Agilent T150 UTM

Data Sheet

T150 Universal Testing Machine

Features and Benefits

- Compliant with ASTM standard
- Unique nanomechanical actuating transducer (NMAT) delivers high sensitivity over a large range of strain
- Dynamic characterization mode captures evolution of mechanical properties with strain
- Flexible and upgradeable universal testing machine that can be configured for a variety of new applications
- Outstanding software offers real-time experimental control and ease of test protocol development

Applications

- Thin individual fibers (polymer/metal/ceramic)
- Spider silk
- Nanofiber from electrospinning
- Biomaterials (e.g., soft tissue scaffold)
- Polymer film
- Textile
- MEMS

Overview

The Agilent T150 UTM is a universal testing machine that offers researchers a superior means of nanomechanical characterization. The state-of-the-art T150 employs a nanomechanical actuating transducer head to produce tensile force (load on sample) using electromagnetic actuation combined with a precise capacitive gauge, delivering outstanding sensitivity over a large range of strain.

The T150 UTM enables researchers to understand dynamic properties of compliant fibers via the largest dynamic range in the industry and the best resolution on the market (five orders of magnitude of storage and loss modulus). It also lets researchers investigate tension / compression properties of biological materials via a dynamic characterization mode that permits accurate measurement at each point during testing.

Additional advantages include fast, accurate generation of real-time test results; improved understanding of strain-rate-sensitive materials and time-dependent response; improved statistical sampling in biomaterials applications; and automated reporting of test results in both Microsoft® Word and Excel.

Agilent Technologies

The user-friendly design of the T150 UTM simplifies training requirements — standard tests can be run on the same day the instrument is installed. Every T150 is backed by highly responsive Agilent Technologies customer service personnel. Knowledgeable and experienced regional applications engineers are available to guide users through more advanced testing, provide outstanding technical support, and offer unmatched applications expertise.

Advanced Design

During tensile elongation, the T150 UTM holds the nanomechanical actuating transducer head stationary and moves the crosshead, providing a very stable system that ensures the lowest noise floor. The system allows the most accurate identification of the critical tension point needed for data correlation during specimen elongation. The T150 also uses data before the onset of tension on the sample with a software algorithm to accurately indentify the start of tension.

The T150 UTM design has high lateral stiffness, attributable to a two-spring design that supports the indenter transducer so that it is restricted to 1 degree of freedom in motion (axis of indentation). The restriction of movement enables the behavior of the instrument to more closely follow the dynamic model.

Utilizing core Agilent technology, loads are developed in the micro-Newton ranges and strain measurements from nanoscale extensions of samples are possible. The nanomechanical actuating transducer head functions as a load cell by sending a precise amount of current to the actuator coil so that the specimen lower grip is maintained in the center.

Furthermore, decoupling load application from displacement sensing ensures that the measured response of material and loading mechanisms are independent. Users can therefore obtain measurements that have minimal crosstalk between force on sample and displacement, thus reducing errors in measurements.

System Components

The T150 UTM includes a nanomechanical actuating transducer head and a software-controlled, automated handset, as well as a fully automated data acquisition and control system with PC, monitor, keyboard, and Agilent

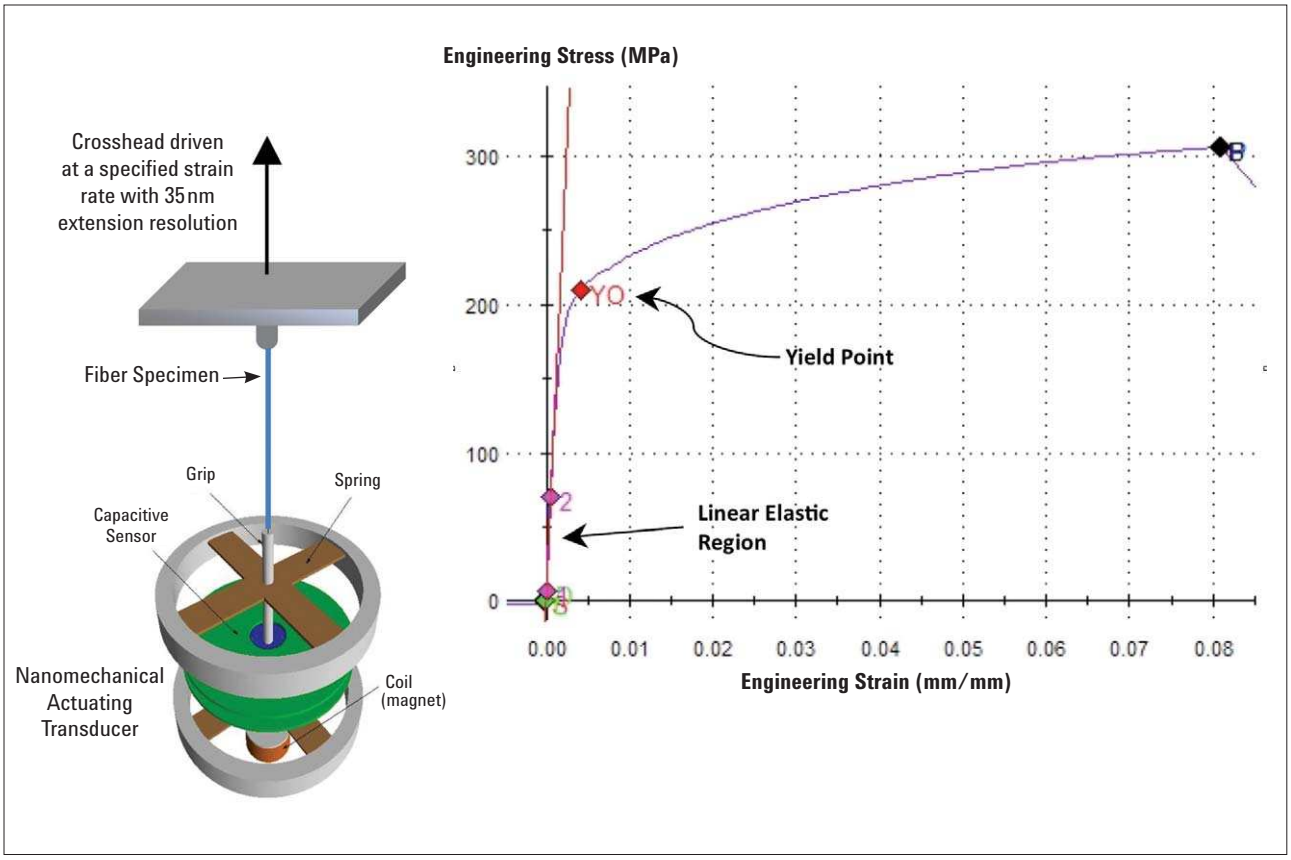

Figure 1. The sensitivity of the T150 nanomechanical actuating transducer (NMAT) enables detection of small loads required for deformation of small diameter individual fibers. The engineering stress-strain curve demonstrates the tensile test results from a test on single Cu wire of 29 µm diameter.

NanoSuite 6.1 Professional software — a powerful package that enables easy use of standard test methods and creation of unique solutions for automated, consistent results.

The T150 is equipped with a micropositioner stage, a helpful sample guide that ensures the sample is orthogonal and aids in the positioning of the upper grip. In addition, an indentation kit including an inversion footer is available allowing the system to be used as an indenter.

Continuous Dynamic Analysis (CDA) Option

The Agilent Continuous Dynamic Analysis (CDA) option offers a direct, accurate measurement of the specimen's stiffness at each point in the experiment, enabling mechanical properties to be determined continuously as the specimen is strained. By measuring both the amplitude and phase relationships between the load and displacement oscillations, CDA makes it possible to determine storage and loss modulus.

The CDA option enables T150 UTM users to gain access to dynamic properties information continuously through the force curve, providing a wealth of information on the material's response. The option also provides the advantage of measuring complex moduli over a range of frequencies.

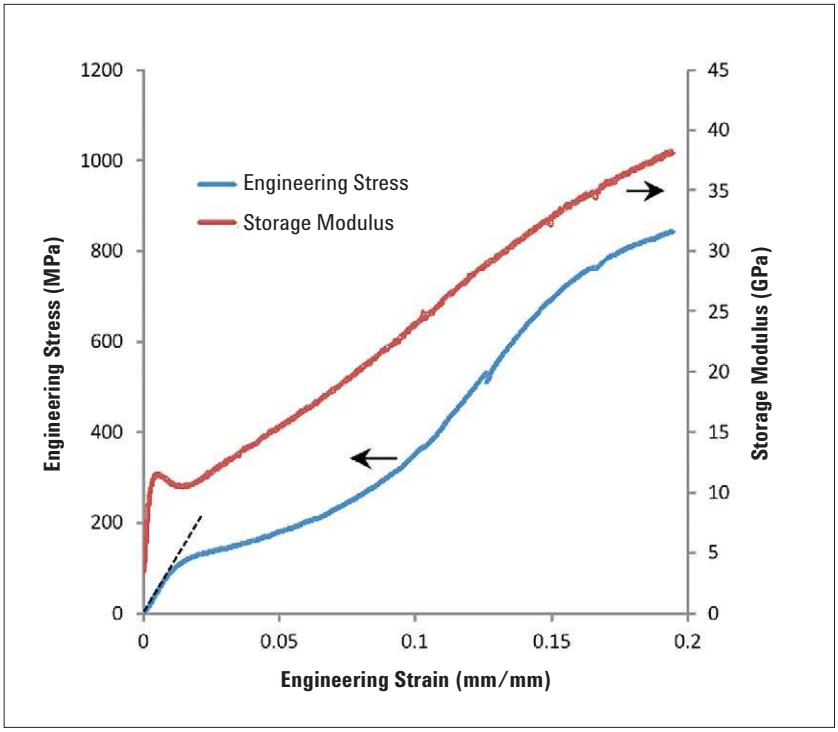

Figure 2. Variation of dynamic storage modulus with increasing strain in a single PET fiber. The continuous dynamic analysis (CDA) option allows the T150 to measure the dynamic mechanical properties continuously during a tensile test.

New Powerful NanoSuite 6.1 Professional Software

Every T150 UTM comes with Agilent NanoSuite 6.1 Professional software, a premium-performance package that gives researchers in scientific and industrial settings an unprecedented combination of speed, flexibility, and ease of use. The Professional version of NanoSuite 6.1 allows users access to various test methods written by Agilent applications engineers; each NanoSuite method is a software file that contains the instructions for performing a test, analyzing the data, and generating an easy-to-read printed report. Agilent is constantly developing and releasing new methods for T150 UTM users.

NanoSuite 6.1 streamlines batch test setup, allows 2D graphs to be plotted on-screen and exported directly to Microsoft Excel while preserving all labels and scales, and enables sample files to be organized by project and subproject. NanoSuite 6.1 also provides Microsoft Windows 7 (32-bit) compliance for current systems and a convenient PDF printer to replace hardware printers.

As in the package's previous iteration, an intuitive interface allows users to set up and run experiments quickly — changing test parameters as often as desired — with just a few clicks. Versatile imaging capabilities and new test methods help researchers get from testing to results in record time.

New Enhanced NanoSuite Explorer 6.1 Software

The Agilent NanoSuite Explorer 6.1 software package is offered as a T150 UTM option. The Explorer version of NanoSuite 6.1 enables researchers to write their own NanoSuite methods via an easy-to-use method creation protocol that reduces the lines of code needed for customized test development. The variety of tests that can be designed within the NanoSuite environment is limited only by the researcher's imagination. No other commercially available package offers this degree of flexibility and control.

Agilent T150 UTM Specifications

Maximum load	500 mN (50.8 gm)
Load resolution	50 nN (5.1 µgm)
Maximum actuating transducer displacement	±1 mm
Displacement resolution	<0.1 nm
Dynamic displacement resolution	<0.001 nm
Maximum crosshead extension	200 mm
Extension resolution	35 nm
Extension rate	0.5 µm/s to 5 mm/s
Dynamic frequency range (sample dependent)	0.1 Hz to 2.5 kHz

CDA Option

Force amplitude range	0.1 µN to 4.5 mN
Frequency range characterization of instrument dynamic response (sample dependent)	0.01 Hz to 200 Hz

Nano Mechanical Systems from Agilent Technologies

Agilent Technologies, the premier measurement company, offers high-precision, modular nano-measurement solutions for research, industry, and education. Exceptional worldwide support is provided by experienced application scientists and technical service personnel. Agilent's leading-edge R&D laboratories ensure the continued, timely introduction and optimization of innovative, easy-to-use nanomechanical system technologies.

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