



DIA-STRON
DELIVERING MEASUREMENT SOLUTIONS

FTT950 Torsion Tester



Overview

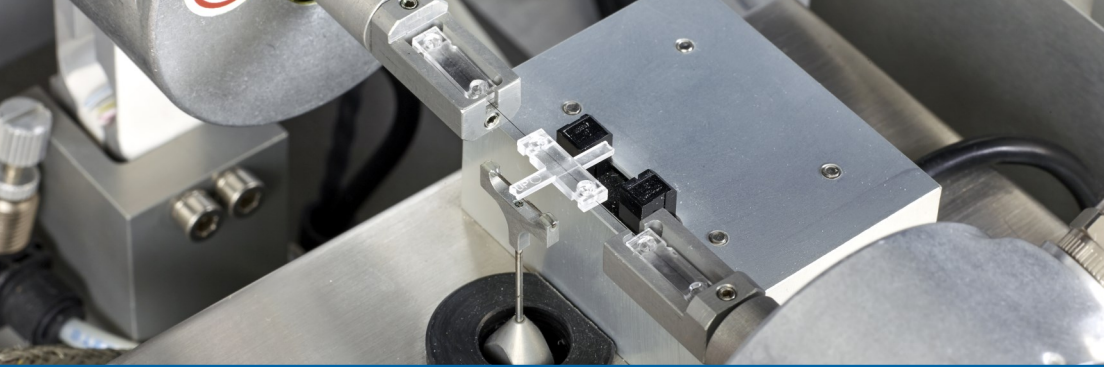
The FTT950 enables the direct measurement of the torsional properties (force and modulus) and the subsequent stress relaxation of single fibres, as well as being fully automated for a high throughput and efficient workflow. Fibres are pre-tensioned to a set force and twisted by up to 360° against a micro-balance, directly measuring torsional properties.

Principal benefits:

- Direct torsional modulus measurements
- High sample throughput rate with the ALS1500
- Fully compatible with the FDAS770 for combined dimensional measurements
- Compact platform allows for system use within an environmental chamber

Applications and claims:

- Impact of products on hair fibre cuticle layers and cortex matrix e.g. oil treatments
- Impact of torsion as a mode of deformation of single fibres during the production of composite materials



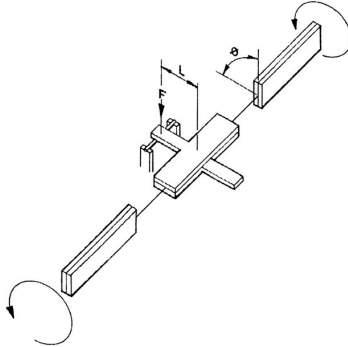
Metrology principle —

Samples are mounted and measured using a 2-part plastic tab with a central paddle attached to the midpoint of the fibre. The measurement is taken by simultaneously rotating the two ends of the fibre, causing the central paddle to contact the force balance. The applied force is recorded and the resulting torque is calculated. Torsional modulus is calculated as the degree of rotation, applied to the cross-sectional area data.

Automation —

The FTT950 can be integrated with Dia-Stron's ALS1500 automation platform for increased productivity. The "Pick & Place" mechanism transports fibre specimens from storage cassette to measurement module and back continuously without user intervention. The system enables consistent, reproducible and repeatable measurement of the torsional modulus with a high testing throughput.

Sample data and analysis —



The Dia-Stron UvWin software determines the torsional modulus G from the cross-sectional measurements of the fibre. The UvWin software analysis function calculates the torsional rigidity constant, D as follows:

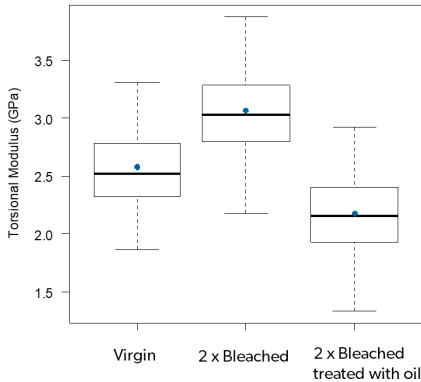
$$D = \pi \frac{a^3 b^3}{a^2 + b^2}$$

The torsional modulus G can then be calculated as follows :

$$G = \frac{FLl}{\theta D}$$

Where G is the torsional modulus (Pa), F is the force measured by microbalance (N), L is the distance of fibre pivot from microbalance (m), D is the torsional rigidity constant (m^4), θ is the angular rotation (radians) and l is the fibre length (m).

Sample data and analysis —



Torsional studies conducted on European hair fibres at 20% RH. Specimens were rotated through an angle of 90° at a rate of $5^\circ/\text{s}$. Torsional modulus (G) was calculated within the UvWin software. The lower modulus of the treated hair is indicative of a softening effect of the treatments.



References —

G. Daniels, E. Luneva, S. Tamburic: "African Hair: Exploring the Protective Effects of Natural Oils and Silicones"; IFSCC Magazine, 23 (4), 249-254 (2020)

R.J. Lunn, Y. Leray, S. Bucknell and D.M. Stringer: "Quasi-Static Torsional Deformation of Single Hair Fibers: Application of a Modeling Approach and Results from Cosmetic Treatments"; J. Cosmet. Sci., 69, 383–395 (2018)

F.I. Bell, P. Carpenter and S. Bucknell: "Advantages of a high-throughput measure of hair fibre torsional properties"; J. Cosmet. Sci, 63, 81-92, (2012)

Technical Specifications

Sample Mounting

Capacity	15 specimens per cassette
Specimen gauge lengths	30mm
Specimen mounting	2-part plastic tabs with central paddle

Programmable Features

Methods	Torsional force, gradient and modulus Torsional stress relaxation Tensile elastic modulus (from pre-tension data)
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Content

UV1000 control unit	FTT950 module
PU1110 pneumatic unit	USB and power cables
Sample loading system	UvWin software for Windows OS

Requirements

Power supply	Universal 85-265V AC
Compressed air	Dry and clean 4.5 bar
Computer	Windows OS: 7 and 10 2 x USB port

General Specifications

Fibre pre-set tension	1 - 100g
Linear extension range	0.01 - 1.5mm/s
Test angle	0 - 360°
Angular rotation rate	0.1 - 20°/s
Stress relaxation period	0 - 3600s
Max. sampling rate	10Hz

Control Unit and Pneumatic Unit (UV1050 and PU1110)

Net weight (each)	2kg
Unit depth (each)	230mm
Unit width (each)	100mm
Unit height (each)	120mm

Automated Sample Loading System

Width (ALS1500)	800mm
Depth (ALS1500)	500mm
Height (ALS1500)	400mm
Weight (ALS1500)	15kg

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