sanitary cleaner containing peroxide				
1	14,7	3,7	27,1	0,92
2	15,0	3,7	31,2	1,13
3	15,2	4,2	39,7	1,60
4	15,1	4,0	34,6	1,72
5	14,8	3,7	27,8	1,14
average	**-**	**-**	**32,1**	**1,30**
standard deviation	**-**	**-**	**5,2**	**0,34**

* Terminal break, sample not evaluated

EX2-2/SX2	**changes in %**	
	tension strength σ_r	**elgnation at break ε_r**
acid H_2SO_4	-5,0	-18,0
lye NaOH	-5,6	-3,1
sanitary cleaner containing peroxide	-9,3	-7,0

2.3.16.3 Charpy impact strength

The Charpy impact strength was tested in accordance with DIN EN ISO 179 / 1-1fU on untreated comparative samples and the media-stored samples.

Test parameters:

Pendulum energy: 1.0 J Impact speed: 2.9 m / s

Span L: 62 mm Test climate: (23 ± 2) ° C / (50 ± 5)% RH

Direction of impact: on the coated side

Results:

EX1-2/SX4 blank test						
sample	h in mm	b in mm	A_i in mm²	E_c in J	**a_{cU} in**	brealing
1	4,40	9,93	43,7	0,340	7,8	C
2	4,10	9,99	41,0	0,292	7,1	C
3	4,15	10,13	42,0	0,373	8,9	C
4	3,70	9,89	36,6	0,314	8,6	C
5	4,00	10,09	40,4	0,312	7,7	C
6	4,15	10,20	42,3	0,303	7,2	C
7	4,05	10,10	40,9	0,351	8,6	C
8	3,87	10,16	39,3	0,318	8,1	C
9	3,80	9,99	38,0	0,354	9,3	C
10	4,04	10,16	41,0	0,318	7,7	C
average					**8,1**	
standard deviation					**0,7**	

EX1-2/SX4 after storage in H_2SO_4						
sample	h in mm	b in mm	A_i in	E_c in J	**a_{cU} in**	breaking
1	3,47	9,63	33,4	0,267	8,0	C
2	3,58	9,51	34,0	0,324	9,5	C
3	3,96	9,93	39,3	0,247	6,3	C
4	3,52	9,77	34,4	0,317	9,2	C
5	3,61	9,66	34,9	0,283	8,1	C
6	3,90	9,97	38,9	0,286	7,4	C
7	3,70	9,80	36,3	0,255	7,0	C
8	3,97	8,98	35,7	0,327	9,2	C
9	3,32	9,74	32,3	0,262	8,1	C
10	3,07	9,93	30,5	0,249	8,2	C
average					**8,1**	
standard deviation					**1,0**	

EX1-2/SX4 after storage in NaOH						
sample	h in mm	b in mm	A_i in mm²	E_c in J	**a_{cU} in kJ/m²**	breaking
1	3,80	9,08	34,5	0,327	9,5	C
2	3,81	9,66	36,8	0,357	9,7	C
3	3,39	9,91	33,6	0,282	8,4	C
4	3,78	9,76	36,9	0,332	9,0	C
5	3,73	9,85	36,7	0,312	8,5	C
6	3,63	9,91	36,0	0,321	8,9	C
7	3,59	9,97	35,8	0,334	9,3	C
8	3,81	9,80	37,3	0,272	7,3	C
9	4,01	9,45	37,9	0,309	8,2	C
10	3,66	9,78	35,8	0,249	7,0	C
average					**8,6**	
standard deviation					**0,9**	

EX1-2/SX4 after storage in sanitary cleaner containing peroxide						
Probe	h in mm	b in mm	A_i in mm²	E_c in J	**a_{cU} in kJ/m²**	Bruch
1	3,20	9,92	31,7	0,272	8,6	C
2	3,72	9,86	36,7	0,270	7,4	C
3	3,73	9,60	35,8	0,288	8,0	C
4	3,80	9,77	37,1	0,301	8,1	C
5	3,65	9,72	35,5	0,331	9,3	C
6	3,92	9,77	38,3	0,250	6,5	C
7	3,80	9,90	37,6	0,265	7,0	C
8	3,40	9,78	33,3	0,321	9,7	C
9	3,51	9,72	34,1	0,353	10,3	C
10	3,74	9,59	35,9	0,277	7,7	C
average					**8,3**	
standard deviation					**1,2**	

Description of the break: C – complete break H – hinge break

EX1-2/SX4	**impact strength changes in %**
Säure H_2SO_4	±0
Lauge NaOH	+1,1
peroxidhaltigerSanitärreiniger	+1,0

EX2-2/SX2 blank test						
sample	h in mm	b in mm	A_i in	E_c in J	**a_{cU} in kJ/m²**	breakingg
1	3,34	10,04	33,5	0,268	8,0	C
2	3,55	10,14	36,0	0,282	7,8	C
3	3,60	10,19	36,7	0,244	6,7	C
4	3,89	10,13	39,4	0,321	8,1	C
5	3,77	10,21	38,5	0,310	8,1	C
6	4,07	10,17	41,4	0,229	5,5	C
7	3,93	10,04	39,5	0,373	9,5	C
8	4,31	10,11	43,6	0,418	9,6	C
9	4,41	10,16	44,8	0,426	9,5	C
10	4,54	10,03	45,5	0,241	5,3	C
average					**7,8**	
standard deviation					**1,6**	

EX2-2/SX2 after storage in H_2SO_4						
sample	h in mm	b in mm	A_i in mm²	E_c in J	**a_{cU} in kJ/m²**	breaking
1	3,46	9,89	34,2	0,291	8,5	C
2	4,18	9,50	39,7	0,303	7,6	C
3	3,97	9,82	39,0	0,194	5,0	C
4	3,90	9,84	38,4	0,233	6,1	C
5	4,50	9,54	42,9	0,358	8,3	C
6	4,19	9,66	40,5	0,270	6,7	C
7	4,42	9,47	41,9	0,342	8,2	C
8	4,12	9,86	40,6	0,325	8,0	C
9	3,71	9,51	35,3	0,236	6,7	C
10	4,23	9,86	41,7	0,319	7,6	C
average					**7,3**	
standard deviation					**1,1**	

EX2-2/SX2 after storage in NaOH						
sample	h in mm	b in mm	A_i in mm²	E_c in J	**a_{cU} in kJ/m²**	breaking
1	4,57	9,37	42,8	0,274	6,4	C
2	4,79	9,04	43,3	0,338	7,8	C
3	3,67	9,81	36,0	0,239	6,6	C
4	4,52	9,63	43,5	0,343	7,9	C
5	4,08	9,80	40,0	0,294	7,4	C
6	3,82	9,66	36,9	0,345	9,3	C
7	4,05	9,61	38,9	0,323	8,3	C
8	4,36	9,45	41,2	0,345	8,4	C
9	4,05	9,79	39,6	0,285	7,2	C
10	4,31	9,44	40,7	0,335	8,2	C
average					**7,8**	
standard deviation					**0,9**	

EX2-2/SX2 after storage in sanitary cleaner containing peroxide						
sample	h in mm	b in mm	A_i in mm²	E_c in J	**a_{cU} in kJ/m²**	breaking
1	3,92	9,41	36,9	0,281	7,6	C
2	4,33	9,27	40,1	0,269	6,7	C
3	4,24	9,64	40,9	0,413	10,1	C
4	4,29	9,23	39,6	0,245	6,2	C
5	3,88	9,60	37,2	0,338	9,1	C
6	4,33	8,77	38,0	0,256	6,7	C
7	4,00	9,63	38,5	0,265	6,9	C
8	4,06	9,59	38,9	0,238	6,1	C
9	3,66	9,78	35,8	0,232	6,5	C
10	4,63	9,67	44,8	0,354	7,9	C
average					**7,4**	
standard deviation					**1,3**	

Description of the break: C – complete break H – hinge break

EX2-2/SX2	**impact strength**
	changes in %
acid H_2SO_4	-6,4
lye NaOH	±0
sanitary cleaner containing peroxide	-5,1

2.3.17 Thermal analysis - DDK - Dynamic difference calorimetry

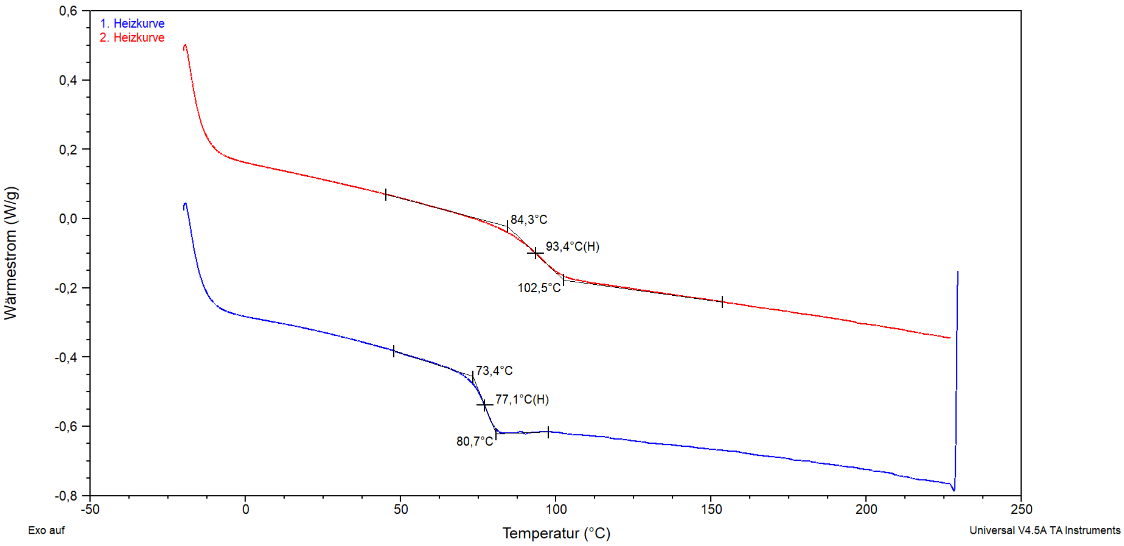
A sample was taken from the outer laminate area from the test pieces used to determine the flexural modulus of elasticity, and a thermal analysis according to DWA-A 143-3, 7.2.6 was carried out on them.

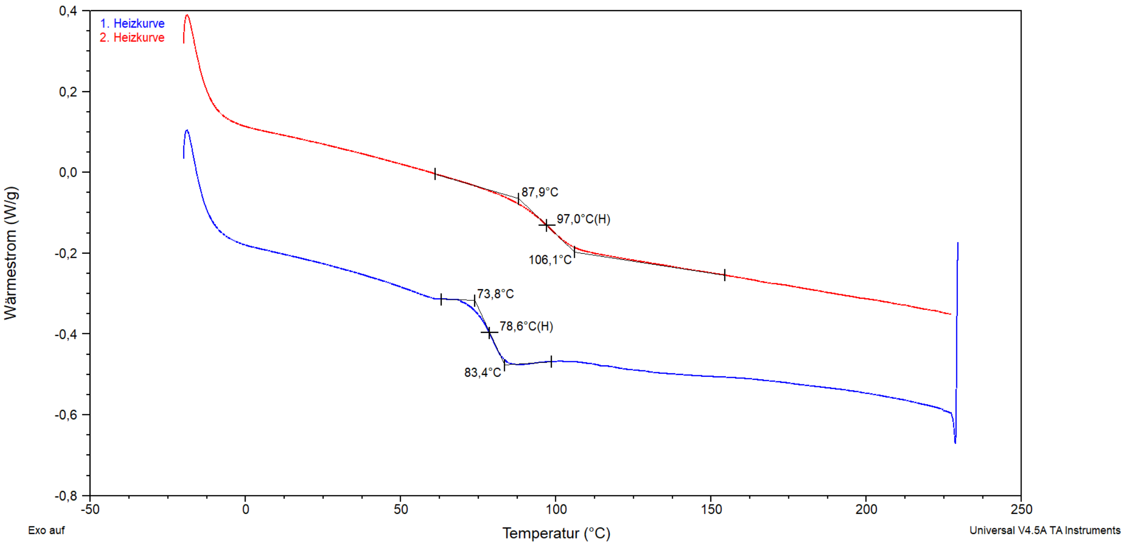
Test parameters:

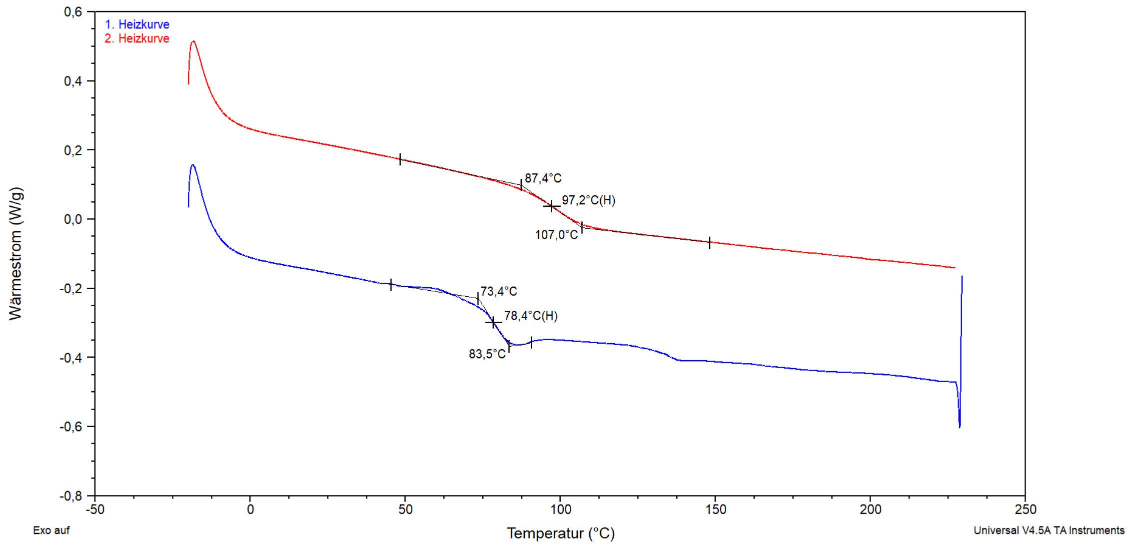
Crucible:	Al high-performance crucible 40 µl		
Purge gas:	nitrogen 5.0, 50 ml / min		
Starting temperature:	-50 ° C	heating rate:	20 K / min
Cooling rate:	20 K / min	final temperature:	230 ° C

results:

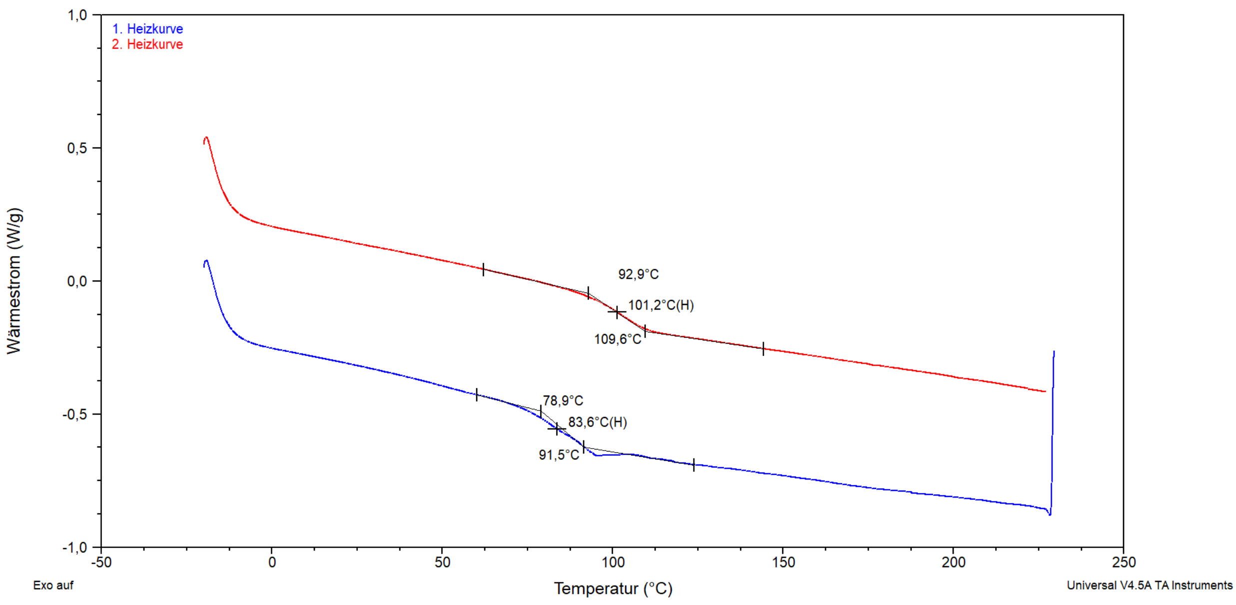
EX1-2/SX4					
sample	**heating curve**	**weight in mg**	**glass transition temperature T_G in °C**	**difference ΔT_G in K**	**enthalpy ΔH**
2	1	18,5	77	-	low exothermic
	2		93	15	
6	1	16,0	79	-	low exothermic
	2		97	18	
11	1	17,8	78	-	low exothermic
	2		97	19	

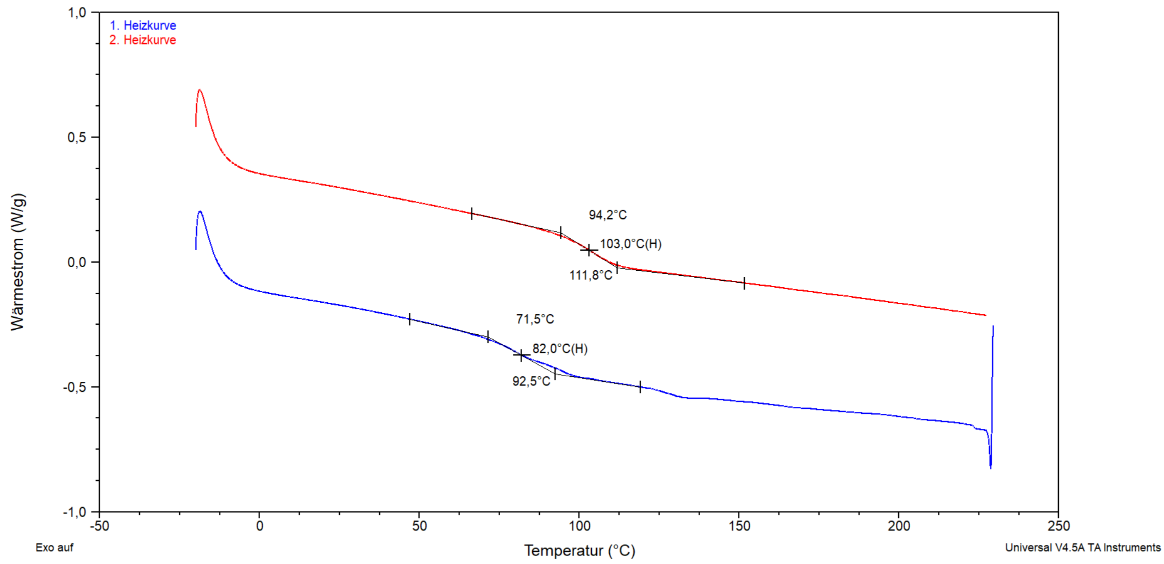


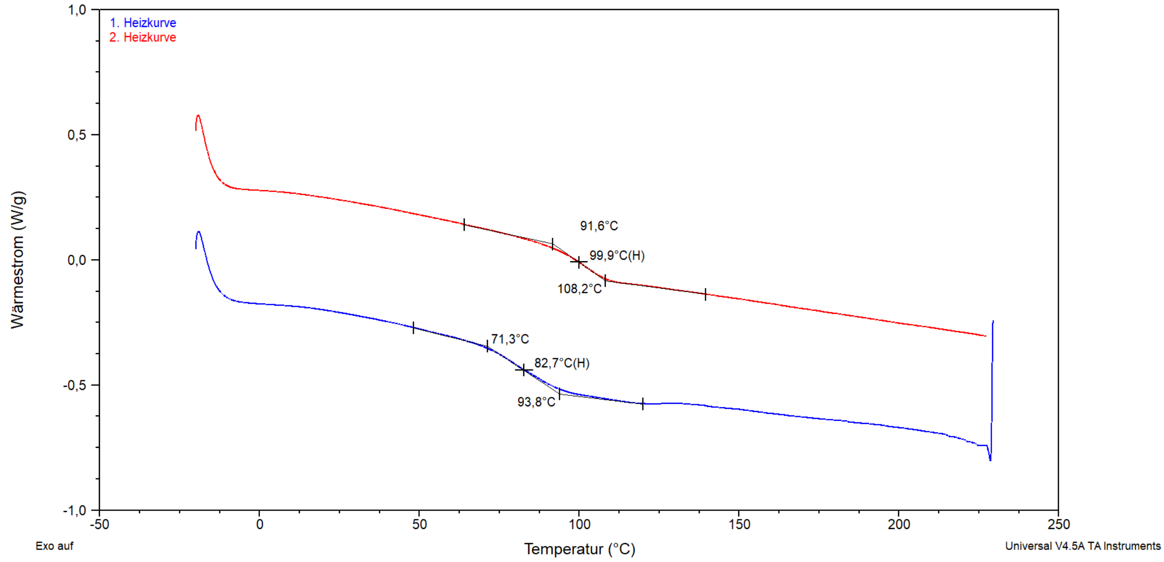




EX2-2/SX2					
sample	**heating curve**	**weight in mg**	**glass transition temperature T_G in °C**	**difference ΔT_G in K**	**enthalpy ΔH**
2	1	16,7	84	-	low exothermic
	2		101	17	
5	1	13,0	82	-	low exothermic
	2		103	21	
9	1	11,2	83	-	low exothermic
	2		100	17	







The results only refer to the samples mentioned above.

10. Appropriate Technical Documentation and/or Specific Technical Documentation

The performance of the product identified above is in conformity with the set of declared performance/s. This declaration of performance is issued, in accordance with Regulation (EU) No 305/2011, under the sole responsibility of the manufacturer identified above.

Signed for and on behalf of the manufacturer by:

Gregor Janc

At Križe on, 15.05.2020.
Signature: