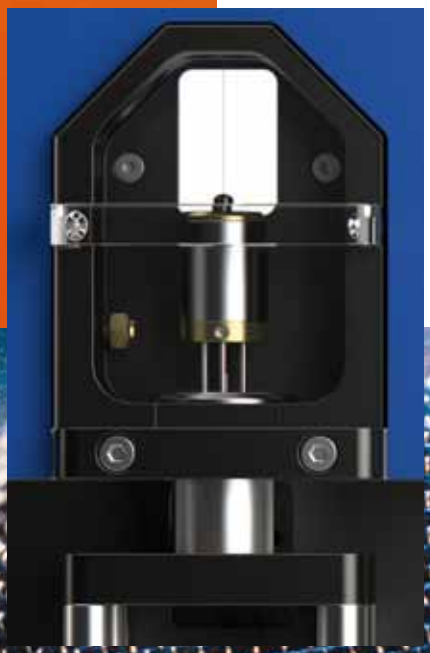
Textechno
textile testing technology



FIMATEST

Fibre-Matrix Adhesion Tester

Fibre-Matrix Adhesion Tester FIMATEST

The performance of composite materials strongly depends on the adhesion of the fibres to the matrix. On the microscopic level different test procedures have been established in various research institutes, however, most results are not comparable, since none of these tests are standardized or commercially available.

In order to make a versatile and reproducible single-fibre pull-out test available to institutes and industrial customers world-wide, Textechno, leading experts in the field of fibre testing, has developed a suitable system together with the Leibniz Institute of Polymer research Dresden (IPF) and the Faserinstitut Bremen (FIBRE). While the IPF has long-standing competence and experience in the field of fibre-to-matrix adhesion, FIBRE has contributed by their experience in image analysis for automating the embedding process. The system consists of two devices: the partially automated embedding station FIMABOND, which is suited for all kind of reinforcement fibres as well as for thermoset, thermoplastic or mineral matrices, and a device that performs high precision pull-out tests as a new accessory to Textechno's single-fibre linear-density and tensile tester FAVIMAT+.

FIMABOND

One of the most critical points to assure reproducible results in a single-fibre pull-out test is the precise embedding of the fibre which is required to avoid shear forces. For this purpose, the fibre has to be embedded exactly in the center of the matrix droplet. This critical adjustment is perfectly performed with the FIMABOND embedding station. FIMABOND features freely programmable temperature profiles up to 400 °C and embedding under inert gas. Well suited for both, thermoplastic and thermoset matrices.

The FIMABOND embedding station

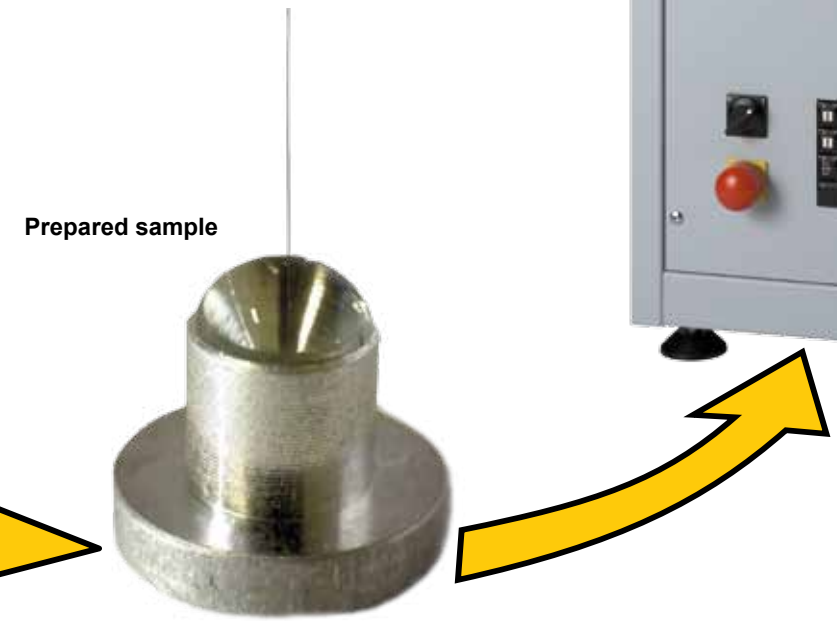
Pull-out Device

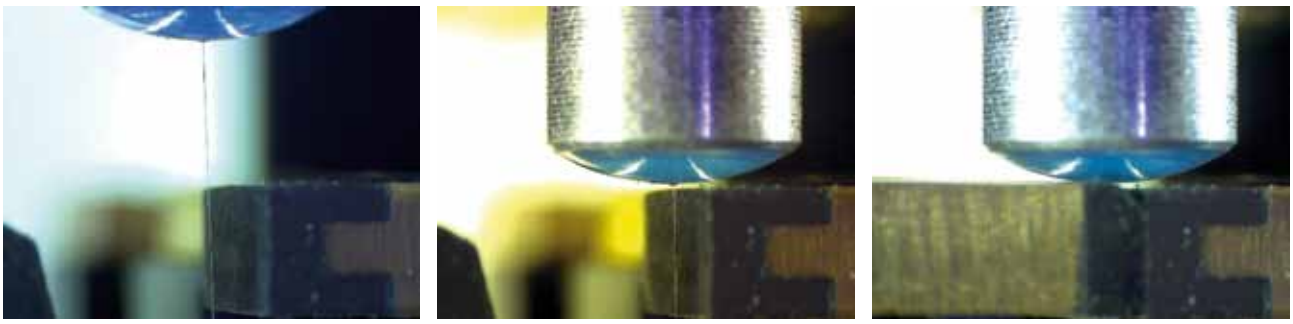
The pull-out testing device is easy to install and operate in the FAVIMAT+. A microscopic camera facilitates the adjustment of the clamps as close as possible to the matrix surface with perfect alignment. The direct clamping of the fibre makes the pull-out test fast and efficient – no need for glues and tedious handling.

The pull-out device

The FAVIMAT+ single-fibre tester with installed pull-out device

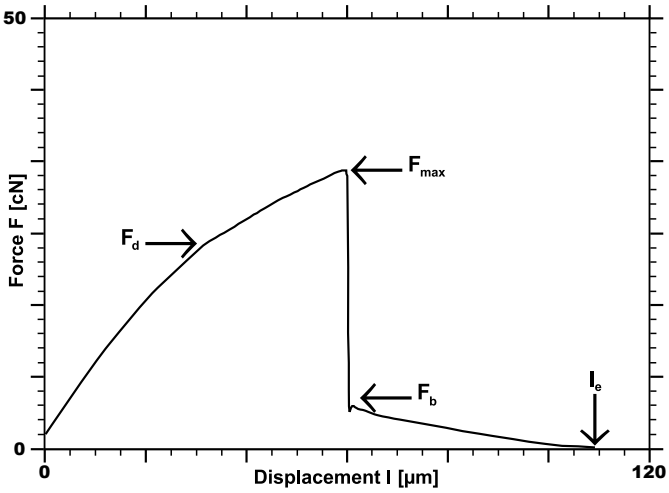
Prepared sample





Direct clamping process of the fibre as seen by the microscope camera of the pull-out device

When the fibre is clamped, the FAVIMAT+ automatically starts the pull-out test and records the force/displacement-curve.



From the force/displacement-curve the system determines all relevant parameters:

- maximum force (F_{max})
- frictional force (F_b)
- debonding force (F_d)
- actual embedding length (l_e).

Based on these measured values the following quantities are calculated:

The **apparent interfacial shear strength** τ_{app} is based on the maximum force F_{max}. It is sufficient for a qualitative estimation and a simple discrimination of different fiber-matrix-adhesion types. After the debonding of the fibre from the matrix, no bondings are left.
The fiber will be completely pulled out and only friction, expressed by the **interfacial frictional stress** τ_f, will occur.

The **local interfacial shear strength** τ_d is based on the debonding force F_d. It describes the absolute measure of the fibre-to-matrix adhesion, independent from friction and corrected for deformation of fibre and matrix during the pull-out test.

The **critical interfacial energy release rate** G_{ic} describes the energy required to debond the fibre per unit contact area. It is an alternative to the strain-based paramater τ_d.

With the integration of the pull-out device into Textechno's FAVIMAT+, the complete system allows for an easy and precise determination of linear density and cross section as well as modulus, breaking strength and elongation on top of the fibre-matrix-adhesion.

Technical data FIMABOND

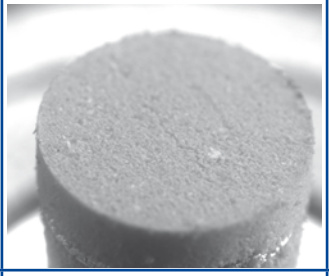
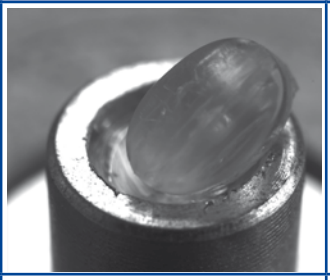
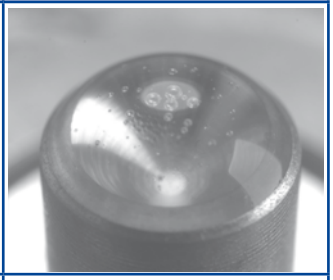
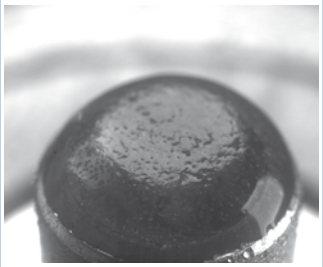
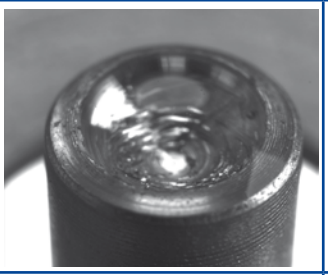
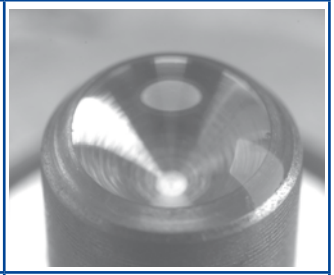
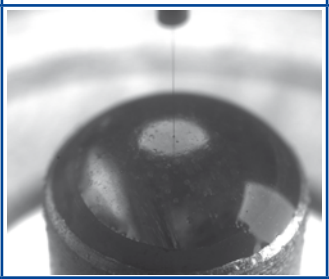
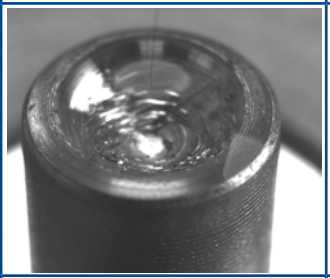
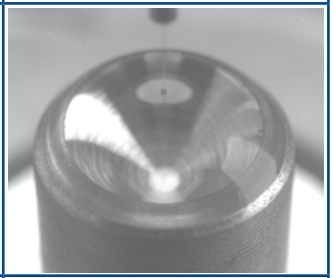
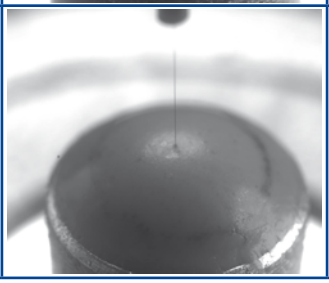
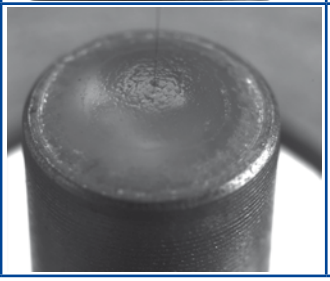
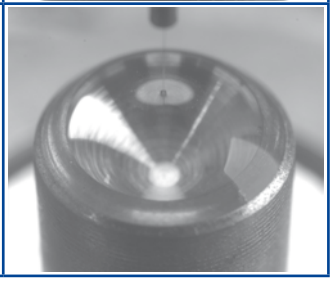
- Mains supply: 230 V, 50 (60) Hz;
- Inert gas (optional): depending on matrix;
- Compressed air: 5 bar
- Lacquer finish: RAL 9006/5002;
- Dimensions: height 670 mm,
  width 480 mm,
  depth 285 mm;
- Weight: approx. 35 kg;

The above technical contents can be subject to changes by Textechno.

Supported by:

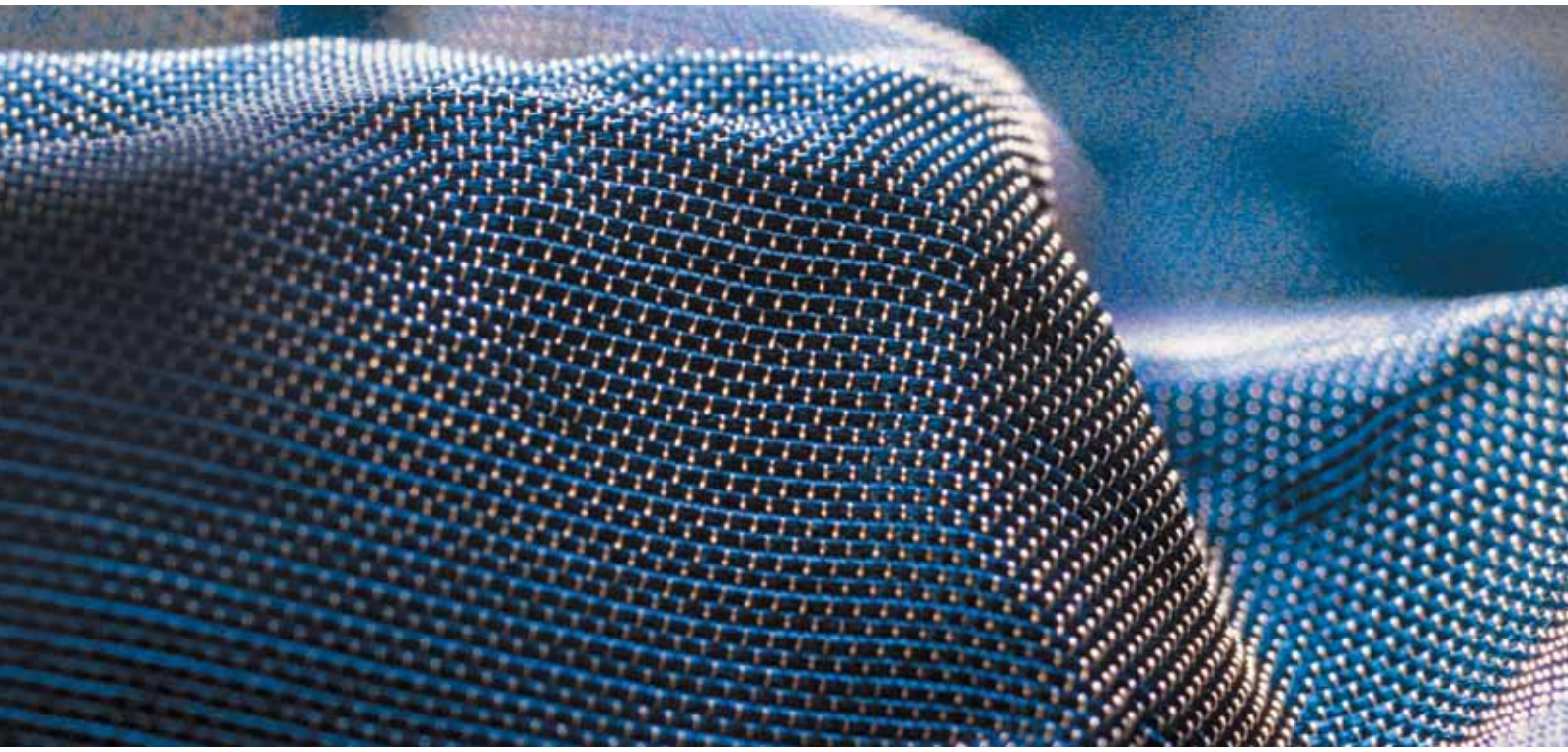
Federal Ministry of Economics and Technology

on the basis of a decision by the German Bundestag

Process steps	PEEK	PP	Epoxy
Inserting Matrix is placed in a crucible under inert gas-atmosphere if desired			
Heating Freely programmable heater up to 400°C			
Embedding Adjustable embedding speed and depth			
Cooling / Curing Active cooling available			

Sample generation as seen by FIMABOND

Textechno
textile testing technology



THE TEXTECHNO GROUP

Your reliable partners for
quality improvement

Textechno Herbert Stein GmbH & Co. KG
D-41066 Mönchengladbach, Germany
www.textechno.com

Textechno
textile testing technology

Lenzing Instruments GmbH & Co. KG
A-4851 Gampern, Austria
www.lenzing-instruments.com

LENZING INSTRUMENTS