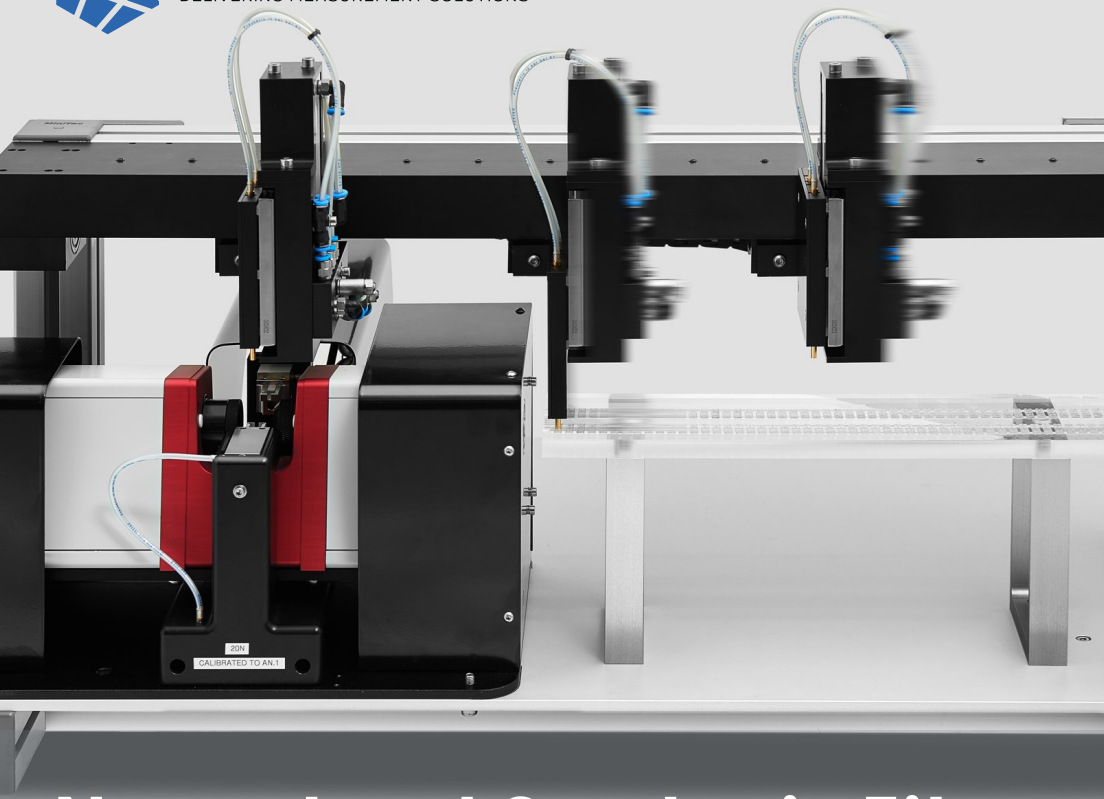
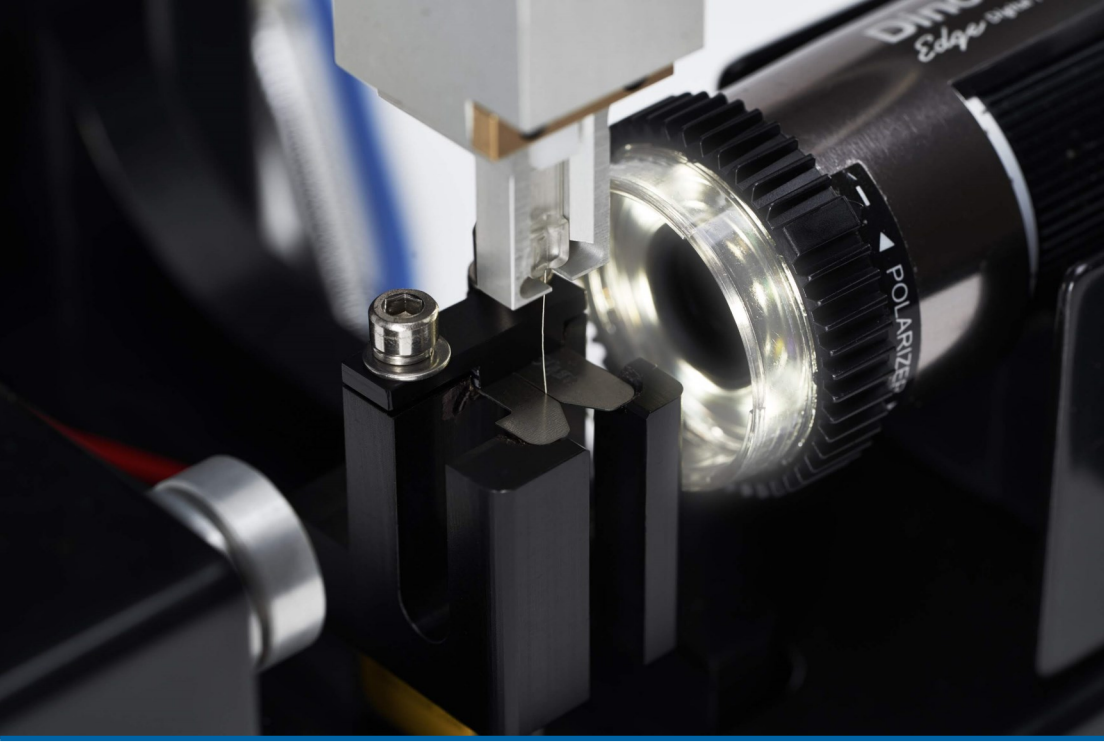
DIA-STRON
DELIVERING MEASUREMENT SOLUTIONS



Natural and Synthetic Fibre Testing Instrumentation

Dia-Stron's history may be rooted in hair fibre metrology, but our mission has always been to drive innovation in line with our customers' ever changing requirements. A customer enquiry in early 2000 led Dia-Stron to begin trialling tensile and dimensional measurements of carbon fibres on our existing hair testing instrumentation, resulting in the development of the range of fibre testing instruments that we offer today.

These instruments have evolved specifically for measuring challenging natural and synthetic fibre samples; starting with the inception of the LEX Linear Extensometer — a tensile measurement system with the high level of precision and sensitivity required for measuring carbon or glass filaments.



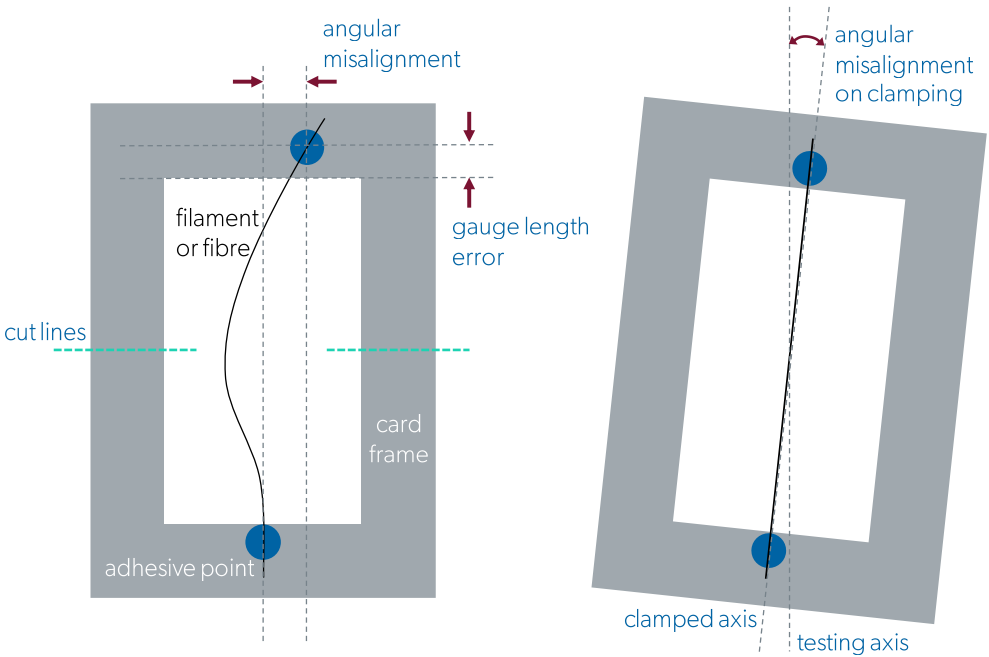
We then released an innovative dimensional analysis module, the LDS Laser Diffraction System, capable of accurate diameter measurements of fibres as small as 5µm. Our latest innovation, the IFSS module, takes us beyond single fibre/filament testing into exploring the relationships between fibres and matrices in composite materials.

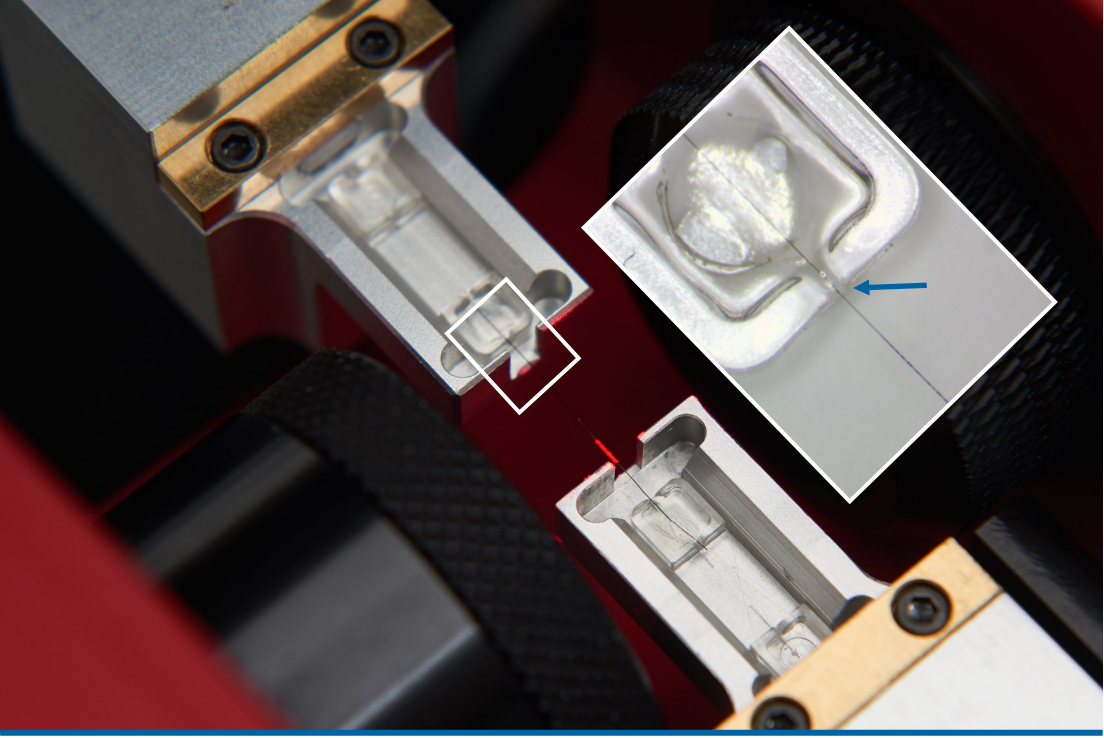
Dia-Stron took part in the FiBreMoD consortium as an industrial partner — an EU-funded project training interdisciplinary researchers to develop and apply state-of-the-art tools for designing the materials and fibre-reinforced composites of the future.

From an error-prone card frame method …

Fibre specimen preparation and testing based on a card frame approach is cumbersome and time consuming. Possible sources of error such as angular misalignment, inaccurate gauge length or imprecise positioning on clamping coupled with low measurement success rate makes single fibre testing laborious for researchers.

A modern, improved and effective technique is required to reliably and productively mount and characterise the mechanical properties of single fibres or filaments.





… to an efficient and contemporary fibre testing approach

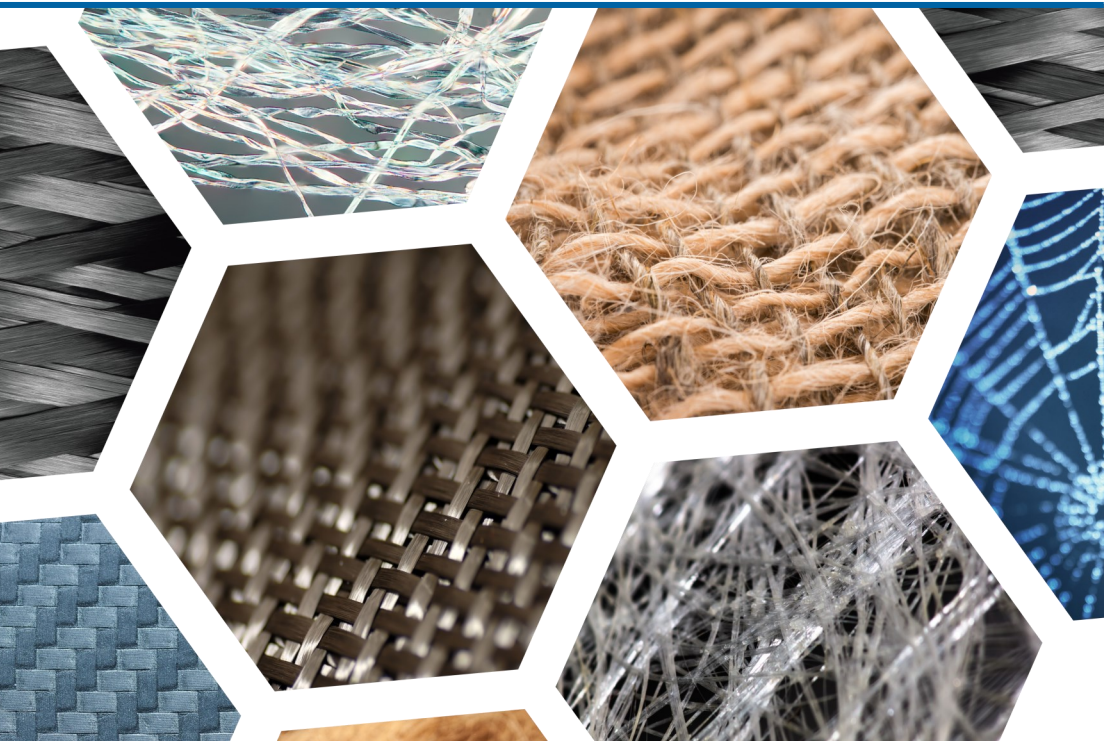
Dia-Stron developed a complete and automated testing solution including specimen preparation, loading, measurement and data analysis, complying with the majority of testing standards dealing with dimensional and tensile properties of single filaments.

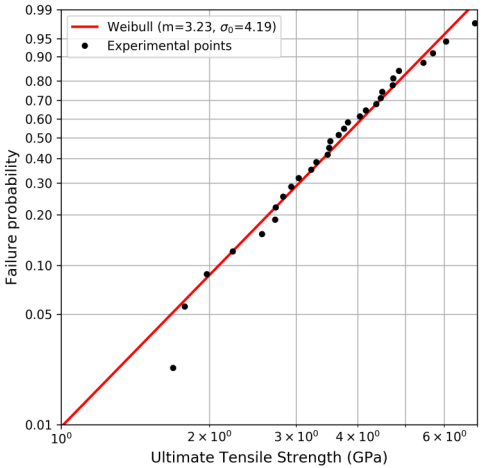
Fibres are mounted between pairs of plastic tabs with alignment features, pre-loaded in a storage cassette, and secured using a UV-curing adhesive. Specimen cassettes are then loaded onto our automated platform for testing, keeping specimens at a consistent gauge length, aligned and square without the need for user intervention.

Fibres & Filaments —

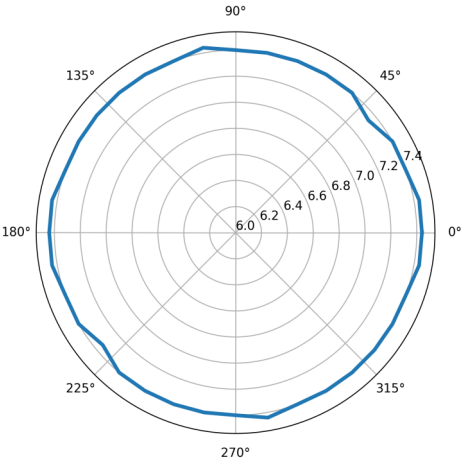
Our instrumentation range has been developed for measurements on two distinct fibre types — synthetic and natural. Synthetic fibres include carbon, ceramic, glass, basalt, aramid, quartz or polymeric fibres such as polyethylene and textiles (polyester). Natural fibres comprise of plant-based fibres such as flax, bamboo, sisal, coco, hemp, jute and cotton, as well as animal-based fibres such as wool, hair and silk.

Single fibre testing is preferred over fibre tow or bundle testing as the most reliable and unambiguous means of characterising fibres and filaments.





Single carbon filament tensile strength



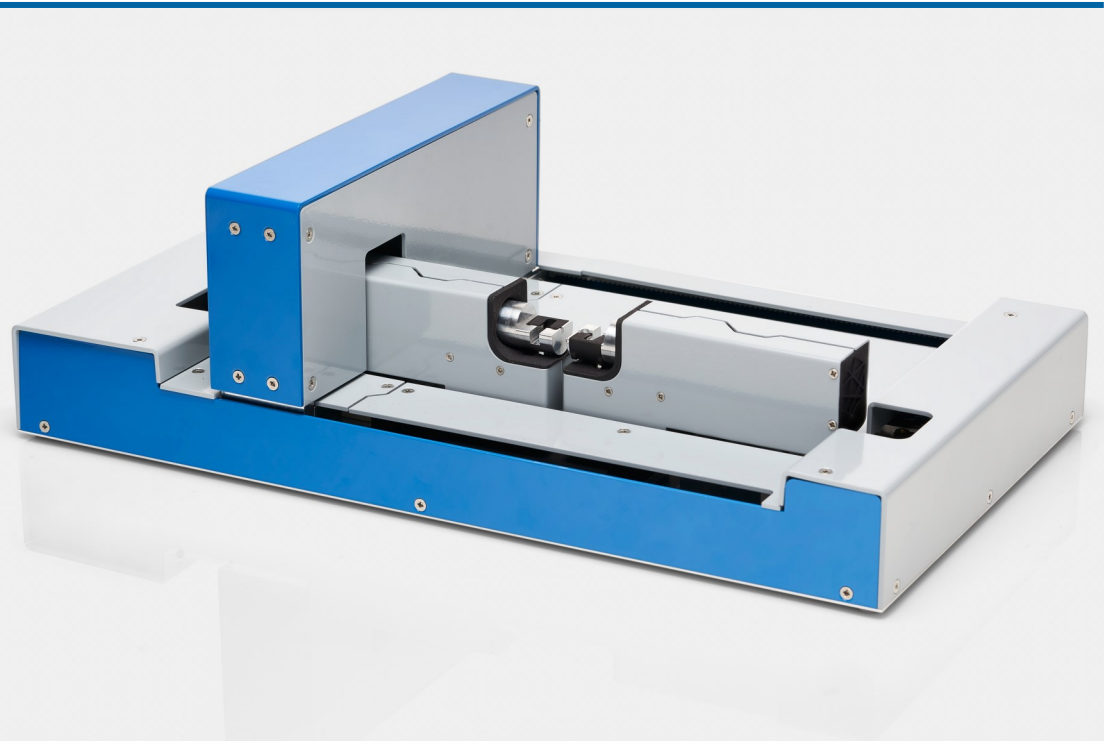
Angular variation in fibre apparent diameter

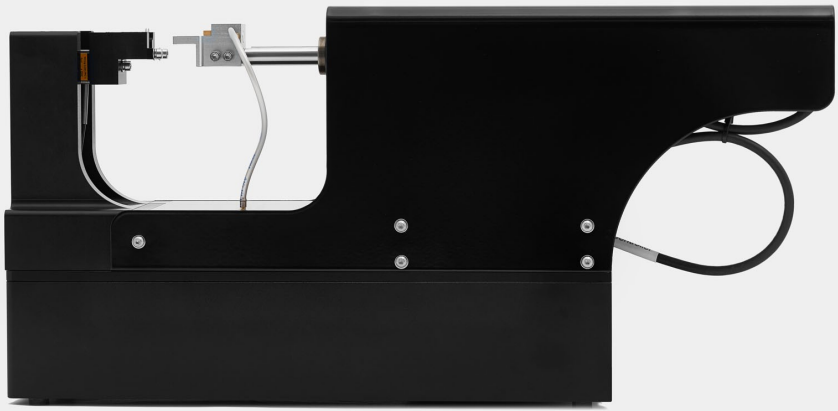
Typical Applications —

- Tensile properties of single fibres such as elastic modulus, break stress/strain
- Interfacial shear strength properties between glass filaments and epoxy resin
- Evaluation of cross-sectional swelling of natural fibres immersed in water
- Fatigue survivability of textile fibres: S/N curves, Weibull & Kaplan Meier analyses
- Assessment of anisotropy of polymeric fibres: tensile, bending, torsion deformations

fibra.stress — Tensile and Dimensional

fibra.stress is a high-precision automated tensile tester with integrated dimensional capabilities. The combined dimensional analysis module measures each fibre cross-section, normalising the tensile data to reduce data variability and help discriminate subtle changes in the fibres. It also enables in-situ dimensional measurements throughout the duration of a tensile test, from which the Poisson's ratio can be calculated. fibra.stress supports a wide range of fibre types/gauge lengths, and multiple methods including extension, stress relaxation and hysteresis.



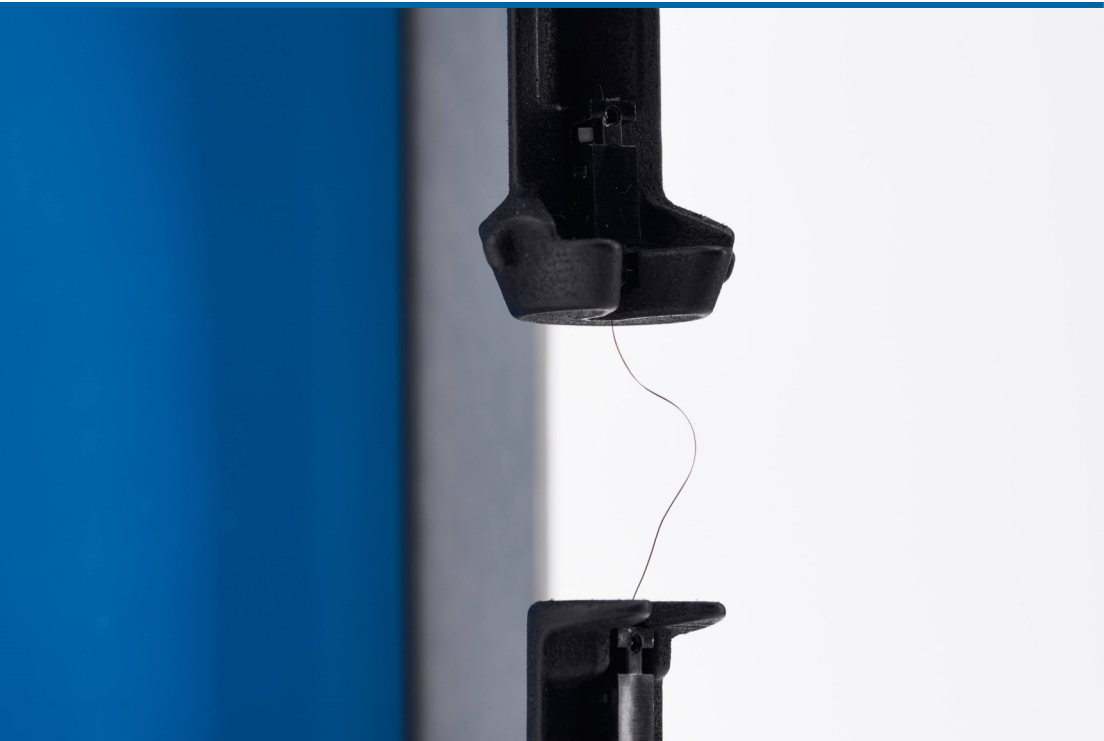


LEX820 — Linear Extensometer

The LEX820 is a high resolution extensometer, developed for brittle fibres that fail at low strain values. The DC micrometer-drive delivers exceptionally smooth travel, combined with a high positional repeatability required to capture accurate strain data. The LEX820 is supplied with either a 20N or 2N load cell which measure force data with an excellent linearity and low compliance. The LEX820 open frame design means that it can also be used in conjunction with techniques such as X-Ray diffraction or neutron scattering.

fibra.lex.decrimp

The fibra.lex.decrimp measures the initial, low force region of the load-extension curve of a crimped fibre using a high definition extensometer. The de-crimping parameters provide an insight into the effects of the crimp on the mechanical properties of the fibre. These parameters can be used to study straightening mechanisms on crimped synthetic fibres, natural fibres, wool and hair.

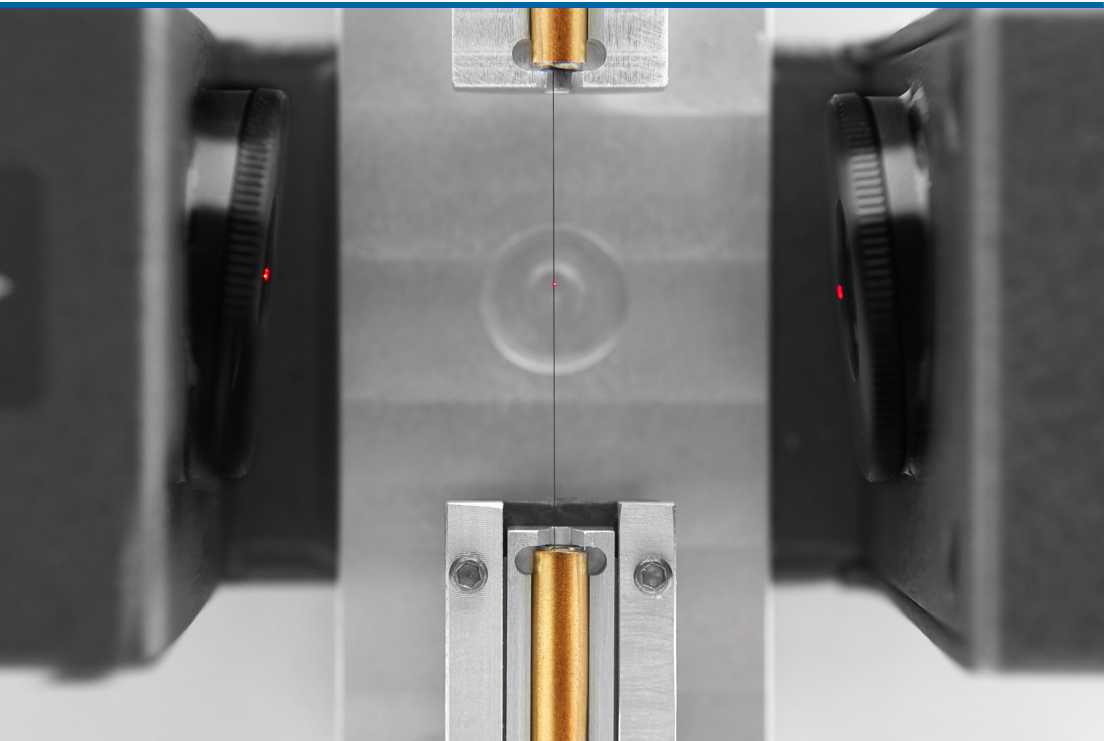


IFSS — Interfacial Shear Strength Module

The Interfacial Shear Strength module (IFSS) is an interchangeable module for the Dia-Stron LEX820, used to measure the debonding force of micro-droplets on single fibres and filaments. The camera and light source enable users to visualise the fibre/droplet during the test and capture the mode of failure in video and still images. The IFSS method can be applied to various fibre and filament types: glass, carbon, ceramic, aramid, basalt or natural fibres.

FDAS770 — Fibre Dimensional Analysis System

The FDAS770 utilises a high-frequency Laser Scanning Micrometer for accurate, non-contact dimensional measurement of fibres with fully automated fibre rotation and translation. Fibre cross-sectional area can be calculated for the conversion of force to stress data. The FDAS770 lends itself to irregular, opaque or semi-transparent fibres, and our sample mounting techniques can support a wide variety of specimens, such as cotton, glass, flax, bamboo and silk. A Dynamic Swelling Module (DSM770) can be incorporated for swelling and wet diameter measurements.



CYC802 — Cyclic Fatigue

The CYC802 module measures the fatigue strength of fibres by subjecting them to repeated cyclic tensile deformations or loading until failure. The module is designed around a high velocity voice-coil drive to apply set strain, force or stress levels on fibre specimens. S/N curve methods are also available in our dedicated software.

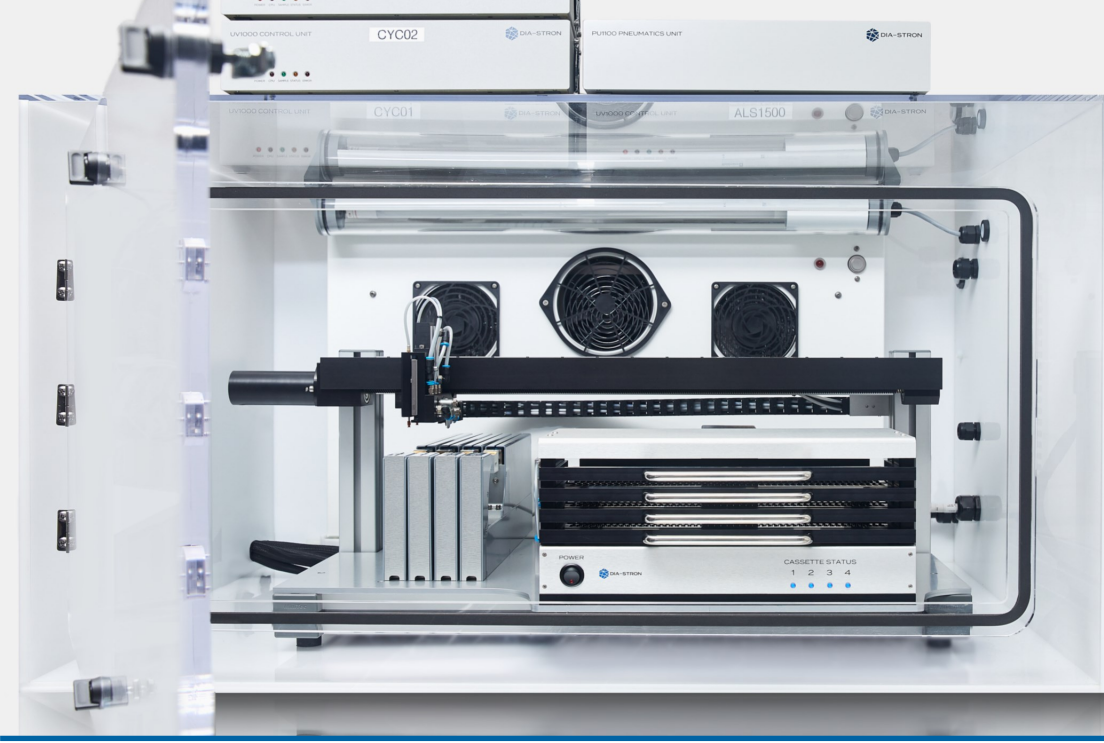
Up to four cyclic modules can be integrated on our automated platform, offering high-throughput testing using up to four 50-fibre linear cassettes in a Cassette Hotel.

Alternative modes of deformation

The FTT950 Torsion Tester measures torsion force, torsion/shear modulus (with dimensional data) and torsion stress relaxation. Fibres are pre-tensioned to a set force and twisted by up to 360° against a micro-balance, directly measuring torsional properties.

The FBS900 Bending System is based on the single cantilever method, where the fibre is flexed against a pin and the bending force measured. Combined with dimensional data, the bending modulus can be calculated and bending stress relaxation monitored.

Dia-Stron FTT950 Torsion Tester



Automation

All Dia-Stron measurement modules can be used in conjunction with our automation platforms, delivering high throughput testing of single fibres for maximum productivity. The “Pick & Place” mechanism transports fibre specimens from storage cassette to measurement modules and back continuously. An additional cassette hotel increases the capacity to 200 fibre specimens that can be measured without user intervention.

The benefits of automation include maximised productivity, improved data quality, consistent specimen integrity and improved safety/ergonomics.

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