TA Instruments

ARES-G2 RHEOMETER

New Castle, DE USA

Lindon, UT USA

Elstree, United Kingdom

Shanghai, China

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Taipei, Taiwan

Tokyo, Japan

Seoul, South Korea

Bangalore, India

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Mexico City, Mexico

ARES-G2 **RHEOMETER**

The only Rheometer to independently measure stress and strain

The ARES-G2 is the most advanced rheometer for research and material development. It is the only rheometer with dual-head, or separate motor and transducer, technology for the PUREST rheological measurements. No other rheometer is capable of measuring stress independently of the applied shear deformation. It is recognized by the rheological community as the industry standard to which all other measurements are compared for accuracy. The ARES-G2 platform offers an array of new features including unrivaled data accuracy, unmatched strain and new stress control, fully integrated fast data sampling, new Smart Swap™ environmental systems with patented active temperature control, powerful new TRIOS Software, and NEW LAOS and FT Rheology Analysis.

SPECIFICATIONS

Force/Torque Rebalance Transducer (Sample Stress)

Transducer Type	Force/Torque Rebalance
Transducer Torque Motor	Brushless DC
Transducer Normal/Axial Motor	Brushless DC
Minimum Transducer Torque in Oscillation	0.05 µN.m
Minimum Transducer Torque in Steady Shear	0.1 µN.m
Maximum Transducer Torque	200 mN.m
Transducer Torque Resolution	1 nN.m
Transducer Normal/Axial Force Range	0.001 to 20 N
Transducer Bearing	Groove Compensated Air

Separate Motor (Sample Deformation)

Maximum Motor Torque	800 mN.m
Motor Design	Brushless DC
Motor Bearing	Jeweled Air, Sapphire
Displacement Control/Sensing	Optical Encoder
Strain Resolution	0.04 µrad
Min. Angular Displacement in Oscillation	1 µrad
Max. Angular Displacement in Steady Shear	Unlimited
Angular Velocity Range	1 x 10^{-6} rad/s to 300 rad/s
Angular Frequency Range	1 x 10^{-7} rad/s to 628 rad/s
Step Change in Velocity	5 ms
Step Change in Strain	10 ms

Stepper Motor

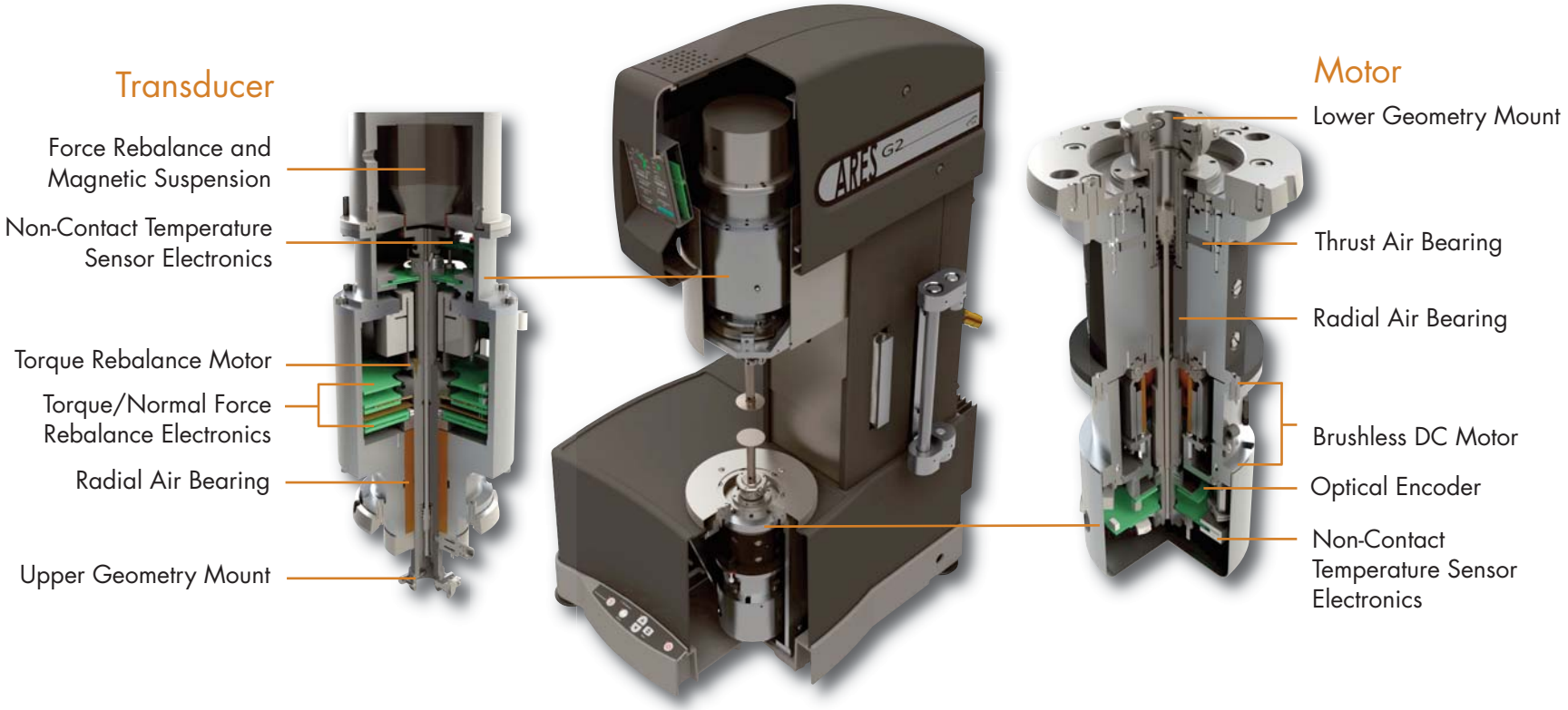
Movement/Positioning	Micro-stepping Motor/Precision lead Screw
Position Measurement	Linear Optical Encoder
Positioning Accuracy	0.1 micron

Temperature Systems

Smart Swap	Standard
Forced Convection Oven, FCO	-150 to 600°C
FCO Camera Viewer	Optional
Advanced Peltier System, APS	-10 to 150°C
Peltier Plate	-40 to 180°C
Sealed Bath	-10 to 150°C

Only ARES-G2 provides independent measurements of stress and strain rate

When it comes to making the most accurate rheological measurements, two heads are simply better than one! Consider that the rheological behavior of materials is described by material functions such as the modulus or viscosity. Modulus is the ratio of stress to strain and viscosity is the ratio of stress to strain rate. In order for a rheometer to make the purest and most accurate rheological measurements, it is best to measure the fundamental parameters of stress and strain or strain rate **independently**. The ARES-G2 provides rheological measurements free of instrument artifacts over wide ranges of stress, strain, and frequency.



ARES-G2 Dual-Head Rheometer Design Advantage

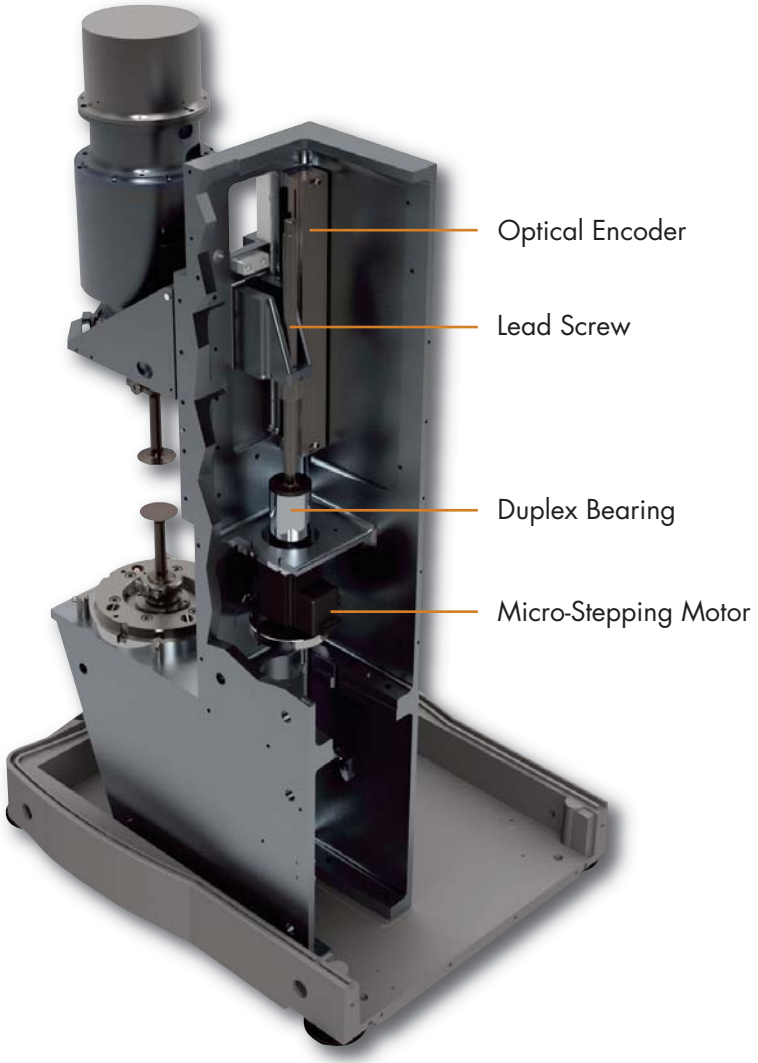
At the heart of the ARES-G2 rheometer is a new advanced motor and transducer. The ARES-G2 FRT Transducer directly measures torque and normal force from the current required to drive rotational and linear motors to maintain zero position. New features of the FRT include a dynamic torque range of 5,000,000 to 1, a more robust air bearing, a patented higher resolution capacitive angle sensor (patent #'s 7,075,317 and 7,135,874), and new patented non-contact temperature sensing technology (patent # 6,931,915. The independent torque measurement eliminates the need to correct for motor friction and inertia, which translates to the purest torque measurement available.

The ARES-G2 direct drive motor is designed to deliver the most accurate rotational motion over wide ranges of angular displacements and speeds. Key components of the design include air bearings, an 800 mN.m high-torque friction-free DC motor, patented non-contact temperature sensing, and an optical encoder. The thrust and radial bearings provide friction free rigid support with excellent concentricity and no axial run-out for superior shear and normal force measurements.

Frame, Vertical Movement, and Alignment

The ARES-G2 frame and vertical movement assembly is built to deliver maximum stiffness, low axial compliance (0.1 µm/N), and the most accurate geometry positioning and alignment.

- The steel frame provides high strength, optimum damping for high frequency testing, and dimensional stability over a wide temperature range.
- The transducer mount is held rigidly against the frame by two hardened steel cross roller slides.
- The slides deliver smooth vertical movement of the head while maintaining concentricity and parallelism. This is critical when setting a gap in parallel plates.
- The transducer head is positioned vertically via a precision ground lead screw. It is attached to a micro-stepping motor by a rigid, preloaded, duplex bearing, which eliminates backlash.
- A linear optical encoder is mounted directly between the stationary frame and moving bracket for precision head positioning, independent of the lead screw movement, to an accuracy of 0.1 micron.



High-Speed Electronics and Data Processing

The ARES-G2 is equipped with new high-speed electronics with digital signal processing for transducer measurements and motor control. While many manufacturers cut costs by combining the test station and electronics into a single box, the separate electronics approach of TA Instruments ARES-G2 isolates the precision measurements from heat and vibration. This approach ensures the best sensitivity and data quality from the test station. The electronics enable fully integrated high speed data acquisition for transient (up to 8,000Hz) and oscillation (up to 15,000Hz) measurements. The high sampling speed provides superior resolution of magnitude and phase of the measured signals. This allows much better higher harmonic resolution for automatic analysis during oscillation tests or post Fourier transformation analysis. Higher odd harmonics that occur in the stress (force) signal in oscillation tests are a result of non-linear response. The ratio of the fundamental frequency to odd harmonics, such as 3rd, 5th, etc. can be calculated and stored as a signal. In addition, the real-time waveforms during oscillation tests can be displayed and saved with data points. The intensity ratio and quality and shape of the waveform are invaluable data integrity and validation tools.

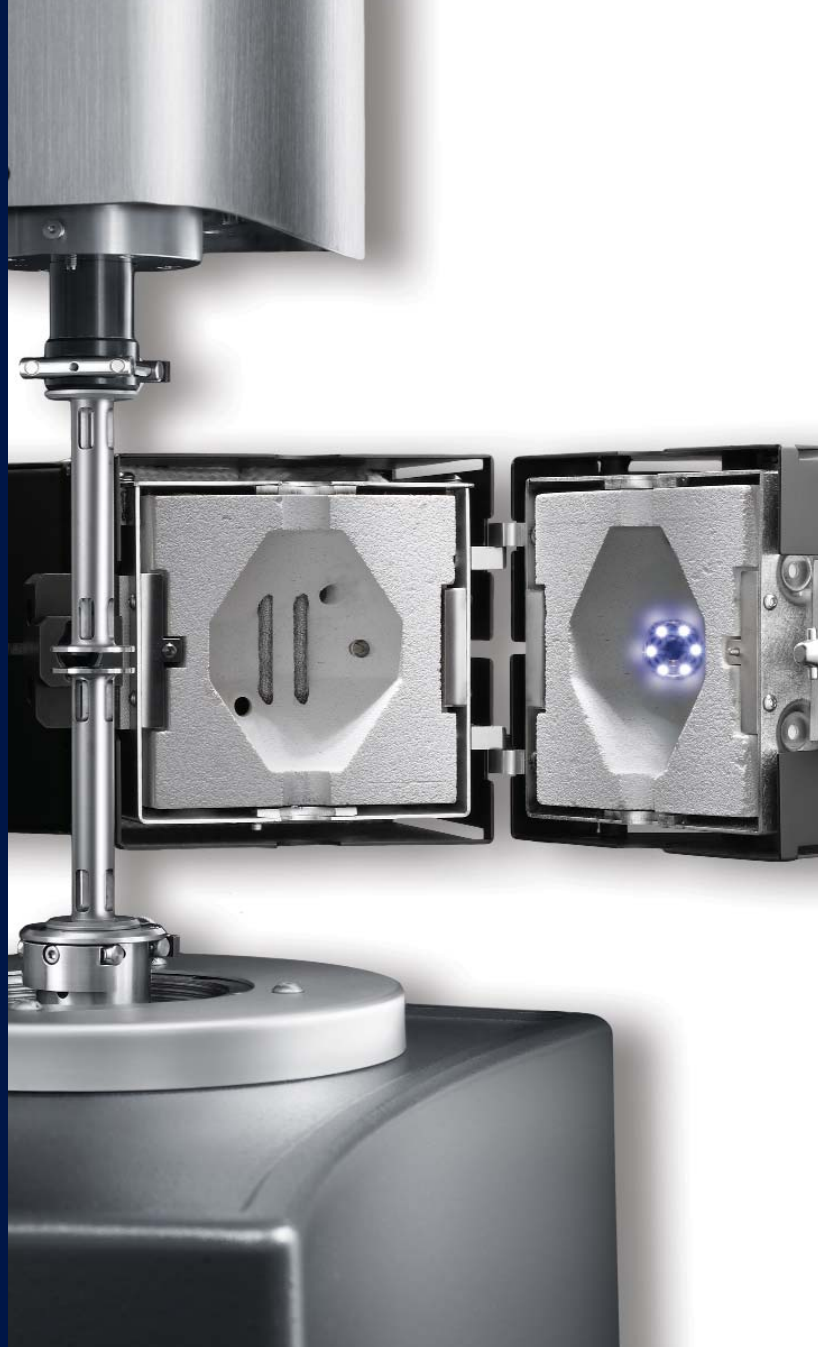
Touch-Screen and Keypad

This graphical interface adds a new dimension in ease-of-use. Interactive activities, such as geometry zeroing, sample loading, and setting temperature, can be performed at the test station. Important instrument status and test information such as temperature, gap, force and motor position are displayed. The touch-screen also provides easy access to instrument settings and diagnostic reporting. A keypad, at the base of the instrument, allows for easy positioning of the measurement head.

ARES-G2 **TEMPERATURE SYSTEMS**

Forced Convection Oven (FCO)

The FCO is an Air/N2 gas convection oven, designed for optimum temperature stability, extremely rapid heating and cooling, and ease-of-use over the temperature range of -150 to 600°C. The maximum controlled heating rate is 60°C/min. Obtaining the -150°C minimum temperature requires an optional liquid nitrogen-cooling device. The FCO, used primarily for polymer melts, thermosetting polymers, and solid polymers, provides superior temperature stability through the use of twin element heaters, which produce counter rotating airflow into the oven chamber. The FCO can be mounted on either side of the test station, and comes standard with long life internal LED lamp and window viewing port. The FCO can be fitted with an optional cameral viewer option for capturing real-time images during experiments. A range of geometries are available for the FCO, including parallel plate, cone and plate, torsion rectangular, extensional viscosity fixture (EVF), and the SER2-A Universal Testing Platform.



New Advanced Peltier Plate, APS

The APS is a Smart Swap™ Peltier temperature controlled environmental system with a temperature range of -10 to 150°C, with a maximum heating rate of 20°C/min and a temperature accuracy of +/- 0.1°C. Unlike other Peltier temperature systems, the APS features parallel plate (cone and plate) as well as DIN conforming concentric cylinder geometries to meet the most demanding applications. The new quick-change lower plate comes standard with a 60 mm diameter hardened chromium surface and a unique bayonet fixture that allows the user to quickly and easily adapt the plate surfaces such as crosshatched or sandblasted. The APS also features an efficient heated solvent trap cover for blocking evaporation during testing of volatile materials.

ARES-G2 **ACCESSORIES**

Dielectric Thermal Analysis Accessory, DETA

The ARES-G2 DETA is an accessory which expands the testing capability of the ARES-G2 rheometer to measure the electric response of materials through probing the capacitive and conductive properties. The DETA accessory is easily installed or removed from the ARES-G2 rheometer. The ARES-G2 platform provides flexible and easy experimental setup and superior DETA data accuracy through standard features, such as the Forced Convection Oven for temperature control to 350°C, axial force control to 20 N with gap temperature compensation capability, and TRIOS software. The DETA can be operated with the ARES-G2 in stand-alone mode or in simultaneous dielectric and mechanical measurement mode. The system is compatible with two popular Agilent LCR meters: E4980A (20 to 2 MHz, 0.005 to 20 V) and 4285A (75 Khz to 30 MHz, 0.005 to 10 V).

Electrorheology Accessory, ER

ER fluids are suspensions of extremely fine non-conducting particles in an electrically insulating fluid, which show dramatic and reversible rheological changes when the electric field is applied. The ARES-G2 ER accessory provides the ability to apply up to 4,000 volts during the course of an experiment using either parallel plate or concentric cylinder geometry. The voltage is applied to the sample via a Trek Amplifier through a high voltage cable. An insulator block between the transducer hub and the upper geometry isolates it from the circuit. Tests can be run with Peltier temperature control providing a range of -40°C to 180°C.

UV Curing Accessory

UV curing adhesives and radiation curable adhesives use ultraviolet light or other radiation sources to initiate curing, which allows a permanent bond without heating. The ARES-G2 UV Curing option uses a light guide and reflecting mirror assembly to transfer UV radiation from a high-pressure mercury light source. The accessory includes upper and lower geometry with removable 20 mm diameter plates, waveguide and collimator, 5 mm waveguide, and remote radiometer/dosimeter. The system interfaces with a UV light source (Exfo Omnicure S2000) with wavelengths in the range of 320 to 500 nm. Optional temperature control to a maximum of 150°C is available using the Advanced Peltier System, APS. Disposable plates are available.

Extensional Viscosity Fixture, EVF

The EVF is a patented fixture for measuring the extensional viscosity of high viscosity materials, such as polymer melts, dough, adhesives, etc. The fixture consists of a fixed and rotating drum, which winds up the sample at constant strain rate, while measuring the force generated in the sample. Since the torque measurement is decoupled from the motor, no beating friction correction is required. The maximum Henky strain with one rotation is four. Temperature control of the EVF requires the ARES-G2 Forced Convection Oven. The maximum use temperature is 350°C.

SER2 Universal Testing Platform

The SER2 is used to perform extensional rheology measurements and a range of physical material testing. Samples are secured to the surfaces of the two windup drums, such that for a constant drum rotation speed, a constant Hencky strain rate is achieved. As the sample is stretched across the drum surfaces, it offers a resistant force on the windup drums that translates into a torque about the primary axis of rotation. For a given extensional rate, the measured torque signal is directly related to the extensional viscosity of the sample.

In addition to extensional measurements on polymer melts, the SER2 is capable of performing a range of physical property measurements such as tensile, peel, tear and friction measurements on small hard and soft solid samples.

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