

Product specification

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Product specification

1 General

This product specification is only valid for SAERTEX-S-LINER® and SAERTEX-M-LINER®.

SAERTEX multiCom® is certified in conformance with DIN EN ISO 9001.

This product specification was made in following:

- DIN EN 476
- general demands on structural elements for the sewerage system and sewer pipes for drainage systems based on the force of gravity
- the profiles of demand for the hose-relining-procedure, as of 11/1999 of the „Hamburger Stadtentwässerung“, chief department Siele HSE 31
- Leaflet RSV 1, February 2000.

2 Materials

The materials, dimensions and installation procedures are chosen in such a way, that the newly erected pipe meets all working demands. The new pipe resists a high pressure flush up to 120 bar during its whole life.

(Expert report, SVB-No. 01.06627-1S from „Ingenieurbüro Siebert“)

The materials are resistant to the components of the municipal sewage and its reactivity products.

2.1 Supporting material

The supporting material consists of several layers of Advantex glass. The inside of the liner is equipped with a thin layer of polyester-fleece. E-glass is not used, as many chemicals can penetrate through the resin, i.e. even if there are no micro-cracks, the glass matrix will be contaminated with chemicals. For this reason the E-glass is more and earlier damaged than the more chemical-resistant Advantex glass.

Advantex glass has the following advantages over E-glass:

- 50 YEARS life duration of GFK(GRP)-laminates with Advantex glass
- Resistant to hydrolyse, class 2 in conformance with DIN 12111 / ISO 719
- Less sensitive to stress / corrosion, especially in an acid environment
- Also suitable for applications with higher temperatures, as the softening point is higher
- A better resistance to chemicals

The following table shows the loss of weight in % for the types of glass at a temperature of 96°C in different mediums; according to the investigation of OCF:

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Chemical:	Hours	E-glass	Advantex - glass
Hydrochloric acid, 0,04 %	720	7,9	4,3
Sulphuric acid, 5 %	720	45,0	13,0
Nitric acid, 25 %	24	4,0 - 6,0	0,7
Acetic acid, 25 %	720	12,0	5,9
pH 2	24	0,96	2,78
Caustic soda lye, 10 %	720	29	22
pH 12	720	3,36	4,09

Further annotations:

- The physical characteristics of Advantex glass are equivalent to those of E-glass

2.2 Coatings (Concealing the inside of the liner)

The inside of the Liner is not coated respectively concealed with a layer. There is an inside foil (laminated foil PA/PE) inserted for installation purposes. This foil has to be removed after the installation process. The Liner has two outside foils. The first foil avoids the escaping of styrene and resin; the second one protects against ultraviolet light and damages while dealing with the liner.

2.3 Resins

The following resins in conformance with DIN 16946 and DIN 18820 are used:

Resin	type acc. to DIN 16946	group acc. to DIN 18820
Unsaturated Polyester resin (UP)	1140	3
Vinylester resin (PHA)	1310	5

It is important to use a resin of group 3 in accordance with DIN 18820 while using UP-resins. UP-resins of a lower group are substantially less resistant to chemicals. The resin groups suitable for the various chemicals are listed in part 3 of DIN 18820.

Likewise, it is important to use UP-resins of type 1140 in conformance with DIN 16946. Types of lower numbers, e.g. 1130 or 1110 have less flexural and tensile strength as well as a reduced thermal stability.

Both resins can be used either for UV-curing or thermal curing with steam.

Generally, the high-quality UP-resin is used. If a very high resistance to chemicals is demanded, it may be necessary to utilise Vinylester resin.

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The following table compares both resins:

Characteristics	UP – reaction resin	PHA – reaction resin
Chemical ingredients	<p><u>Glycoles:</u></p> <p>Neopentylglycole, minimum 80 mol-% and maximum 20 mol-% of a monovalent diol with at least one secondary OH-group</p> <p><u>Acids:</u></p> <p>Isophthal acid and Terephthal acid and HET-acid Etyhlendicarbon acids</p>	<p><u>Glycoles:</u></p> <p>Bisphenol A</p> <p><u>Acids:</u></p> <p>Acrylic- and Methacrylic acid</p>
Type of resin	<p>Group 3, DIN 18820, part 1 Type 1140 in conformance with DIN 16946, part 2</p>	<p>Group 5, DIN 18820 1310 in conformance with DIN 16946; in contrast to UP-resin:</p> <p>Flexural Strength: higher Tensile Strength: higher Elastic Modulus: homogeneous Elongation at the Breaking Load: higher</p>

Characteristics	UP – reactivity resin	PHA – reactivity resin
Resistance to chemicals	Less resistant than the PHA-resins; i.e. not resistant respectively resistant only at a low temperature to certain chemicals In particular cases the resistance has to be inquired.	Better than the resistance of the UP-resins; i.e. it bears more chemicals at a higher temperature and concentration In particular cases the resistance has to be inquired.
Resistance to hydrolyse (Splitting of a compound by means of water)	Applicable up to 80 °C	Applicable up to 80 °C Slightly less sensitive to hydrolyse than UP
Creep behaviour		less creep behaviour
Price	lower in price than PHA at a rate of approx. factor 3	

3 Installation and Curing procedure

SAERTEX-LINER® has to be installed and cured according to our “Installation Instructions”. Among others, you will find in these instructions the maximum forces to draw the liner in, the preparatory work, and the inflation and working pressures and temperatures.

The resin supplier states a temperature of 80°C for the curing procedure. From the third stage of curing on, this temperature will be exceeded. In order to achieve optimum characteristics, a post-curing stage at a temperature of 80°C for a period of 3 hours was recommended. This period has been reduced, as the third and fourth curing stages exceed 80°C.

One inner and two outer foils avoid the infiltration of water or air from inside or outside. These foils avoid the escaping of resin, too, so that the Liner can not become impoverished of styrene. For this reason the liner can also be used in drinking water protection areas zone III A.

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4 Internal property control

4.1 Resins

We receive a certificate of construction which documents the viscosity, the curing data and the contents of the solid material. In addition to the certificates of construction, we re-check all resins regarding viscosity, reactivity and contents of the solid-material after we have received them. In case of deviation we do not use the resin.

Characteristics of the applicable resins in conformance with DIN 16945

Characteristics	UP-resin	Vinylester-resin
Density, 25 °C	1,05 - 1,15 g/ml	1,0 - 1,255 g/ml
Flash point	32 °C	35 °C
Acid number	12 - 16	
Content of volatile components	35 - 45 %	35 - 50 %

The stability of the stored resin mixtures can be pursued by a comparative sample (demonstrative sample).

4.2 Admixtures

The admixtures we insert correspond with DIN 19565, 16898 and 16869. We receive from each admixture supply a certificate of construction which documents the moisture, degree of whiteness, size of granulation > 45 µm and electrical conductivity.

4.3 Processing

The production of the liners, the making of the resin mixtures and the impregnation of the liners are precisely specified by procedural instructions and testing methods. The determined test results and the field process figures are documented.

The following tests in conformance with DIN 16945 point 6 on the used resin mixtures are executed:

- rise of temperature
- gelling time
- viscosity

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4.4 Material of the Liner

The construction of the Liner material as well as the thickness of the layers, the area weight and the pre-treatment are part of the data sheets, we place at our customer's disposal. The liner material is composed of stitch-bonded glass-fibre fabrics.

Advantages of stitch-bonded fabrics over woven fabrics:

- In case of loading the glass fibres in stitch-bonded fabrics may glide on top of each other while in woven fabrics they are rubbed at the crossings. This leads to a higher rate of attrition which results in shorter life duration of the reinforced glass fibre material.
- In woven fabrics the glass fibres may break at the crossings caused by external effects like tensile strength. This is not possible in stitch-bonded fabrics.
- Woven fabrics are more elastic than stitch-bonded fabrics because of the crossings. That means effecting forces are absorbed with delay. In stitch-bonded fabrics, however, these forces are absorbed in a far more direct way. This advantage of the stitch-bonded fabrics leads to a higher resistance against deformation for SAERTEX-LINER®.

The construction of the liner material for the various wall-thicknesses and dimensions is defined by precise instructions and specifications for procedure, material and size. The observance of these pre-conditions are watched by a QM-System in conformance with DIN ISO 9001.

At present, there are two versions of the liner material available:

1. SAERTEX-S-LINER®

The SAERTEX-S-LINER® also consists of various layers of glass fibre fabrics and is constructed according to the sandwich system with an inner and outer liner. Additionally, it is produced with an unidirectional stitch-bonded layer which reinforces the Liner substantially – as it is shown in the table in paragraph 7.

The SAERTEX-S-LINER® has a glass content of about 45 %.

2. SAERTEX-M-LINER®

The SAERTEX-M-LINER® consists of various layers of glass fibre fabrics, too. But, without an unidirectional stitch-bonded layer.

The SAERTEX-M-LINER® has a glass content of about 40 %.

By using Advantex glass, the best possible resistance to corrosion is ensured. The advantages have already been explained in paragraph 2.1.

4.5 Mechanical test

The data of the installed liners are checked by our customers. In addition, we manufacture test-liners for controlling purposes, in order to check whether the characteristic values of the material are achieved and whether the density is all right. The determination respectively the static load capacity of the liner according to ATV M 127-2 is executed by our customers.

For the calculation of the static load capacity of the liner, our customers need the maximum possible gap between channel and liner. The gap amounts to a maximum of about 0,5 % of the liner-radius.

4.6 Testing of resistance

The testing of the resistance of the liner to municipal waste water was last certified in 2002 by "Ingenieurbüro Siebert". The test was executed in conformance with DIN EN 175.

"Ingenieurbüro Siebert" checked the fire behaviour in conformance with DIN 4102 and DIN 53438.

Classification:

Firing of the surface: F 1/4, flame goes out immediately

Firing of the edge: K 2/4, initial flame survives.

The resistance to high pressure cleaning was tested as already described in paragraph 2.

The impact toughness was checked according to DIN 53453 by "Ingenieurbüro Siebert". The calculated value for the Liner 13447 amounts to 77,6 kJ/m². The toughness of the liner S-13447 was determined by LGA in conformance with DIN EN ISO 179 and amounts to 74,4 kJ/m².

4.7 Samples

It is in the responsibility of our customers to take and preserve samples for checking purposes.

We take a test sample of every liner here at SAERTEX multiCom® and check if it cures under installation temperatures. These samples are put in the archives.

4.8 Leakage test

The leakage test of the liner in conformance with DIN EN 1610 is executed by our customers.

5 External property control

Our customers organise their own external property control.

6 Certificate of stability

6.1 Short-term stability figures:

SAERTEX-S-LINER®

DN mm	wall thickness / mm								
	4	5	6	7	8	9	10	11	12
100	0,6269	1,2635	2,2538	3,6957					
150	0,1782	0,3554	0,6269	1,0166	1,5497				
200	0,0737	0,1461	0,2564	0,4135	0,6269	0,9067			
250	0,0373	0,0737	0,1289	0,2072	0,3131	0,4514	0,6269		
300	0,0214	0,0422	0,0737	0,1182	0,1782	0,2564	0,3554	0,4779	
350	0,0134	0,0264	0,0460	0,0737	0,1109	0,1593	0,2205	0,2961	0,3878
400	0,0089	0,0176	0,0306	0,0490	0,0737	0,1057	0,1461	0,1960	0,2564
450	0,0063	0,0123	0,0214	0,0342	0,0514	0,0737	0,1017	0,1363	0,1782
500	0,0045	0,0089	0,0155	0,0248	0,0373	0,0534	0,0737	0,0987	0,1289
550		0,0067	0,0116	0,0186	0,0279	0,0399	0,0550	0,0737	0,0962
600		0,0051	0,0089	0,0143	0,0214	0,0306	0,0422	0,0565	0,0737
650			0,0070	0,0112	0,0168	0,0240	0,0331	0,0442	0,0577
700			0,0056	0,0089	0,0134	0,0191	0,0264	0,0353	0,0460
750			0,0045	0,0072	0,0109	0,0155	0,0214	0,0286	0,0373
800				0,0060	0,0089	0,0128	0,0176	0,0235	0,0306
850				0,0050	0,0074	0,0106	0,0146	0,0195	0,0254
900					0,0063	0,0089	0,0123	0,0164	0,0214
950					0,0053	0,0076	0,0104	0,0139	0,0181
1000					0,0045	0,0065	0,0089	0,0119	0,0155
1050						0,0056	0,0077	0,0103	0,0134
1100						0,0049	0,0067	0,0089	0,0116
1150							0,0058	0,0078	0,0102
1200							0,0051	0,0069	0,0089



Area for the rehabilitation of pipes, in case the old sewage system alone is no longer statically stable.

Short-term-E-modulus
about 12.000 N/mm²

stiffness class SN *)	short-term ring stiffness SR [N/mm ²]
630	0,005
1250	0,01
2500	0,02
5000	0,04
10000	0,08

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*) ring stiffness class in accordance with DIN 16869-2

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SAERTEX-M-LINER®

dimenison mm	wall thickness / mm	
	3	4
100	0,1381	0,3376
150	0,0397	0,0960
200	0,0165	0,0397
250	0,0084	0,0201
300	0,0048	0,0115
350	0,0030	0,0072
400	0,0020	0,0048



Area for the rehabilitation of pipes, in case the old sewage system alone is no longer statically stable.

Short-term-E-modulus
about 7.000 N/mm²

stiffness class SN *)	short-term ring stiffness SR [N/mm ²]
630	0,005
1250	0,01
2500	0,02
5000	0,04
10000	0,08

*) ring stiffness class in accordance with DIN 16869-2

6.2 Long-term stability figures:

SAERTEX-S-LINER®

Factor of reduction A1 as per DIN 53769 part 3: A1 = 1,35

SAERTEX-M-LINER®

Factor of reduction A1 as per DIN 53769 part 3: A1 = 1,82

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7 Material tests and expert reports

7.1 Generally valid tests and expert reports

the company

- certified according with DIN EN ISO 9001, Certificate: QS-145HH

the raw materials

- product data sheets of the used UP-resins
- product information about the Advantex glass
- expert's comment (TN 980601), suitability of Advantex glass fibres

the liner

Expert reports of "Deutsches Institut für Bautechnik" (German building of civil engineering)

- general building supervision registration | Registration-No.: Z-42.3-350

Expert's comment of "Ingenieurbüro Siebert"

- Styrene emission of the cured liner on the basis of the ATV A115
- Use of reinforced duroplastics on the basis of unsaturated polyester resins to rehabilitate waste water channels and pipes considering environmental influences
- resistance to municipal waste water
- resistance of the media, determination of the resistance to the influence of chemicals in a deformed state (DIN EN 1120)

Expert reports of "Ingenieurbüro Siebert"

- Verification of the suitability for the PA 0320 load caused by high pressure flushing devices according to the „Hamburger Modell“
- Test of the water absorption of the SVB-No.: 01.06580-1 S cured laminate
- Test of the chemical suitability in SVB-No.: 95.00326 S conformance with DIN 53769 part 5
- Test of the chemical suitability SVB-No.: 01.07192 S following DIN EN 175 for the current recipe of the resins (April 2002)

Examinations of "Hygiene Institut Gelsenkirchen"

- Employment of the liner in drinking Dir.Tgb.-No.: C 765/99/st water protection areas according to the DVGW-Method W 270
- Employment of the liner in drinking Dir.Tgb.-No.: W 1775/98/G

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water areas according to the DVGW-
Method W 270

Expert reports of "Technische Universität Darmstadt" (technical university)

- Abrasion resistance according to DIN SVB-No.: 01.06627-1 S 19565

7.2 Tests and expert reports about SAERTEX-S-LINER®

Expert reports of "Ingenieurbüro Siebert"

- Tensile strength acc. to DIN EN ISO 527-4 SVB-No.: 01.06580-1 S
- Break elongation acc. to DIN EN ISO 527-4 SVB-No.: 01.06580-1 S
- Flexural strength acc. to DIN EN 761 SVB-No.: 01.07192 S
- Short-term outside pressure test according to DIN EN 1228 SVB-No.: 01.07192 S
- Long-term outside pressure test according to DIN EN 761 SVB-No.: 01.07192 S
- Chemical suitability acc. to DIN EN 175 SVB-No.: 01.07192 S
- Measuring of ring split SVB-No.: 01.07192-2 S
- Short-term internal pressure test according to DIN 53758 and 53769 part 2 SVB-No.: 02.06580-2 S

Material tests of "Landesgewerbeamt Bayern (LGA)"

- Density of the laminate acc. to DIN 53479, Method A MK5801451/1
- Impact toughness acc. to DIN EN ISO 179 MK5801451/1
- Fire protection test according to DIN 4102 part 1 MK5801451/1

7.3 Tests and expert reports about SAERTEX-M-LINER®

Expert reports of "Ingenieurbüro Siebert"

- Flexural-E-modulus acc. to DIN EN ISO 178 SVB-No.: 05.15966
- Flexural strength acc. to DIN EN ISO 178 SVB-No.: 05.15966
- Short-term outside pressure test according to DIN EN 1228 SVB-No.: 05.15966
- Long-term outside pressure test according to SVB-No.: 05.15966

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- DIN EN 761
- Aptitude and original inspection test

SVB-No.: 05.15966

8 Miscellaneous

Some of our customers possess already the "RAL Gütezeichen Kanalbau". All other customers have a sound long-term experience and are therefore definitely able to show the corresponding proofs according to the demands of "Güteschutz Kanalbau".

As our customers receive pre-manufactured and impregnated liners, no liner is permeated on the jobsite.

15.11.2006
SAERTEX multiCom® GmbH