TA Instruments

DISCOVER the WORLD'S FINEST DYNAMIC MECHANICAL ANALYZER

Dynamic Mechanical Analyzer

TA Instruments invites you to experience the ultimate in Dynamic Mechanical Analyzers, the Discovery DMA 850. Building on superior technologies of the world's best-selling DMA, improvements in every aspect of DMA performance deliver the most accurate and reproducible measurement of mechanical properties over a wide temperature range. It's never been easier to get great DMA data!

Features and Benefits:

- Non-contact, low mass motor delivers continuous forces from 0.1 mN to 18 N to measure everything from soft to stiff materials
- Frictionless, low-compliance air bearing design ensures superior force sensitivity and accuracy
- Unique optical encoder technology provides 0.1 nm resolution over a 25 mm continuous range of travel for ultimate testing versatility
- New DirectStrain™ and Intelligent Autoranging controls allow you to measure the widest range of sample stiffness and frequencies for the best data, the first time, every time
- Choice of two dedicated environmental systems for precise, responsive control under the most relevant test conditions
- Exclusive Air Chiller Systems provide effective controlled cooling to -100°C without the cost or hassle of liquid nitrogen
- Purpose-built, high-stiffness, low mass clamps are easy to use and ensure data repeatability
- New innovative "app-style" touch screen puts instrument functionality simply One-Touch-Away™, enhancing usability and making it easier than ever to get great data
- Powerful TRIOS software provides simple setup and execution through separate test interfaces designed for novice or expert users
- Commitment to quality backed by the industry's **ONLY** five-year furnace warranty for peace of mind

Responsive Direct Drive Motor

The DMA 850's non-contact motor applies both dynamic and static deformation over the full 25 mm range of motion, providing exceptional control in all modes and clamp positions.

The motor is constructed of high-performance lightweight composites that maximize axial and torsional stiffness while minimizing system inertia. Sophisticated control electronics enable the **fastest motor control over the widest continuous range of force, from 0.1 mN to 18 N**. This enables the system to capture a broad spectrum of material properties with the highest level of sensitivity and accuracy. These precision controls also provide vast improvements in transient response, including a step-displacement response of 50 ms, as well as a 100× improvement in stress-control accuracy.

Unlike competitive motor designs that provide either high force or high resolution, or require separate inferior motors for linear travel, the DMA 850 achieves a continuous range of linear travel and high-resolution force measurement.

Stiff, Frictionless Air Bearing Support

The non-contact drive motor transmits force directly to a rectangular air bearing slide. The slide is guided by eight porous carbon air bearings. Pressurized gas forms a frictionless surface that permits the slide to "float." The slide connects directly to the drive shaft and sample clamp for an unsurpassed 25 mm of frictionless displacement. The rectangular shape of the drive shaft completely eliminates off-axis motion.

Only TA Instruments employs sophisticated air bearing technology for DMA measurements. Systems without this design feature suffer from poorly controlled deformation in unsupported designs, or diminished sensitivity where spring guidance is employed.

Wide Range, High Resolution Optical Encoder

Based on diffraction patterns of light through gratings, optical encoders provide exceptional resolution over very wide ranges compared to LVDT's used in competitive devices. Due to the excellent 0.1 nanometer resolution of the optical encoder, very small amplitudes can be measured precisely. Enhanced optical encoder sensitivity, combined with refined motor controls, results in **displacements up to 100× smaller than previous drive technology, including control of displacements as small as 5 nm**.

The non-contact motor, frictionless air bearing support, and wide range optical encoder provide unparalleled flexibility for small and large samples, materials that creep, expand, or contract during an experiment, and application of static or transient deformations.

An accurate mechanical measurement is built on a foundation that completely transfers all motor deformation to the sample, while also eliminating any influence from external factors such as system resonance, thermal drift or frame deformation.

Optimized Mechanics

The critical drive components of the DMA 850 are mounted within a high-stiffness aluminum casting that is rigidly mounted to an FEA-optimized instrument frame. Competitive systems based on moveable, hanging, or soft-mounted frames are constrained in their effective frequency-range by the combination of sample stiffness and system resonance. The rigid design of the DMA 850 overcomes this limitation, providing accurate modulus and tan δ values across the broadest range of measurement frequencies and sample stiffness.

Temperature-Controlled Transducer

The transducer is temperature-controlled to eliminate drift associated with temperature changes from the sample or laboratory environment. The result is the most stable platform for mechanical characterization of materials even under extreme conditions. The DMA 850 is the only commercial DMA instrument to feature a temperature-controlled force and displacement transducer, providing unparalleled measurement stability and accuracy.

Faster Calibration

New system mechanics mean that routine calibrations are faster and easier than ever. Quick, robust calibration routines guide the user for better measurement accuracy in **80% less time** than previous DMA technology. Spend less time maintaining your instrument, and more time getting valuable material insights.

OPTIMIZED CASTING and
FRAME MECHANICS provide
UNPARALLELED MEASUREMENT ACCURACY

FEA – Optimized Instrument Foundation

DMA-RH Accessory

This precision environmental system provides accurate control of sample temperature and relative humidity for DMA experiments. A custom-designed humidity and temperature chamber optimized for mechanical measurements provides stable, reliable control of temperature and humidity over a wide range of operating conditions. The system successfully prevents condensation, a common occurrence in controlled-humidity environments which makes accurate control of relative humidity impossible. Stable, responsive peltier elements precisely control sample temperature while calibrated digital mass flow controllers deliver pre-heated gas of the prescribed ratio to achieve the target humidity.

The DMA-RH accessory offers the widest range of temperature and relative humidity.

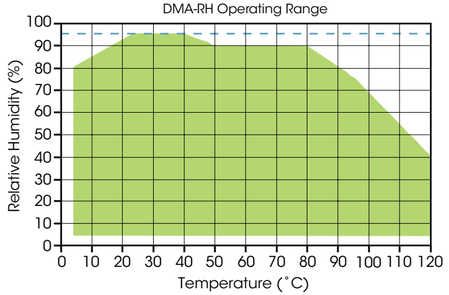
Temperature Range	5 to 120°C
Temperature Accuracy	±0.5°C
Heating/Cooling Rate	Maximum ±1°C/min
Humidity Range	5 to 95% See operating range chart.
Humidity Accuracy	5-90% RH: ±3% RH >90% RH: ±5% RH
Humidity Ramp Rate (both increasing and decreasing)	2% RH/min (fixed)

The DMA-RH Accessory is a fully integrated unit and includes the following hardware components:

1. The sample chamber mounts directly to the DMA. Peltier elements in the chamber precisely control the temperature to ±0.1°C. The sample chamber accommodates standard DMA clamps (tension, cantilever, and 3-point bending).

2. A heated vapor-transfer line is maintained at a temperature above the dew point temperature of the humidified gas in order to avoid condensation and provide accurate results.

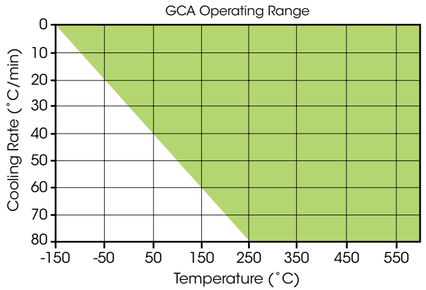
3. The DMA-RH Accessory contains the humidifier and electronics which continuously monitor and control temperature and humidity of the sample chamber.



Gas Cooling Accessory (GCA)

The GCA extends the operating range of the DMA 850 to -150°C. It uses cold nitrogen gas generated from controlled evaporation of liquid nitrogen. Automated filling of the tank can be programmed to occur after the scan is complete.

The GCA will provide ballistic or controlled cooling rates over the entire operating range of the DMA 850 (-150 to 600°C). In general, the maximum cooling rate is a function of the installed clamp and the thermal characteristics of the sample. The figure below shows the typical range* of controlled cooling rates available as a function of temperature.



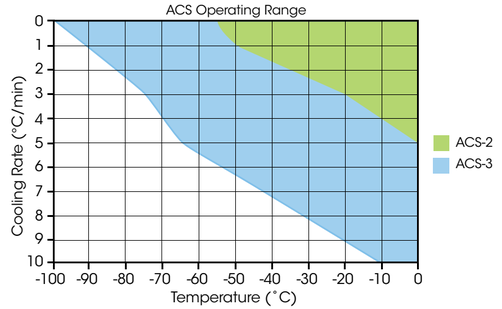
*Actual performance may vary slightly depending on laboratory conditions and the clamping system installed.

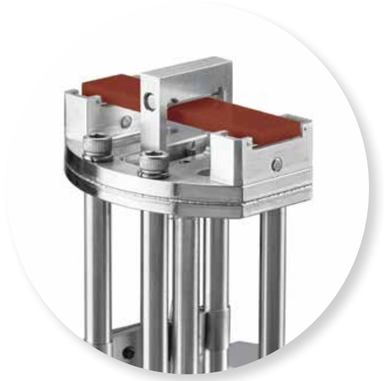
Nitrogen Purge Cooler (NPC)

The NPC is an economical cooling option that provides crash-cooling and controlled-heating at temperatures as low as -160°C. The innovative design purges nitrogen gas (2 to 8 bar at 30 L/min) through a heat exchanger immersed in a 2.5 L dewar filled with liquid nitrogen and into the furnace. The compact design minimizes space requirements and the crash-cooling capability make it an ideal choice for increasing throughput of low temperature experiments.

Air Chiller Systems (ACS)

The new ACS models offer unique gas flow cooling systems that provide the capability for subambient testing without the use of liquid nitrogen. Available in two models, the ACS-2 and ACS-3, the chillers feature a multi-stage cascading compressor design that employs compressed air (7 bar, 200 l/min) as the cooling medium. The ACS-2 and ACS-3 models permit operation of the DMA 850 with Standard Furnace at temperatures as low as -50 °C and -100°C respectively*. The chiller systems can eliminate liquid nitrogen usage and associated hazards from any laboratory and offers an incredible return on investment.





3-Point Bend

3-point bending, or free bending, is often considered a "pure" mode of deformation because clamping effects are eliminated. Sample spans of 5 mm, 10 mm, 15 mm, 20 mm, and 50 mm are available to accommodate a wide range of sample stiffness and specimen sizes. A unique low-friction, roller bearing supported design available on the 20 mm and 50 mm clamps improves modulus accuracy and reproducibility by accommodating and accounting for twist or curvature in the test specimen.

Shear Sandwich

Two equal-size pieces of the same material are sheared between a fixed and moving plate for the measurement of shear modulus, G. This mode is ideal for soft materials such as gels, pressure sensitive adhesives, and high viscosity resins.

Compression

Parallel plate compression measurements are most suitable for low to moderate modulus materials such as foams and elastomers. It can also be used to measure expansion or contraction, tack testing for adhesives, compression set of rubber o-rings, and much more. A new self-aligning mechanism ensures the parallelism of upper and lower plates, enhancing strain and force uniformity while simplifying user interaction and improving modulus accuracy and precision.

The standard compression kit includes parallel plates of 15 mm and 40 mm diameter, ideally designed for bulk measurements of moderate to low stiffness samples. The penetration kit is designed for higher stiffness materials and local measurements through the use of smaller probes: hemispherical, 1 mm penetration, or 6 mm plate.

Powder Clamp

The transition temperatures of loose powders can be difficult to measure by mechanical techniques. The powder accessory for the DMA 850 is used with the dual cantilever clamp to observe transition temperatures of loose powdered materials by DMA, combining the enhanced sensitivity of mechanical analysis with the simple sample preparation of powder characterization techniques.

Specifications

Max Force	18 N
Min Force	0.0001 N
Force Resolution	0.00001 N
Frequency Range	0.001 to 200 Hz
Dynamic Deformation Range	± 0.005 to 10,000 µm
Strain Resolution	0.1 nm
Modulus Range	10^3 to 3×10^{12} Pa
Modulus Precision	± 1%
tan δ Sensitivity	0.0001
tan δ Resolution	0.00001
Temperature range	Standard Furnace: -160 to 600°C RH Accessory: 5 to 120°C

Environmental System	Temperature Range	Heating/Cooling Rates	Purge Gas
Standard Furnace	-160˚C to 600˚C	20˚C/min Heating 10˚C/min Cooling	Air, nitrogen, argon, helium
DMA-RH Accessory	5˚C to 120˚C	± 1˚C/min	Controlled humidity 5% to 95% RH

Features

Standard	Optional
TRIOS software including **DMA*Express*** and **DMA*Unlimited***	Standard Furnace
35 mm Single/Dual Cantilever Clamp	DMA-RH Accessory
Strain control including NEW DirectStrain	Tension Clamps
Stress control	3-Point Bend Clamps
Color App-Style Touch Screen	Compression Clamps
Unlimited test sequencing	Powder Clamp
TTS analysis	Shear Sandwich Clamp
Oscillation: Strain sweep, Frequency sweep, Temperature Ramp (Single, Multi-frequency), Temperature Step (Single, Multi-frequency/TTS), Time sweep, Fatigue	Submersion Clamps
Strain control: Stress relaxation, Stress relaxation TTS, IsoStrain	GCA
Stress control: Creep, Creep-Recovery, Creep TTS, IsoStress	NPC
Rate control: Strain ramp and Stress ramp to generate stress-strain curves	ACS-2 or ACS-3
Sample conditioning: temperature, applied force or displacement	TRIOS Guardian software for 21 CFR11 compliance