

# Expanded-scope CIPP liner tests

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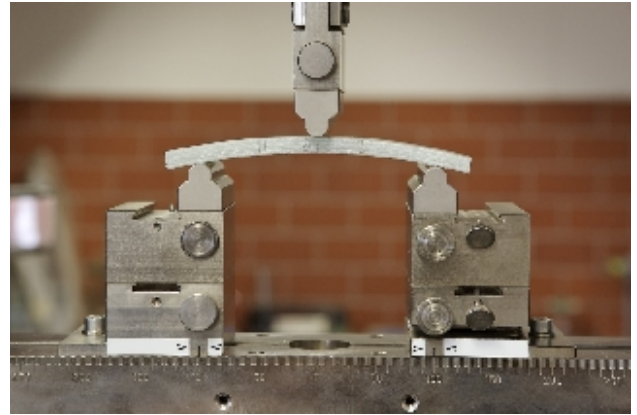


## CIPP liner test standards

The **minimum scope** of testing for CIPP liners consists of the three-point bending test for determination of modulus of elasticity and bending stress, and the water tightness test. Further tests are available, as defined in the ZTV Materials Testing (CIPP liner test standards), which make it possible to determine the quality of CIPP liners even more **precisely**.

## CIPP liner test standards

## Three-point bending test



Three-point bending test on a CIPP-Liner

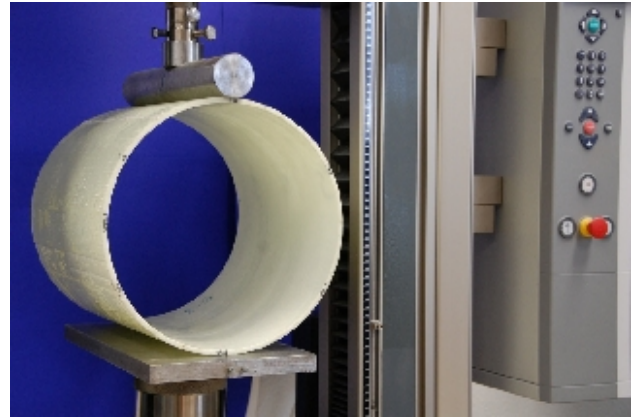
The three-point bending test (DIN EN ISO 178 and DIN EN ISO 11296, Part 4) is used to determine modulus of elasticity and bending stress at fracture (short-term modulus of elasticity and short-term bending stress).

The **thickness of the load-bearing wall** of the CIPP liner, for which design criteria are available from the structural-analysis calculation and the contract documentation, is also determined.

**Target values** for the mechanical characteristics of “modulus of elasticity” and “bending stress” can be found in the national technical approvals for the CIPP liner method used.

An **overview** of the technically approved CIPP liner methods, including details of materials characteristics, can be found in the Annex to the ZTV Materials Testing (CIPP liner test standards).

## Vertical compression test



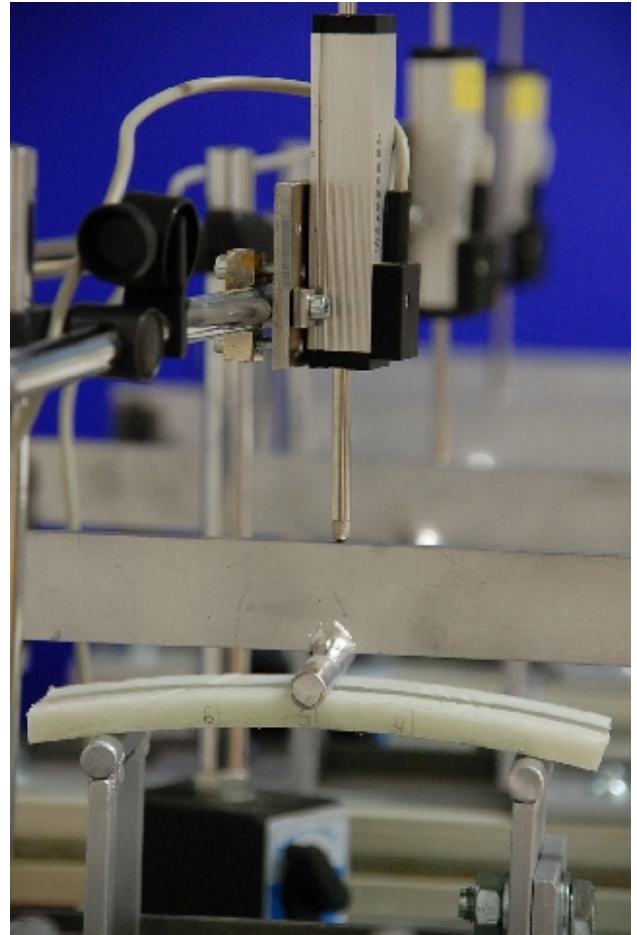
Crown pressure test on a CIPP liner

Initial ring stiffness and modulus of elasticity are tested in the vertical compression test (DIN EN 1228).

The vertical compression test is nowadays usually performed for **sewer-lateral liners** and small diameter CIPP liners (DN 150 and less), since the taking of a complete pipe section, rather than a sub section is usually possible in such cases.

Alternatively, differential scanning calorimetry (**DSC**) **analysis** can be performed on small samples, in order to verify at least the **curing** of the resin, instead of the mechanical characteristics (see below).

## 24-hour creep



24 hour creep test for CIPP liners

This test can be performed as part of the three-point bending test or of the vertical compression test (DIN EN ISO 899, Part 2). The **deformation** of the sample across time under constant load is measured.

The deformation of a CIPP liner under constant load becomes increases with time. This phenomenon is referred to as **creep behaviour**.

This is taken into account in the structural design of a CIPP liner by assuming the long-term characteristics data for modulus of elasticity and **bending stress** at fracture. These can be determined from the short-term values for the three-point bending test by means of the so-called **reduction factor**, which is stated in the DIBt approvals

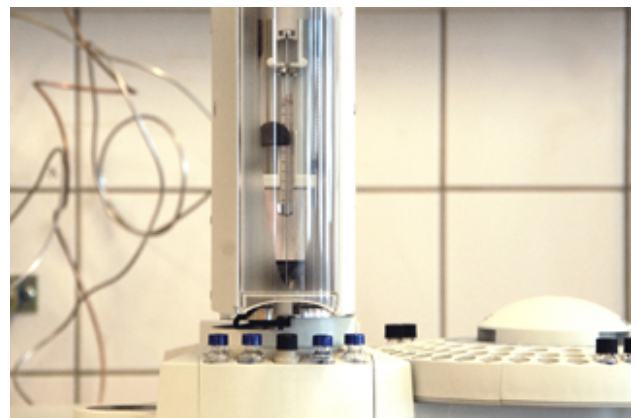
Testing of **24-hour creep** is performed to check, by exposing a sample of CIPP liner to load for 24 hours, whether the CIPP

liner possesses the expected **long-term behaviour**.

In addition, this indirectly checks the curing of the CIPP liner as an **incompletely** cured liner sample will not meet the limits for 24-hour creep.

The target values for this can be found in the respective DIBt approvals.

## Determination of residual styrene content



Determination of residual styrene content

Polyester resin contains **styrene**, which is fixed after curing. The free (non-fixed) styrene content (residual styrene content) therefore provides information on the **through-curing** of a CIPP liner sample.

**Free styrene content** is determined using a gas chromatograph after extraction using dichloromethane (DIN 53394, Part 2).

## DSC analysis

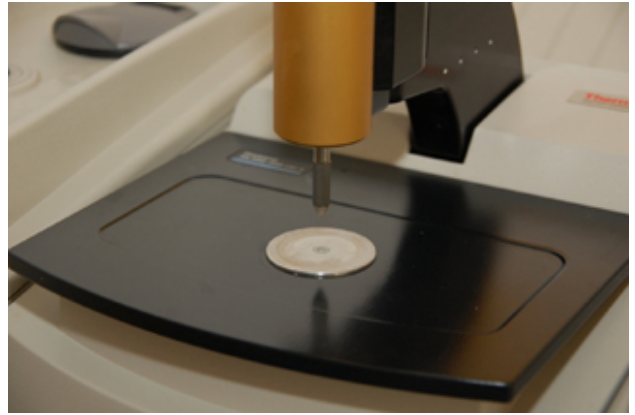


DSC analysis of resin samples

Differential scanning calorimetry is a thermal analysis procedure, through which curing of **epoxy resins** can be verified (DIN 53765) using small samples (up to 20 mg).

The **glass transition temperatures** TG1 and TG2 ( $^{\circ}\text{C}$ ) of a sample are determined in two heating operations. Enthalpy (J/g) is also stated. DSC analysis is used primarily in the case of **sewer-lateral liners** if site samples cannot be taken for performance of mechanical tests

## Spectral analysis



Spectral analysis of CIPP liners

Spectral analysis is used to determine whether the **quality of resin** installed conforms to the resin quality originally offered by a contractor.

The **infrared spectrum** of the site sample is compared against a **reference spectrum** as specified in the DIBt approval (ASTM 5576, DIN 55673, with reference).

Every supplier of CIPP liners is required under DIBt approval to submit to the test laboratory a reference sample of his **approved resin system**.

## Determination of filler and glass content





## Determination of filler and glass content

The **textile glass** and **mineral filler content** of a CIPP liner sample is determined by means of the calcining method (DIN EN ISO 1172).

## Water-tightness test



Water-tightness test on a CIPP-liner

The water tightness test is performed in the laboratory in order to determine whether the cured laminate of the CIPP liner is water **tight** (in accordance with APS Test and Inspection Code, ZTV Materials Testing, DWA-A 143-3).




## Density



Precision scale for determination of density

The density of a CIPP liner sample can be used to determine whether the liner has been **adequately impregnated** with resin. Any air inclusions present can cause **leaks** in the laminate (DIN EN ISO 1183, Part 1).

The density of a CIPP liner sample is stated in the DIBt approval.

IKT gGmbH Eichenbruch 1 D-45806 Gelsenkirchen T: +49 209 17805-0 F: +49 209 17805-88		<b>APS Sample data sheet</b> (Inliner Testing Institutes Workgroup) <b>for materials testing of CIPP liners</b>																					
<input type="checkbox"/> <b>Initial test</b>		<input type="checkbox"/> <b>Repeat test</b>		to Test Report No.: _____																			
<b>Details of sampling</b>		<table border="1"> <tr> <td colspan="2">Supervised by (Name)</td> <td colspan="2">Sampling</td> <td colspan="2">Sampling confirmed</td> </tr> <tr> <td colspan="2"></td> <td>Date</td> <td>Time</td> <td colspan="2">(competent management personnel)</td> </tr> <tr> <td colspan="2"></td> <td></td> <td></td> <td>Block capitals</td> <td>Signature</td> </tr> </table>				Supervised by (Name)		Sampling		Sampling confirmed				Date	Time	(competent management personnel)						Block capitals	Signature
Supervised by (Name)		Sampling		Sampling confirmed																			
		Date	Time	(competent management personnel)																			
				Block capitals	Signature																		
<b>Specimen identification</b>																							
Client material-testing		Material ID																					
Client		Line designation																					
Construction project		Specimen designation																					
Company performing		Date of installation																					
Manufacturer (CIPP)		Condition of old pipe																					
Material		<input type="checkbox"/> Resin <input type="checkbox"/> Fibre	<input type="checkbox"/> Cartridge <input type="checkbox"/> Bag	<input type="checkbox"/> II <input type="checkbox"/> III <input type="checkbox"/> IV	<input type="checkbox"/> II <input type="checkbox"/> III <input type="checkbox"/> IV																		
Pipe geometry		<input type="checkbox"/> Round <input type="checkbox"/> Flat	<input type="checkbox"/> Pipe <input type="checkbox"/> Other	<input type="checkbox"/> Inside <input type="checkbox"/> Sole zone <input type="checkbox"/> Head	<input type="checkbox"/> Inside <input type="checkbox"/> Head																		
<b>Required short-term properties as per client's information</b>																							
Bending modulus of elasticity $E_b$ [MPa]		Circumf. mod. of elast. $E_c$ [MPa]																					
Bending stress at rupture $\sigma_b$ [MPa]		Initial ring stiffness $S_0$ [N/m]																					
Statistical load-bearing wall thickness $t_{stat}$ [mm]		Max. creep tendency $K_{cp}$ [%]																					
Reduction factor for continuous loads $A_c$		Density $\rho$ [g/cm³]																					

Sample data sheet

## Sample data sheet Materials testing of CIPP liners

Please enclose this form when you send us your samples. This ensures that your **sample** can be correctly identified.

Please complete a sample data sheet for each individual site sample you send us.

Sample data sheet for CIPP liners

To  
IKT - Institute for Underground Infrastructure  
Exterbruch 1  
45886 Gelsenkirchen  
Germany

by e-mail: [CIPP@ikt.institute](mailto:CIPP@ikt.institute)



Please send us an offer for testing CIPP liner samples

Name of project site: \_\_\_\_\_  
Expected number of specimens: \_\_\_\_\_  
Expected period of project site: \_\_\_\_\_

Request for quotation CIPP  
liners

## Request for quotation Materials testing of CIPP liners

Do you require standard or expanded-scope tests?

We will provide a quotation tailored to your needs, to ensure that your **QA requirements** are met.

Request for quotation CIPP liners

## Contact

Deutsches  
Institut  
für  
Bautechnik



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test centre for building  
products

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IKT is accredited with the  
DAkkS National Accreditation  
Body for tests on CIPP liners  
and plastics