

**ADDITIONAL TECHNICAL CONTRACT CONDITIONS (ATCC)  
For CIPP liner testing**

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### **1 General information**

#### **1.1 Application**

The purpose of this ATCC is to eliminate the possibility for differing interpretations of the generally applicable standards for material inspection of on-site curing hose liners. For this purpose, the experimental design, the requirements for the sample specimen and the requirements for the experimental procedure for each material inspection for each testing laboratory are specified in a binding manner. In this way, the client and the company responsible for implementation are ensured that the comparability of the results of the material inspections are within the remaining experimental tolerance.

#### **1.2 Definitions**

Client	The client of the construction site is at the same time the client of the testing laboratory
Client	The testing laboratory
Company responsible for implementation	The company contracted to perform the installation of the hose liner

#### **1.3 Contractual basis**

A material sample of the installed hose liner is sent to the testing laboratory by the client. This material sample is accompanied by a contract letter and the completed sample data sheet (see point 2 and Appendix 1). The criteria specified in this ATCC apply for the laboratory test on this material and as a supplement to the contract.

If prior notice of more than 5 working days is given, the 3-point deflection test and leak test are to be performed within 2 working days and the results are to be provided to the client. The creep tendency is to be determined 4 weeks after curing of the hose liner. All other tests are to be realized within 10 working days.

The results are: (to be filled out by the client)

- To be provided to the company responsible for implementation and client simultaneously.
- Only to be provided to the client.

The results of the material test are the property of the client. Any use of the results requires the consent of the client.

#### **1.4 Expertise of the laboratory**

##### **1.5.1 Accreditation**

The contracted testing laboratory has been accredited by the Deutscher Akkreditierungsrat (German Accreditation Council). The minimum requirement is accreditation according to DIN EN ISO/IEC 17025 for all contracted material tests, and thus all related national and international standards.

##### **1.5.2 Recognized construction monitoring body**

The contracted testing institute is recognized by the Deutsches Institute für Bautechnik (DIBt, German Institute for Construction Technology) as a monitoring body for monitoring according to § 17 Paragraph 6 of the Musterbauordnung (MBO, Master Building Code).

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### **1.5.3 Supplement to the approvals from 1.5.1 and 1.5.2**

Recognition as a monitoring body by the DIBt is required 1 year after the ATCC come into effect.

The client and the company responsible for implementation, via the client, have the right to inspect the certifications and accreditation certificates specified in 1.5 at any time. If this is not agreed to, the order can be revoked from the testing laboratory or the laboratory can be excluded from future consideration.

The aforementioned qualifications have been examined before commissioning by the client. If one of these requirements is rejected during the existing contractual relationship, the client must be informed immediately.

### **1.5 Commissioning of third parties**

If a third party is commissioned to perform individual material tests, the client must be informed before the third party is commissioned. A third party may only be commissioned with the express consent of the client.

Third parties must be accredited for testing procedures according to DIN EN ISO/IEC 17025. Upon request, this will be demonstrated to the client of the material test.

### **1.6 Location of the samples, request for return**

The client has the right to recover the analyzed samples. The company responsible for implementation can request, via the client, samples that have not fulfilled the values specified in the contract between client and implementing company. It is not permissible to return samples directly to the company responsible for implementation.

Handing samples over to third parties may only be performed with the express consent of the client.

The test specimens are stored by the test laboratory for 6 months and are then disposed of properly.

### **1.7 Handover and representation of the test results**

The test results are summarized by the client in a test report, which contains the requirements specified in point 4 of this work. In this way, a clear, complete and comprehensible representation of the test results is created.

If there are individual deviations from the testing regulations specified under point 3, this must be explicitly noted and justified in the test report according to point 4.

If, when received by the test laboratory, the shape or geometry of the sample deviates from the specifications in point 3, the client is to be informed and it should be clarified whether or not the tests should be performed. Otherwise, no payment will be made.

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### 2. Sample data sheet

The sample data sheet ensures that all necessary material and site data are recorded. The authorized signatory representative of the company responsible for implementation is required to examine the records regarding sample identification for completeness and accuracy and to confirm with a signature.

The sample data sheet is completed on site by the client and company responsible for implementation after the sample is taken. The correctness of the data is confirmed by both contract parties with signatures. Independent thereof, it is the responsibility of the client to commission any additional tests.

The original sample data sheet remains with the client. The company responsible for implementation receives a copy. An additional copy of the original is sent with the sample to the testing institute.

### 3. Material tests

Material testing must be performed according to the following criteria. If there is a deviation from these specifications, this must be recorded in the test report. Point 1.8 is to be noted.

All material tests to be performed should ensure that the delivered quality complies with the ordered quality.

#### 3.1 Three-point deflection test

##### Valid and applicable standards

DIN EN ISO 178	Plastics determination of flexural properties
DIN EN 13566-4	Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks Section 4 – On-site curing hose lining Appendix C (normative) – modifications to DIN EN ISO 178 on deflection tests.

##### Test equipment

Test equipment is only permitted that fulfills the requirement of DIN EN ISO 178 with supplements from DIN EN 13566-4 Appendix C and those that comply with these ATCC.

Basic properties	Definition according to DIN EN ISO 178
Support	According to DIN EN 13566/4. In addition to the standard: A support that can tilt perpendicular to the sample axis.
Pressure fin	Defined fin spacing according to DIN EN 13566-4: perpendicular tilt with respect to the sample axis (for radial test, in the longitudinal axis of the sample).
Display of force and deflection	According to DIN EN ISO 178, point 5.4

##### Sample specimen form and dimensions

Test in direction of circumference according to DIN EN 13566-4.

If the rise of the center of the sample specimen exceeds the level of the support “0.07 x support” (support center spacing), (see picture C.1 DIN EN 13566-4), the three-point deflection in the radial direction no longer complies with the standard. Here the apex pressure test according to EN 1228 or a three-point deflection test in axial direction is to be performed with the sample geometry according to Table C1 DIN EN 13566-4. In such a case the procedure must be clarified with the client. It is important that the results are comparable with the results of the same tests (axial, radial, apex pressure).

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Sample width/length

According to DIN EN 13566/4

- The sample width must be 50 +/-1 mm when it is taken.
- If the sample is taken axially, the sample width must be used according to DIN EN 13566-4, Table C1
- Performance of the apex pressure test according to point 3.2 of these ATCC

Average composite thickness  $e_m$

The composite thickness is determined by subtracting the thicknesses of the inner and outer foil and the pure resin layers from the total thickness.  
The outer pure resin layer may not exceed 20% of the composite thickness. In case of thicker outer pure resin layers, the sample has to be discarded.  
Evaluation and sample scrap (10% deviation) according to DIN EN 13566-4, C4.1. The specification of the average composite thickness  $e_m$  is performed in mm with one decimal place.  
The points at which the composite thickness is measured are marked with a color so that they can be found again at a later time.

Length of the sample specimen  $l$

$l \geq L + 4 \times e_m$

### Performance of material test

Span  $L$

According to DIN EN 13566-4, point C4.2 and C4.3

$(10 \pm 1) \times e_m < L < (16 \pm 1) \times e_m$   
The span distance of each test is to be measured with a measurement accuracy of  $\pm 1$  mm (calipers) and photographic documentation is to be included in the test report.

Arrangement of the sample

According to DIN EN 13566-4, C4.4 and picture C.1.

Load speed

According to DIN EN ISO 178, point 8.5

Pre-force

10 mm/min

Pre-force

5N

### Miscellaneous

All geometric data of the sample specimens and the actual span width  $L$  as well as the test speed are to be documented in the test report. In addition, the span width is to be documented with pictures. Permissible tolerance  $\pm 1$  mm.

Determination of  $\sigma_b$ :

Measurement recording: 0.02 s, 1  $\mu$ m

Break recognition:

Sensitivity: Strain 0.05 mm

Drop off: 0.05%  $F_{max}$

For sample specimens that do not indicate fracture according to these criteria, the bending stress  $\sigma_{fc}$  is determined using the conventional deflection  $s_c$ . (DIN EN ISO 178, 3.5)

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If the  $\sigma/\epsilon$  line continues to run parallel to the Hooke's line after a brief drop in the elastic range, then this brief drop is considered as insignificant.

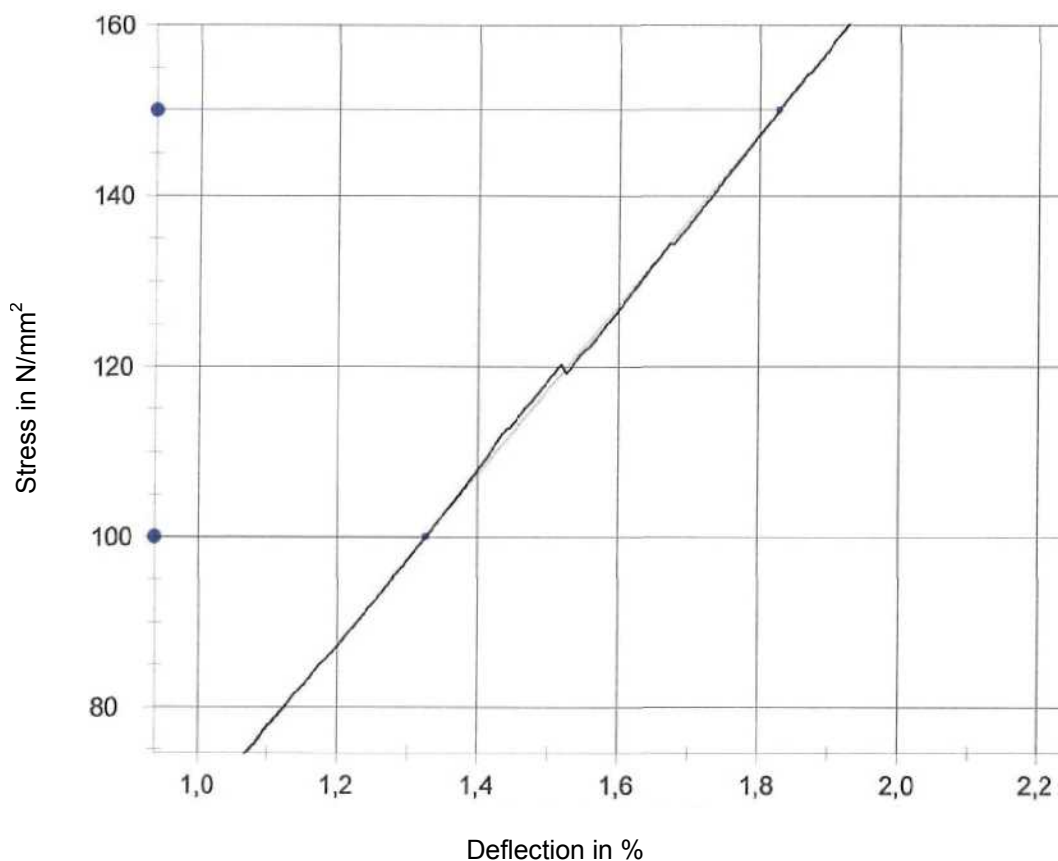


Figure 1: (enlarged detail of the tension-strain curve) Break without subsequent change in the tension-strain behavior of the sample specimen. The break shown here indicates a failure of the pure resin layers without mechanical damage to the supporting laminate.

Determination of the E modulus:      Regression in linear region of the curve,  $\Delta\epsilon \geq 0.2\%$

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### 3.2 Apex pressure test

#### Valid and applicable standards

DIN EN 1228

Determination of the specific initial annular rigidity

Average composite thickness  $e_m$

Determination according to DIN EN 13566/4, C4.1.  
Number and distribution of measurement points according to EN 1228.

It is not permissible to grind down the pure resin layers. The outer pure resin layer may not exceed 20% of the composite thickness. In case of thicker outer pure resin layers, the sample has to be discarded

The points at which the wall thickness is measured are marked with a color so that they can be found again at a later time.

The specification of the average composite thickness  $e_m$  is performed in mm with one decimal place.

Length of the sample

according to 13566 T4, point 7.5 Table 5

Application of load

EN 1228 point 7.3

Type of load: A

Procedure: B

Load introduction

Plate + flattened round bar, one of them can be tilted

Pre-force

5 N

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### 3.3 24 h creep tendency

#### Valid and applicable standards

DIN EN ISO 899-2                      Determination of creep behavior

Sample preparation, determination of the dimensions, test device analog to DIN EN ISO 178.

Formulas for calculation of the deflection stress and the E modulus analog to DIN EN ISO 178, where for the E modulus, not the slope of a straight line but rather the values of force/deflection are used after 1 hour or after 24 hours.

Pre-load	5 N
Determination of sample load	Initial deflection: $s = \frac{0,0206 \cdot L_v^2}{d_m}$
	$L_v$ = Support spacing
	$d_m$ = average pipe diameter

Data recording                      after 1 hour and 24 hours

The 24-hour creep tendency is determined after 4 weeks of installing the liner.



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### 3.4 Determination of the trace styrene content

The trace styrene content provides information on the curing of styrene-containing reacting resin materials.

#### Valid and applicable standards

DIN 53394 Part 2	Determination of monomer styrene in reacting resin molding materials on the basis of unsaturated polyester resins.
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#### Test equipment and test methods

The test equipment used is described in detail in the listed standards.

#### Sample specimen

Taking the sample specimen	A diamond cutter is used to take the sample specimens; the blade is water cooled.
Sample specimen properties	The sample specimens are to be taken along the entire sample thickness of the liner sample; coatings are to be removed
Sample specimen size	According to DIN 53394-2

#### Sample specimen preparation

For extraction procedures, sample specimen preparation is an important component of the analyses. The sample specimens required for extraction are to be removed from the part/material with little thermal stress (i.e. carefully avoiding local heating at the area of removal) so that the entire thickness of the product is recorded representatively.

#### Performance of the tests

Foils/coatings are to be removed directly before testing.

Number of samples according to DIN 53394-2.

#### Extraction tools

Dichloromethane according to DIN 53 394-2, other extraction methods are not to be used.

#### Results presentation

The result is specified according to DIN 53394-2 as a mass percentage  $\omega$  [%]. The specified mass percentage is with respect to the entire amount weighed of liner material.

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### **3.5 Differential scanning calorimetry, DSC**

Using DSC testing methods, the curing of epoxy resin systems is determined and compared with a reference value.

#### **Valid and applicable standard**

DIN 53765 "Testing of plastics and elastomers; thermal analysis; DSC"

#### **Testing equipment and test methods, DIN 53765 - A - 20**

The test equipment used is described in detail in the listed standards. The maximum of the test temperature has to be 230 °C.

#### **Sample specimen form and mass**

Sample specimen form Flat with at least 4 mm<sup>2</sup> cross-sectional area

Mass to be weighed Table 2 DIN 53765

#### **Performance of the tests**

Foils/coatings are to be removed directly before testing.

The samples selected for the test must be taken from the outer area of the structural laminate. Outer pure resin collections must be excluded from testing.

#### **Results presentation**

The result is specified according to DIN 53765 with glass transition temperatures  $T_{G1}$  and  $T_{G2}$ .

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### **3.6 Spectral analysis**

Spectral analysis is used to examine whether the resin quality used corresponds to the offered resin quality. These methods do not determine the quantitative composition, but rather the qualitative composition.

Every provider must hand over a cured reference sample to the corresponding test laboratory for its approved liner system-resin system. The test laboratory commissioned by the client prepares a reference spectrum for the provided sample.

#### **Valid and applicable standard**

No valid standard; ASTM 5576, DIN 55673 (basis)

#### **Test equipment and test methods**

FT-IR (with ATR) based on DIN EN 1767

#### **Performance of the tests**

Light penetration: Resolution 2% transmission

At least 8 scans are required.

Comparison with reference spectra

#### **Results presentation**

Presentations are to be prepared in at least the following wave number areas: 600–2000 cm<sup>-1</sup>.

The degree of agreement of the two spectra (reference spectrum and spectrum of the material at hand) is to be determined with respect to the band position. The test spectra are to be included on the report of the results.

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### 3.7 Determination of the filler material and glass content

#### Valid and applicable standard

DIN EN ISO 1172 Determination of textile glass and mineral filler material content, calcination processes (ISO 1172: 1996)

This standard specifies two calcination processes for determination of textile glass and mineral filler material content of glass-fiber reinforced plastics.

Procedure A: For determination of textile glass content if there is no mineral filler material.

Procedure B: For determination of textile glass and mineral filler material content when both components are present. Deviating from the norm, the separation of the residue is done by hand.

#### Test equipment and test methods

The test equipment and test methods used are described in detail in the standard.

#### Sample preparation

The preparation of the sample is described in point 6 of DIN EN ISO 1172 "Preparation of sample specimens".

#### Results presentation

For the presentation of the results, the result of the end sample material and the initial sample material as a mass percentage, with respect to the total sample mass, is specified. The specification of the filler material used is performed in the sample data sheet.

1. Example: Synthetic fiber felt with aluminum hydroxide filler. The measurement is the weight of aluminum oxide of the sample. From this value, the aluminum hydroxide content is determined using the molar ratio of the initial material (aluminum hydroxide) and end material (aluminum oxide) using calcination.
2. Example: The GFRP base material without filler is the measurement of the glass weight of the sample.

Nominal value (initial material mass content of the composite material, indicated in the sample data sheet) and actual value (mass content of the initial material) of the total sample are to be compared in the presentation of the results.

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### **3.8 Leak test of the material sample of the liner**

#### **Valid and applicable standard**

The leak test described in DIN EN 1610 is leak test performed on a conduit basis. This can not be transferred to laboratory test with very small test surfaces. For this reason, the following leak test is to be performed on the material sample specimens of the liner.

#### **Test equipment and test methods**

The test is performed at three locations on the sample specimen.

The test is to be performed at room temperature ( $23 \pm 5$  °C).

#### **Sample preparation**

Coatings that are an integral component of the liner according to DIBt certification are not destroyed.

For coatings that are not an integral part of the liner according to DIBt certification, the following procedure is used:

- The foil thickness or coating thickness is measured with precise digital calipers.
- The depth of the cut is to be limited so that the installation aids such as outer and inner foil are cut and significant damage to the laminate is prevented.
- A grid of cuts of 10 perpendicular cuts is made. The spacing between the cuts is 4 mm.

The samples are to be stored at least 4 hours before testing at the specified test climate conditions.

#### **Performance of material test**

Low-pressure test: negative pressure is applied to the sample from the outside.

The probe surface has a diameter of 45 mm  $\pm$ 5 mm.

The testing medium is attached to the inside of the sample.

Testing pressure -0.5 bar  $\pm$ 25 mbar

Test duration: 30 minutes

Test medium: drinking water (colored) without wetting agent

Selection of three individual tests per sample

#### **Test result**

There may not be water penetration at any of the three test locations. Water penetration is considered to have occurred if paper laid on the sample becomes colored by the moisture. Coloring in the laminate is permissible.

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**4. Test results**

The results of the material test are to be entered in Appendix 2 of this ATCC and to be reported to the client in this form. Evaluation of the results by the test institute is only to be performed where it is explicitly requested. Only a record of the actual state is required.

**Presentation of the test results**

Test	Standard	Value	Unit	Result
Three-point deflection	DIN EN ISO 178, DIN EN 13566-4	Composite thickness $e_m$	mm	1 decimal place
		Bending modulus of elasticity	N/mm <sup>2</sup>	3 significant numerals <sup>1)</sup>
		Bending failure stress $\sigma_B$	N/mm <sup>2</sup>	3 significant numerals <sup>1)</sup>
Apex pressure trial	DIN EN 1228	Composite thickness $e_m$	mm	1 decimal place
		Annular rigidity $S_0$	N/m <sup>2</sup>	Integer
		Circumference modulus of elasticity $E$	N/mm <sup>2</sup>	3 significant numerals
Creep tendency	DIN EN ISO 899-2	Composite thickness $e_m$	mm	1 decimal place
		Modulus of elasticity $E_{1h}$	N/mm <sup>2</sup>	3 significant numerals
		Modulus of elasticity $E_{24h}$	N/mm <sup>2</sup>	3 significant numerals
		Creep tendency $K_{N24h}$	%	1 decimal place
Creep tendency	DIN EN761	Composite thickness $e_m$	mm	1 decimal place
		Circumference modulus of elasticity $E_{1h}$	N/mm <sup>2</sup>	3 significant numerals
		Circumference modulus of elasticity $E_{24h}$	N/mm <sup>2</sup>	3 significant numerals
		Creep tendency $K_{N24h}$	%	1 decimal place
Trace styrene content	DIN 53394, Part 2	Weighted sample	g	3 decimal places <sup>1)</sup>
		Trace styrene content	%	1 decimal place <sup>1)</sup>
DSC analysis	DIN 53765	Glass transition temperature ( $T_{G1}, T_{G2}$ )	°C	Integer <sup>1)</sup>
Determination of the filler material and glass content	DIN EN ISO 1172	Resin content	%	1 decimal place
		Filler material content	%	1 decimal place
		Glass content	%	1 decimal place

1) According to the applicable standard

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**Appendix 1: Sample data sheet**

<input type="checkbox"/>	<b>Initial test</b>	<input type="checkbox"/>	<b>Repeat test</b>	For testreport no.:	
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**Information on the taking of the sample**

Sample-taking	Confirmation that the sample has been taken (company responsible for implementation/ construction management)		Confirmation that the sample has been taken (client/construction management)	
Date	Block letters	Signature	Block letters	Signature

**Sample identification**

Client, material testing		Liner material ID			
Client		Length of the liner			
Building project		Conduit identification			
Company responsible for implementation		Sample identification			
Liner manufacturer		Date of installation			
Resin type	<input type="radio"/> UP <input type="radio"/> VE <input type="radio"/> EP <input type="radio"/> Other	Extraction location	Conduit <input type="radio"/>	End shaft <input type="radio"/>	Inter. Shaft <input type="radio"/>
Base material	<input type="radio"/> Synthetic f. <input type="radio"/> GFRP		Apex <input type="radio"/>	Springer <input type="radio"/>	Base <input type="radio"/>
Pipe geometry	<input type="radio"/> Circle DN ..... <input type="radio"/> Oval ...../.....	Extraction position	Apex <input type="radio"/>	Springer <input type="radio"/>	Base <input type="radio"/>
Coating is an integral component of the liner	<input type="radio"/> Yes <input type="radio"/> Outside <input type="radio"/> No <input type="radio"/> inside				
<b>Minimum probe size: 20 x wall thickness in direction of circumference and 35 cm in longitudinal direction. If a creep tendency test is commissioned, the length must be at least 40 cm. It is possible to divide the sample. Minimum size of the individual segments: 50 mm width and 20 x wall thickness in the longitudinal direction. For apex pressure test, a ring section of least 40 cm in length must be extracted.</b>					
Actual sample size	In direction of circumference	cm	In longitudinal direction	cm	

**Tests to be performed (to be marked by the client)**

<b>Mechanical properties (standard test)</b>	
<input type="checkbox"/>	<b>3-point deflection test in radial direction (standard test)</b> according to DIN EN ISO 178/DIN EN 13566-4 <b>and Section 3.1 of the ATCC material test</b> for determination of - E modulus - Bending stress
<input type="checkbox"/>	- <b>3-point deflection test in axial direction (necessity see 3.1 "Sample specimen form and dimensions")</b> - <b>Apex pressure test (necessity see 3.1 "Sample specimen form and dimensions")</b> according to DIN EN 1228 <b>and Section 3.2 of the ATCC material test</b> for determination of the E modulus
<b>Waterproof test (standard test)</b>	
	according to Section 3.8 ATCC material test on sample specimens of on-site curing hose liners
Inspection of the curing of the laminate if the E modulus or bending stress is too low	
<input type="checkbox"/>	<b>Determination of the trace styrene content</b> according to DIN 53394-2 <b>and Section 3.4 of the ATCC (GC) (for UP resins)</b>
<input type="checkbox"/>	<b>Thermal analysis (DSC measurement)</b> according to DIN 53765 <b>and Section 3.5 of the ATCC material test (for epoxy resins)</b>
Inspection of the long-term behavior when the E modulus or bending stress is too low	
<input type="checkbox"/>	<b>24-hour creep tendency 3-point</b> based on DIN EN ISO 899-2 <b>and Section 3.3 of the ATCC material test</b>
<input type="checkbox"/>	<b>24-hour creep tendency apex pressure</b> according to DIN EN 761 ( <b>not addressed in the ATCC material inspection</b> )
<b>Material identification</b>	
<input type="checkbox"/>	<b>Spectral analysis</b> based on DIN 55673, DIN EN 1767 <b>and Section 3.6 of the ATCC material test</b>
<input type="checkbox"/>	<b>Calcination method</b> based on DIN EN ISO 1172 <b>and Section 3.7 of the ATCC material test</b>
<input type="checkbox"/>	<b>Density measurement</b> based on DIN EN ISO 1183-1 ( <b>not addressed in the ATCC material test</b> )

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**Appendix 2: presentation of the results**

<input type="checkbox"/>	<b>Initial test</b>	<input type="checkbox"/>	<b>Repeat test</b>	For testreport no.:	
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**Information on the taking of the sample**

Supervision by (name)	Sample-taking		Confirmation that the sample has been taken (company responsible for implementation/construction management)		
	Date	Time	Block letters	Signature	

**Sample identification**

Client, material testing		Liner material ID	
Client		Length of the liner	
Building project		Conduit identification	
Company responsible for implementation		Sample identification	
Liner manufacturer		Date of installation	
Resin type	<input type="radio"/> UP <input type="radio"/> VE <input type="radio"/> EP <input type="radio"/> Other	Extraction location	Conduit <input type="radio"/>
Base material	<input type="radio"/> Synthetic f. <input type="radio"/> GFRP		End shaft <input type="radio"/>
Pipe geometry	<input type="radio"/> Circle DN .....	Extraction position	Inter. Shaft <input type="radio"/>
	<input type="radio"/> Oval .....		Apex <input type="radio"/>
Coating is an integral component of the liner	<input type="radio"/> Yes <input type="radio"/> No		Springer <input type="radio"/>
	<input type="radio"/> Outside <input type="radio"/> inside		Base <input type="radio"/>

According to ATCC material test and the supplements to the standards contained therein, the following test results have been achieved:

<input type="checkbox"/>	Bending E modulus, bending stress according to DIN EN ISO 178/DIN EN 13566-4			24-hour creep tendency based on DIN EN ISO 899-2	
	Test date	E <sub>f</sub> [MPa]	σ <sub>fb</sub> [MPa]	Test direction	
				<input type="radio"/> axial	<input type="radio"/> radial
	Total thickness e [mm]	Composite thickness e <sub>m</sub> [mm]		<input type="checkbox"/>	K <sub>n24</sub> [%]

<input type="checkbox"/>	Circumferential E modulus, start annular rigidity according to DIN EN 1228			24-hour creep tendency based on DIN EN ISO 899-2	
	Test date	E <sub>u</sub> [MPa]	S <sub>0</sub> [N/m <sup>2</sup> ]	Test direction	
				<input type="radio"/> axial	<input type="radio"/> radial
	Total thickness e [mm]	Composite thickness e <sub>m</sub> [mm]		<input type="checkbox"/>	K <sub>n24</sub> [%]

<input type="checkbox"/>	Waterproof according to Section 3.8 ATCC material test				
	Test date	Testing time [min]	Testing pressure [bar]	Test result	
		30	0,5 ± 5%	<input type="radio"/> no leak	<input type="radio"/> leak

<input type="checkbox"/>	Calcination procedure according to DIN EN ISO 1172				
	Test date	Resin content [%]	Total residue [%]	Glass content [%]	Aggregate [%]

<input type="checkbox"/>	Spectral analysis based on ASTM D5576 (FT-IR)			Density according to DIN EN ISO 1183-1	
	Test date	Resin		<input type="checkbox"/>	Density ρ [g/cm <sup>3</sup> ]

<input type="checkbox"/>	Thermal analysis according to DIN EN ISO 11357-1/DIN 53765 (DSC)					
	Test date	Glass transition temperature T <sub>G</sub> [°C]			Enthalpy [J/g]	
		T <sub>G1</sub>		ΔT <sub>G</sub>	<input type="radio"/> exothermic	<input type="radio"/> endothermic

<input type="checkbox"/>	Trace styrene content according to DIN 53394-2 (GC)					
	Test date	Weight of sample [mg]	Trace styrene content [mg/kg]	Trace styrene content [%]	Sample weight with respect to	
					Total weight	Pure resin

**Evaluation of the results** To be performed by the test institute:  yes  no

Requirement	Actual value	Nominal value	Requirement	Actual value	Nominal value
Modulus of elasticity in bending			Circumference modulus of elasticity E		
Bending stress			Initial annular rigidity		
Static rec. composite thickness			24h creep tendency		
Waterproof			Density		

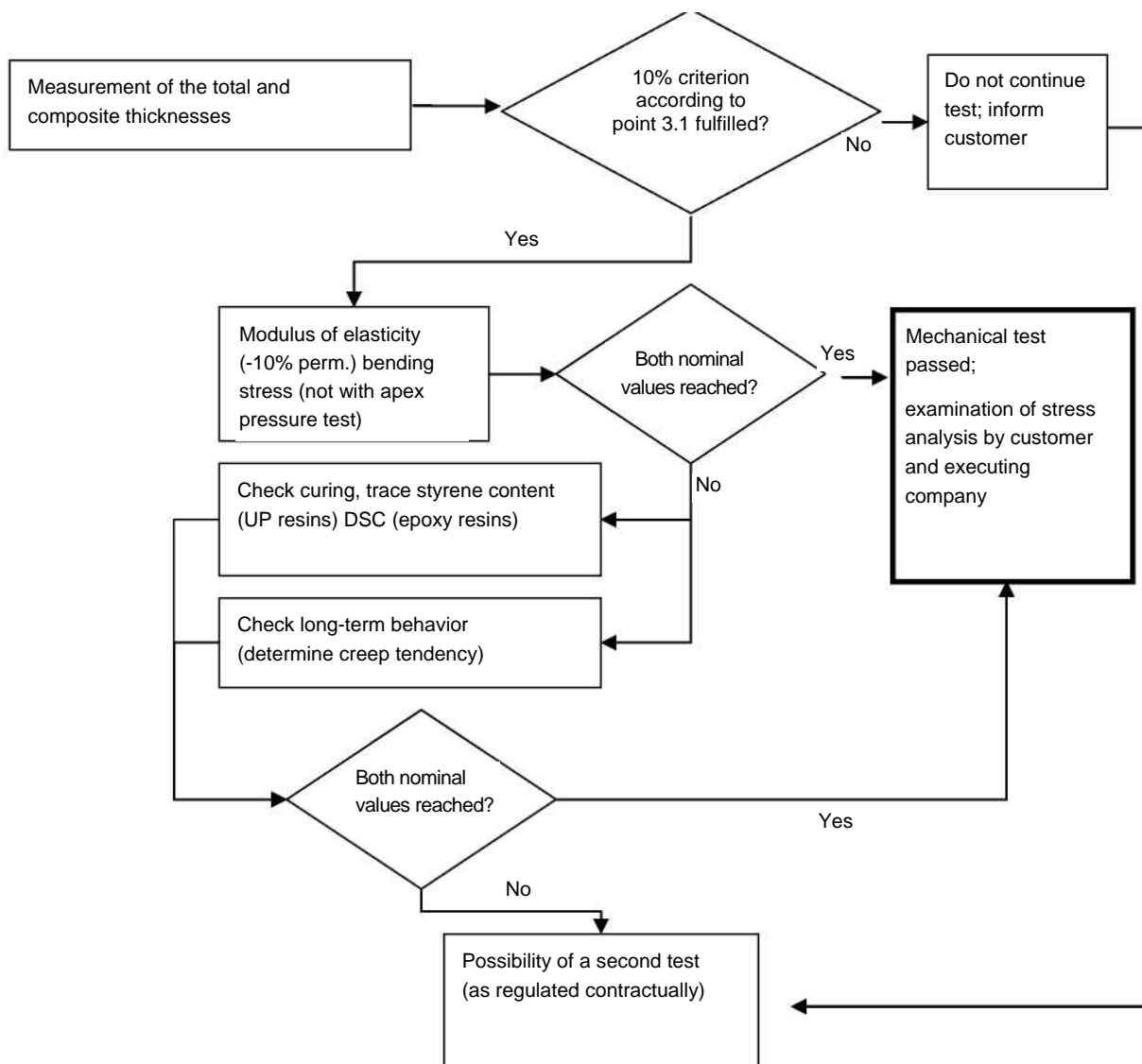


**ADDITIONAL TECHNICAL CONTRACT CONDITIONS (ATCC)**  
**For CIPP liner testing**

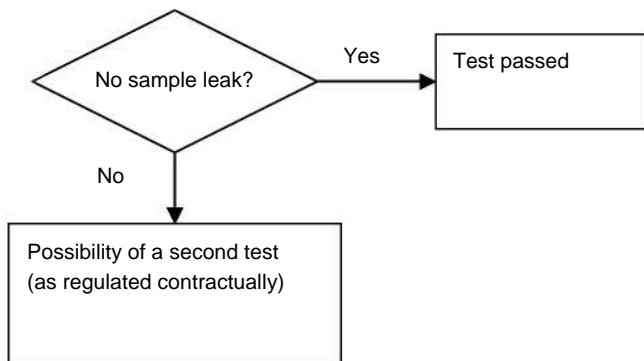
**Appendix 3: Flow diagram**

**Standard check three-point deflection test radial** (if depth gauge < 0.07 x support spacing)

**Three-point deflection test axial/apex pressure test** (if depth gauge > 0.07 x support spacing)



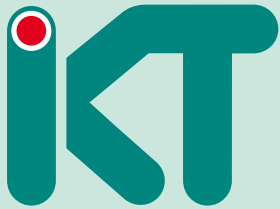
**Standard leak tightness test (porosity test) of the laminate**



**Spectral analysis** (optional)

**Determination of filler material and glass content** (optional)

neutral  
independent  
non-profit institute



IKT - Institute for Underground Infrastructure

# ABOUT IKT



**IKT - Institute for Underground Infrastructure** is a research, consultancy and testing institute specialized in the field of sewers. It is neutral and independent and operates on a non-profit basis. It is oriented towards practical applications and works on issues surrounding underground pipe construction. Its key focus is centred on sewage systems. IKT provides scientifically backed analysis and advice.

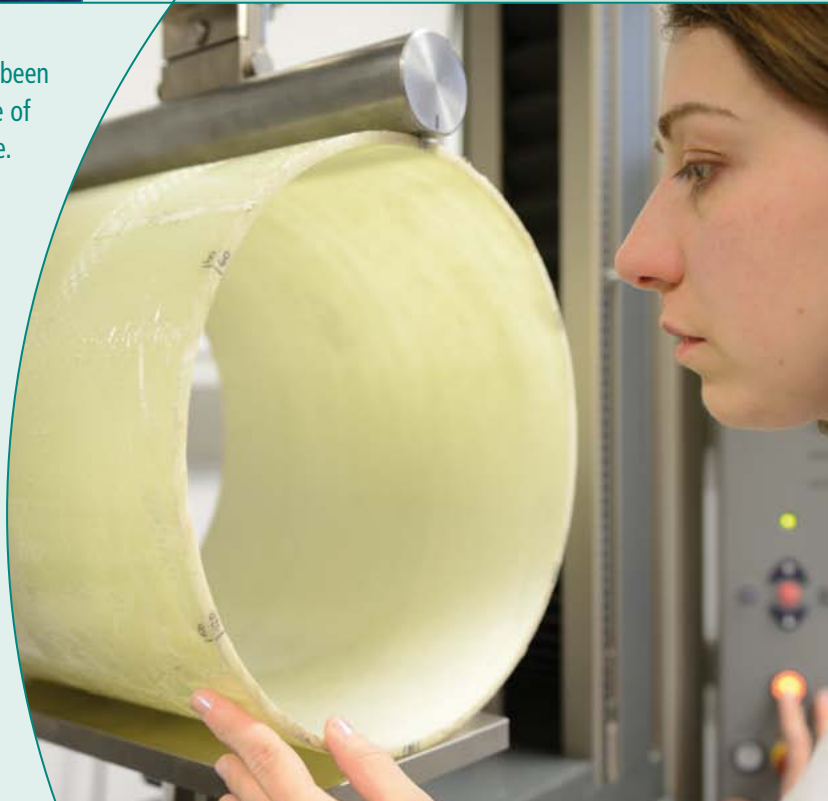
IKT has been established in 1994 as a spin-off from Bochum University, Germany.

The initial funding for setting up the institute has been provided by the Ministry for the Environment of the State of North-Rhine Westphalia, Germany's largest federal state.

However, IKT is not owned by the Government. Its owners are two associations which are again non-profit organizations of their own:

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[www.ikt-online.org](http://www.ikt-online.org)



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