



TA INSTRUMENTS

Rheometers



**Rheometers**

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## TA INSTRUMENTS, WORLDWIDE

**M**ore worldwide customers choose TA Instruments than any competitor as their preferred rheometer supplier. We earn this distinction by best meeting customer needs and expectations for high technology products, quality manufacturing, timely deliveries, excellent training, and superior after-sales support.



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QUALITY PRODUCTS

All rheometers are manufactured according to ISO 2000 procedures in our New Castle, DE (USA) or our Crawley, UK facilities. Innovative flow manufacturing procedures and a motivated, highly-skilled work force ensure high quality products with industry-leading delivery times.



# AR

SENSITIVE › VERSATILE › RELIABLE





# AR RHEOMETERS

The AR Series rheometers offer unmatched performance and ease-of-use due to unique and superior design. These technologies are optimized and integrated into rheometer systems that deliver the best fundamental rheology measurements. Continuous innovations drive each generation of the AR Series for better performance and improved testing efficiency. Unprecedented low torque performance, unparalleled stress and direct strain control, intuitive software, and a versatile design make the AR Series the obvious choice for the widest range of applications.

## TA INNOVATIONS

- First commercial controlled stress rheometer
- First commercial rheometer with a magnetic bearing
- UHP/EHP Active Temperature Control
- Optical encoder technology
- Drag cup motor technology
- First high torque drag cup motor
- Patented drag cup temperature sensor
- Smart Swap™ technology
- Smart Swap™ geometries
- Real-time waveform display and storage
- ETC camera viewer
- Streaming video with sample image capture software
- First rheometer with Peltier technology
- Isolated normal-force transducer
- Navigator software



CR - Controlled Rate Mode  
CS - Controlled Stress Mode

[1] Internal Resolution for D to A converter at torque of  $0.1 \mu\text{N}\cdot\text{m}$

[2] Direct Strain Control provides single cycle oscillation and continuous oscillations during experiments.

[3] Lower temperature limits require use of a suitable fluid in an external circulator.

# AR-G2

TA Instruments is proud to announce another breakthrough in rheometer technology. The new AR-G2 is the first commercial rheometer with patented<sup>(1)</sup> magnetic thrust bearing technology for ultra-low, nano-torque control. The AR-G2 is packed with new features including new patented<sup>(2)</sup> advanced drag cup motor technology, Smart Swap™<sup>(3)</sup> Geometries, streaming video and image capture software, ETC camera viewer and ethernet communications. With improvements in nearly every rheometer specification, the performance of the AR-G2 stands alone. It is the most advanced controlled stress, direct strain and controlled rate rheometer available.

(1) Patent # 7,017,393 (2) Patent # 6,798,099 (3) Patent # 6,952,950



A  
R

Minimum Torque Oscillation CR	0.003 $\mu$ N.m
Minimum Torque Oscillation CS	0.003 $\mu$ N.m
Minimum Torque Steady CR	0.01 $\mu$ N.m
Minimum Torque Steady CS	0.01 $\mu$ N.m
Maximum Torque	200 mN.m
Torque Resolution	0.1 $\mu$ N.m <sup>[1]</sup>
Motor Inertia	18 $\mu$ N.m.s
Angular Velocity Range CS	0 to 300 rad/s
Angular Velocity Range CR	1.4E-9 to 300 rad/s
Frequency Range	7.5E-7 to 628 rad/s
Displacement Resolution	25 nrad
Step Change in Velocity	7 ms
Step Change in Strain	30 ms
Direct Strain Control	Standard <sup>[2]</sup>
Thrust Bearing	Magnetic
Normal/Axial Force Range	0.005 to 50 N
Smart Swap™	Standard
Smart Swap Geometry	Standard
Peltier Plate	-40 to 200 °C <sup>[3]</sup>
Environmental Test Chamber (ETC)	-160 to 600 °C
ETC Camera Viewer	Optional
Concentric Cylinder	-20 to 150 °C <sup>[3]</sup> Peltier Control
Upper Heated Plate	-30 to 150 °C <sup>[3]</sup>
Electrically Heated Plate (EHP)	-80 to 400 °C
Camera Option with Streaming Video and Image Capture	Optional

# AR 2000ex

The AR 2000ex brings an all new electronics package to the time-tested hardware of the world's best selling rheometer, further extending the long list of unique features. The AR 2000ex rheometer design includes a unique, ultra-low inertia drag cup motor and porous carbon air bearings for outstanding controlled stress, direct strain and controlled rate performance. The AR 2000ex features the original Smart Swap™ quick interchanging and self-configuring environmental systems. Enhanced features of the AR 2000ex include the new ETC with fast heating rates, ETC and Peltier Camera Viewers (with image capture software), a new Electrically Heated Plate Temperature System, and ethernet communications. The AR 2000ex is extremely versatile and appropriate for a wide variety of applications including fluids of any viscosity, polymer melts, solids and reactive materials.



Minimum Torque Oscillation CR	0.03 $\mu\text{N}\cdot\text{m}$
Minimum Torque Oscillation CS	0.1 $\mu\text{N}\cdot\text{m}$
Minimum Torque Steady CR	0.05 $\mu\text{N}\cdot\text{m}$
Minimum Torque Steady CS	0.1 $\mu\text{N}\cdot\text{m}$
Maximum Torque	200 $\text{mN}\cdot\text{m}$
Torque Resolution	1 $\text{nN}\cdot\text{m}$ <sup>(1)</sup>
Motor Inertia	15 $\mu\text{N}\cdot\text{m}\cdot\text{s}$
Angular Velocity Range CS	0 to 300 $\text{rad/s}$
Angular Velocity Range CR	1E-8 to 300 $\text{rad/s}$
Frequency Range	7.5E-7 to 628 $\text{rad/s}$
Displacement Resolution	40 $\text{nrad}$
Step Change in Velocity	25 $\text{ms}$
Step Change in Strain	60 $\text{ms}$
Direct Strain Control	Standard <sup>(3)</sup>
Thrust Bearing	Porous Carbon Air
Normal/Axial Force Range	0.005 to 50 $\text{N}$
Smart Swap™	Standard
Peltier Plate	-40 to 200 $^{\circ}\text{C}$ <sup>(4)</sup>
Environmental Test Chamber (ETC)	-160 to 600 $^{\circ}\text{C}$
Concentric Cylinder	-20 to 150 $^{\circ}\text{C}$ <sup>(4)</sup>
	Peltier Control
Upper Heated Plate	-30 to 150 $^{\circ}\text{C}$ <sup>(4)</sup>
Electrically Heated Plate (EHP)	-80 to 400 $^{\circ}\text{C}$

# AR 550

The AR 550 is an extremely rugged general-purpose rheometer for soft solids and fluids. The AR 550 offers many of the same time-tested design features incorporated in our AR 2000ex and AR-G2, such as optical encoder, durable air bearing, and drag cup motor. The AR 550 is the base model around which our Quality Control Rheometer, QCR II, and asphalt rheometer, CSA II are built. Both are configured with our unique Navigator automated software. In any configuration, the AR 550 offers a robust cost-effective solution for both the research lab or the manufacturing floor.



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R

Minimum Torque Oscillation CR	1 $\mu\text{N}\cdot\text{m}$
Minimum Torque Oscillation CS	1 $\mu\text{N}\cdot\text{m}$
Minimum Torque Steady CR	1 $\mu\text{N}\cdot\text{m}$
Minimum Torque Steady CS	1 $\mu\text{N}\cdot\text{m}$
Maximum Torque	50 $\text{mN}\cdot\text{m}$
Torque Resolution	2 $\text{nN}\cdot\text{m}$ <sup>[2]</sup>
Motor Inertia	26 $\mu\text{N}\cdot\text{m}\cdot\text{s}$
Angular Velocity Range CS	0 to 100 $\text{rad/s}$
Angular Velocity Range CR	1E-3 to 100 $\text{rad/s}$
Frequency Range	6.3E-4 to 250 $\text{rad/s}$
Displacement Resolution	0.62 $\mu\text{rad}$
Step Change in Velocity	1 $\text{s}$
Thrust Bearing	Jet Air
Normal/Axial Force Range	0.01 to 50 $\text{N}$
Peltier Plate	-10 to 150 $^{\circ}\text{C}$
Concentric Cylinder	-20 to 150 $^{\circ}\text{C}$ Circulator Control

CR - Controlled Rate Mode

CS - Controlled Stress Mode

[1] Internal Resolution for D to A converter at torque of 0.1  $\mu\text{N}\cdot\text{m}$

[2] Internal Resolution for D to A converter at torque of 1  $\mu\text{N}\cdot\text{m}$

[3] Direct Strain Control provides single cycle oscillation and continuous oscillations during experiments.

[4] Lower temperature limits require use of a suitable fluid in an external circulator.

# AR TECHNOLOGY

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## 1 DRAG CUP MOTOR

The motor applies torque, and controls speed and oscillation frequency. Drag cup motors, unlike some motor designs, can apply extremely smooth acceleration and are ideal for creep and recovery measurements. Inertia is kept to an absolute minimum, reducing the influence of the system on test results in oscillation and transient measurements. The result is more accurate measurements of weak material structures and faster response to step changes in torque and strain.

## 2 THRUST BEARING

Thrust bearings provide stiff, "frictionless" axial support of the drive shaft and measuring geometry. The low-end torque performance of the instrument depends on residual bearing friction, which results in residual torques. TA Instruments' rheometer designs incorporate a variety of thrust bearings including new magnetic, jet air and porous carbon air bearings.

## 3 RADIAL AIR BEARINGS

Radial air bearings provide stiffness and support in the radial direction. The AR-G2 and AR 2000ex are uniquely designed with two porous carbon radial bearings. The dual radial bearing design is ideal for the testing of high stiffness samples, such as solids in torsion as well as soft solids and low viscosity fluids. The AR 550, designed for fluids and soft solids, incorporates a single radial jet air bearing.

## 4 OPTICAL ENCODER

Low inertia optical encoders are used in all AR rheometers for high-resolution measurement of angular displacement (strain) and speed (shear rate) over wide ranges. The ability to measure very small displacements allows for the characterization of very delicate material structures. The ability to measure and control a wide range of speed adds to the instrument's versatility.

## 5 NORMAL FORCE TRANSDUCER

A unique AR rheometer feature is the design and placement of the normal force sensor. The highly sensitive, ultra-stiff, normal force sensor is isolated from the motor and bearing assembly, and located below the lower geometry. The benefit of isolating the normal force transducer is twofold. First, both the normal force sensor and the motor/bearing assembly are designed for maximum stiffness. When shearing a viscoelastic material, the normal force generated by the sample pushes against the measuring surfaces. Minimizing movement is key to accurate normal force measurements. Second, the normal force sensor is environmentally isolated for thermal stability.

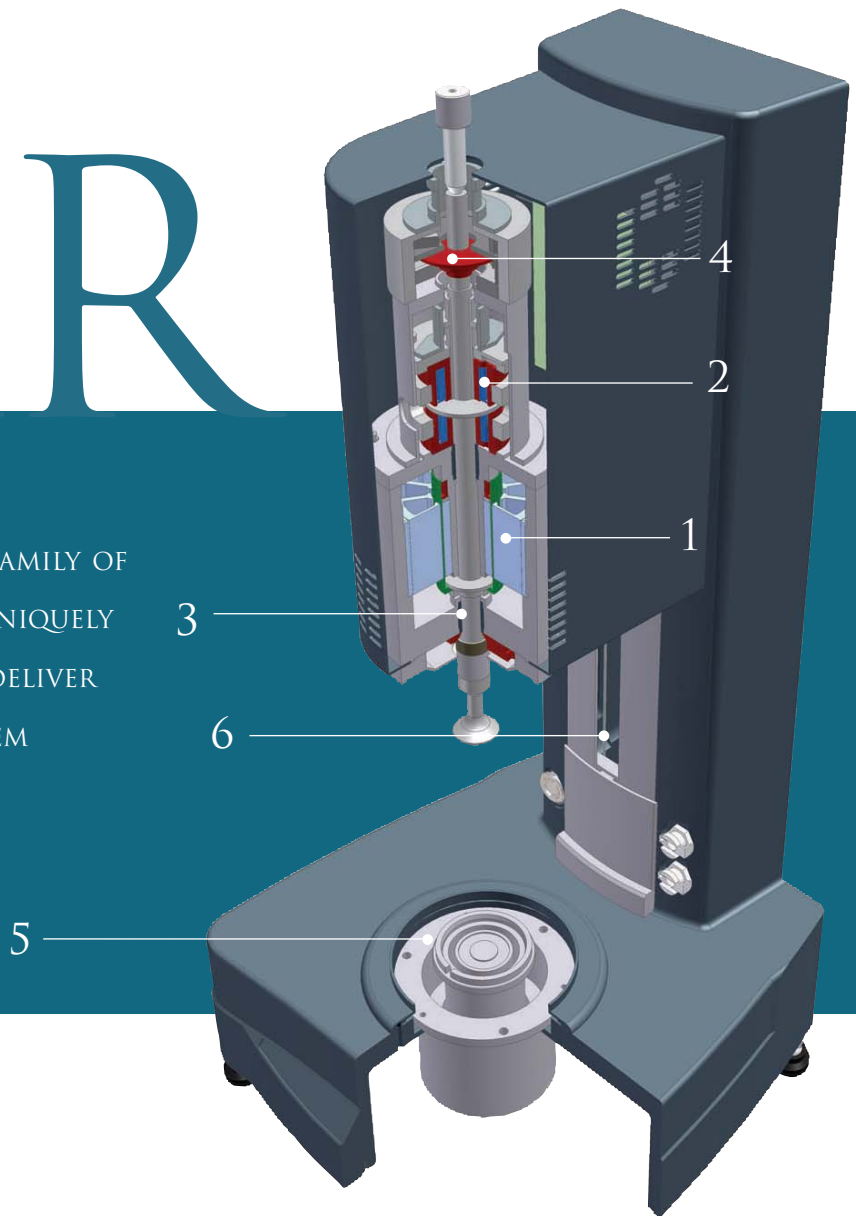
## 6 RIGID ONE-PIECE ALUMINUM CASTING & LINEAR BALL SLIDE

All TA rheometers are designed to minimize system deflection in order to maximize the deformation applied to the sample. AR rheometers are built on a rigid, single-piece aluminum casting and the rheometer head assembly is attached to the casting via a rigid linear ball slide. A motor and an optical encoder are located in the base of the frame to drive the ball slide vertically and measure its movement. This ensures precision positioning of the geometry with an accuracy of 1 micron. TA Instruments' rheometers are built to last and deliver a lifetime of reliable performance.

# AR

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R

THE AR SERIES  
REPRESENTS A FAMILY OF  
RHEOMETERS UNIQUELY  
DESIGNED TO DELIVER  
OPTIMUM SYSTEM  
PERFORMANCE.



# AR TECHNOLOGY - AR-G2

Breakthrough technologies make our new AR-G2 the world's most advanced controlled stress, direct strain and controlled rate rheometer. With a revolutionary, patented, magnetic levitation thrust bearing and new patented drag cup motor technology, unprecedented nano-torque control is now possible adding a new dimension to rheological characterization. New patented Smart Swap™ Geometries and Real-Time Streaming Video and Image Capture features take ease-of-use to a new level. The AR-G2 represents a whole new approach to rheometer technology.





## 1 MAGNETIC THRUST BEARING

Why a magnetic bearing? Larger gaps in the absence of a continuous flow of pressurized air, translates to unprecedented low levels of friction in the bearing. More importantly, the ability to control and measure torques in the nanoN.m range. No other rheometer can boast such low-end torque sensitivity. The larger gap in the thrust bearing is robust and not susceptible to contamination. The additional benefits of the magnetic bearing over traditional air bearing designs are the following:

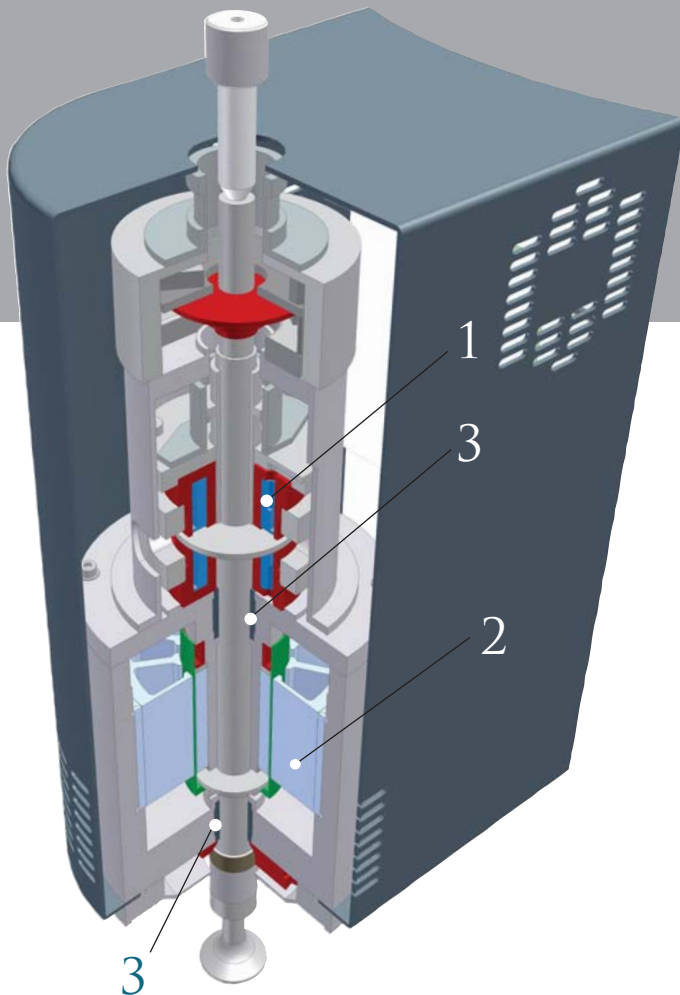
- Ultra low torques applied to the sample
- Smaller sample volumes can be used
- Ability to probe delicate material structures
- Study of low viscosity materials over a broad range of conditions

## 2 PATENTED DRAG CUP MOTOR

Our new patented advanced drag cup motor is designed to further reduce system friction by increasing the motor gap by 100%. Dramatic improvements in low end torque performance are realized without compromising high-end performance. The motor delivers enhanced transient response and an extended angular velocity control range. The motor incorporates a patented drag cup temperature sensor. For the first time in any rheometer design, the temperature of the drag cup is measured, ensuring the most accurate torque output.

## 3 RADIAL AIR BEARING

The AR-G2 incorporates two porous carbon radial air bearings located near the top and bottom of the drive shaft. Contributions to friction from the radial bearings is minimal. The combination of magnetic thrust and radial air bearings makes the AR-G2 a commercially viable and robust solution for new levels of low torque performance, without sacrificing the high-torque performance.



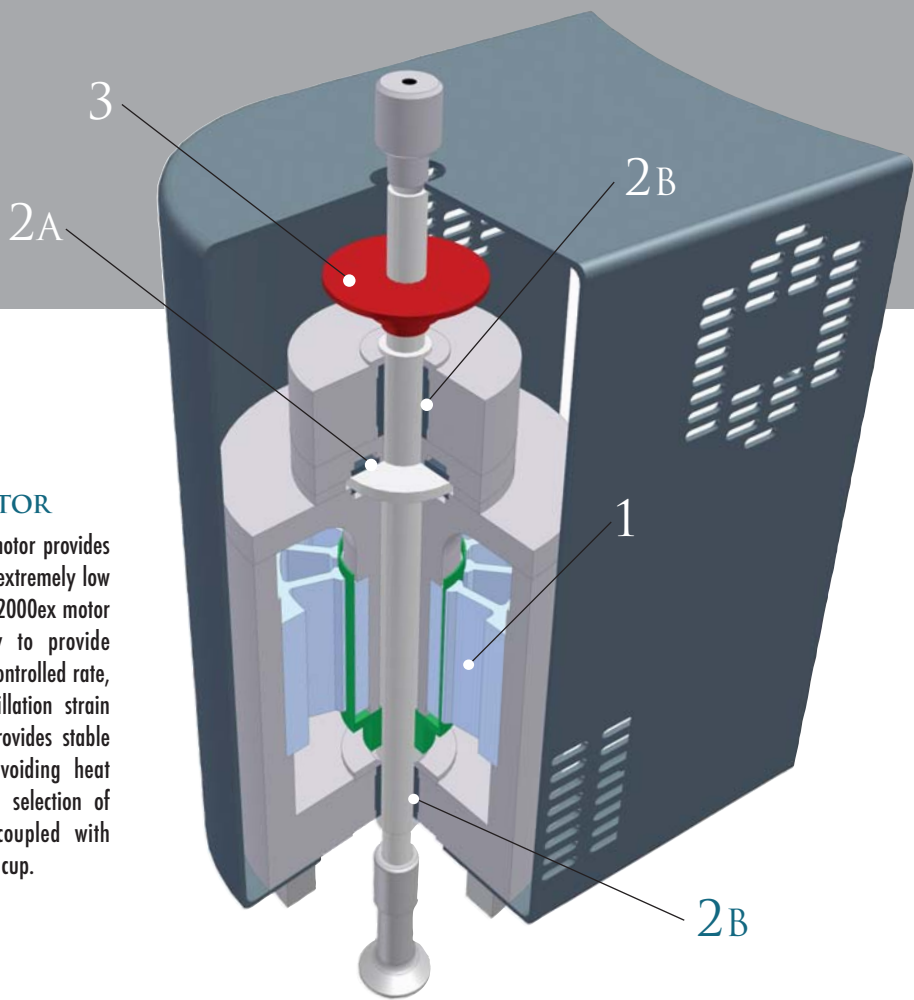
# AR TECHNOLOGY - AR 2000ex

The AR 2000ex is the world's most popular rheometer. With a broad torque range, superior strain resolution, wide frequency range, and ingenious convenience features, it is extremely versatile and appropriate for a wide variety of applications including low viscosity fluids, polymer melts, solids and reactive materials.



# 1 AR 2000ex DRAG CUP MOTOR

The AR 2000ex drag cup motor provides six decades of torque with extremely low moment of inertia. The AR 2000ex motor was designed specifically to provide superior controlled stress, controlled rate, step-strain, and direct oscillation strain control. The AR 2000ex provides stable high torque output by avoiding heat issues through the careful selection of motor drive frequency, coupled with internal cooling of the drag cup.



# 2 POROUS CARBON AIR BEARINGS

The AR 2000ex has a unique triple air bearing design. A single thrust bearing [2A] and two radial porous carbon air bearings [2B] provide maximum axial and radial stiffness. This configuration ensures confidence in measurements of high modulus materials, while providing low and uniform levels of residual torque.

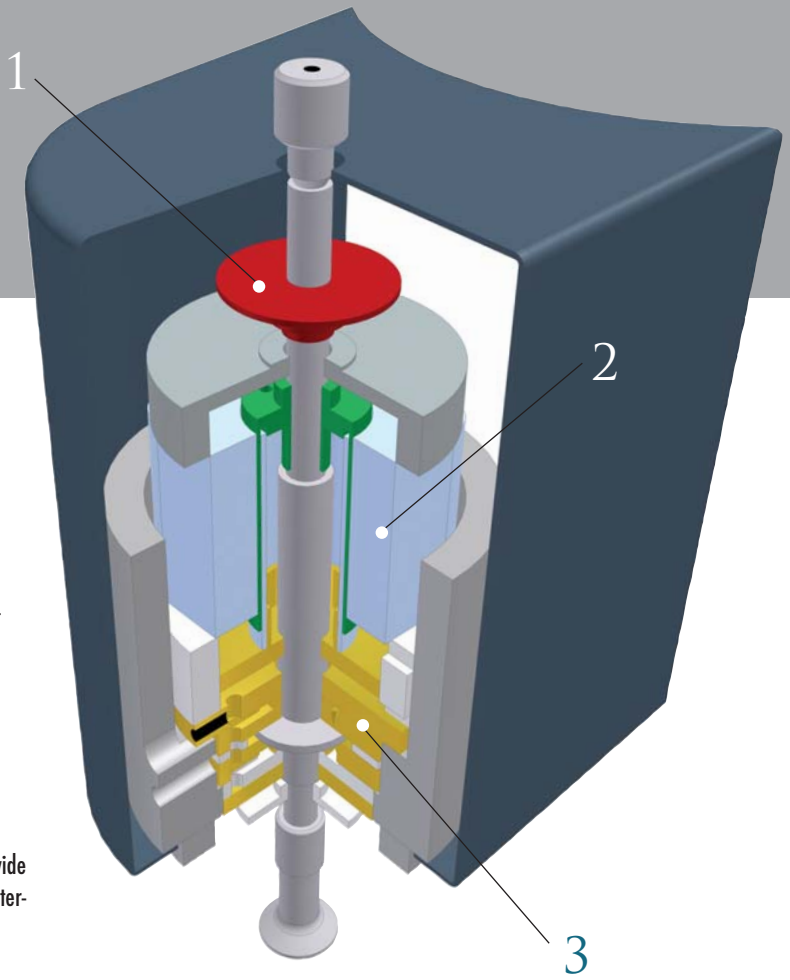
# 3 OPTICAL ENCODER

The AR 2000ex measures angular deflection and speed, using a low inertia, high-resolution optical encoder. The ability of the AR 2000ex to measure small angular displacements, and low and high angular velocities adds to its versatility.

# AR TECHNOLOGY - AR 550

The AR 550 is a robust, cost-effective, general-purpose rheometer. It features a unique motor design, durable thrust and radial jet air bearings, and high-resolution optical encoder. With a generous torque range, it is ideal for characterizing the rheological behavior of complex fluids and soft solids. The AR 550 can be configured with Peltier plate or concentric cylinder temperature systems. Normal force control and measurement capability is optional at the time of purchase or can be added as a future upgrade.





## 1 OPTICAL ENCODER

The AR 550 measures angular deflection using a low inertia, high-resolution optical encoder. The AR 550 offers excellent versatility in measuring both small displacements, down to 0.62  $\mu\text{rad}$ , and high angular speeds to 100 rad/s.

## 2 DRAG CUP MOTOR

The AR 550 Drag Cup Motor provides a wide range of torque for routine rheological characterization of soft solids and complex fluids.

## 3 JET AIR BEARINGS

The AR 550 incorporates robust jet air bearings for axial and radial stiffness. Rotational mapping automatically adjusts for any residual system torques.

### MULTIPLE PLATFORMS

The AR 550 is the base model for both our Quality Control Rheometer, the QCR II, and for our dedicated Asphalt Rheometer, the CSA II.

### › QCR II

The QCR II is an ideal solution for transferring rheological tests from research to manufacturing facilities or quality control labs. The QCR II includes Navigator software for automating sample testing and analysis.

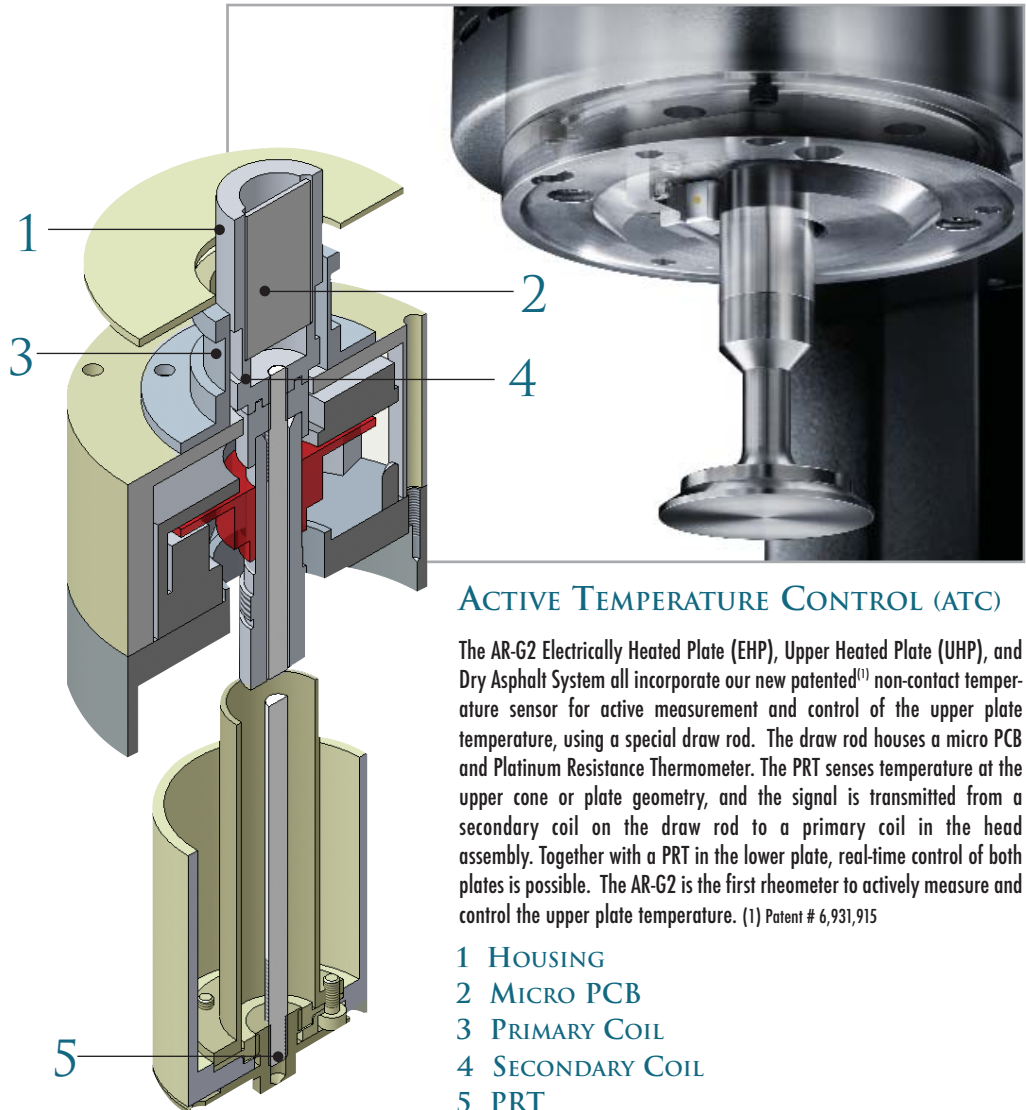
### › CSA II ASPHALT RHEOMETER

The CSA is a dedicated Dynamic Shear Rheometer configured to satisfy FHWA requirements. A complete system includes a rheometer with a water immersion measurement cell and computer-controlled circulator, 8 and 25 mm plates, sample molds, and Navigator software.

# NEW AR-G2 TECHNOLOGY

## SMART SWAP™ GEOMETRIES

The AR-G2 features our new patented Smart Swap Geometries with automatic detection. Smart Swap geometries include an integrated magnetic cylinder that stores unique geometry information. When attached, the information is automatically read and the software is configured with appropriate parameters (type, dimension, material). The Smart Swap option brings the AR-G2 one step closer to being a truly “Intelligent” rheometer system.



## MAGNETIC THRUST BEARING

The AR-G2 is the first commercial rheometer built with a patented magnetic thrust bearing. More traditional rheometer designs incorporate air bearings for low friction support of the drive shaft. Although air bearings are sometimes referred to as “frictionless”, there is still friction present, mostly due to the high pressure air and small clearances. The AR-G2 magnetic thrust bearing provides a gap measured in millimeters as opposed to microns, as in traditional air bearing designs. This translates to unprecedented low levels of friction in the bearing and more importantly, the ability to control and measure torques in the nN.m range. No other rheometer can boast such low-end torque sensitivity in both controlled stress and controlled strain modes. The larger gap in the thrust bearing is robust and not susceptible to contamination.



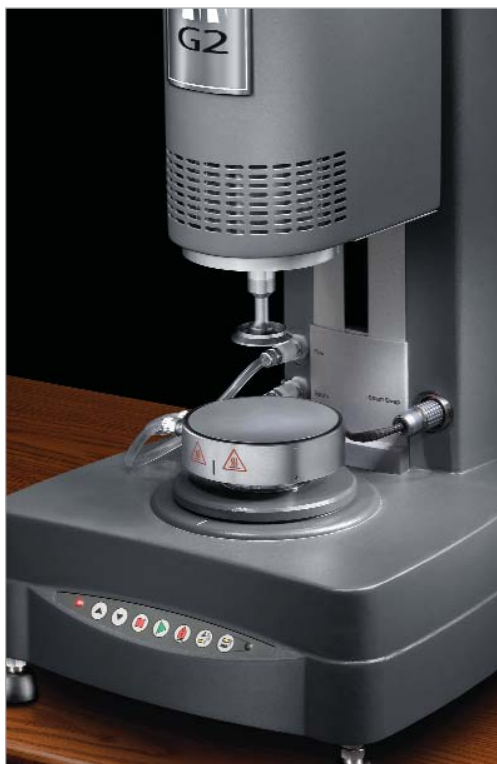
# SMART SWAP™ ACCESSORIES

## SMART SWAP™ TEMPERATURE SYSTEMS

Only TA Instruments offers the convenience and versatility of Smart Swap temperature control options. Smart Swap temperature control options are attached to the instrument on its unique magnetic base. Intelligent Smart Swap options can be interchanged in as fast as 10 seconds. Once attached, the instrument automatically detects and configures the system.

### PELTIER PLATE

The most common temperature control option for the AR rheometers is the Peltier plate. The AR-G2 and AR 2000ex Peltier plates have a temperature range of -40 to 200 °C with a typical heating rate of up to 20 °C/min and a temperature accuracy of +/- 0.1 °C. A PRT (platinum resistance thermometer) sensor positioned at the center of the plate ensures accurate temperature measurement and control.



### CONCENTRIC CYLINDER

Concentric Cylinders are commonly used for very low viscosity fluids, dispersions of limited stability, and applications where fluid/solvent evaporation may be a problem. For the AR 550, the Concentric Cylinder system uses an external fluid circulator to precisely control temperature. The AR-G2 and AR 2000ex Smart Swap Concentric Cylinder system features Peltier temperature control and provides a temperature range of -20 to 150 °C with heating rates up to 15 °C/min.



## UPPER HEATED PLATE (UHP)

The UHP is designed for use with the AR-G2 and AR 2000ex Smart Swap Peltier Plate and provides both upper plate temperature control and an enclosed purge gas environment. Designed for optimum heat transfer and minimum thermal equilibration time, the UHP sets a new standard in non-contact heating. Automated zero heat flow calibration yields temperature gradients of less than  $\pm 0.1$  °C. The UHP is modeled to provide matched upper and lower plate temperature during heating ramps of up to 15 °C/min to a maximum temperature of 150 °C. The AR-G2 UHP features our new patented Active Temperature Control, ATC. The ATC makes the AR-G2 UHP the only Peltier/upper heated plate system combination available that incorporates direct temperature control of both the upper and lower plates. Flexible cooling options include an external circulator or innovative vortex cooling.



## DRY ASPHALT

The AR 2000ex and AR-G2 Dry Asphalt System combines our superior Upper Heated Plate with a unique lower stepped Peltier Plate. The Dry Asphalt System meets SHRP, ASTM and AASHTO requirements. Automated zero heat flow calibration yields temperature gradients of less than  $\pm 0.1$  °C. The system includes 8 and 25 mm parallel plates, sample molds, and a trimming tool. The AR-G2 Dry Asphalt System features our new patented Active Temperature Control, ATC. The ATC makes the AR-G2 Dry Asphalt system the only stepped Peltier/upper heated plate system combination available that incorporates direct temperature control of both the upper and lower plates. Flexible cooling options include an external circulator or innovative vortex cooling.



# SMART SWAP™ ACCESSORIES



## ENVIRONMENTAL TEST CHAMBER (ETC)

The ETC uses a controlled convection/radiant-heating concept. It is typically used for polymer applications and can be used with parallel plate, cone and plate, disposable plate, and rectangular torsion clamps for solids. The ETC has a temperature range of  $-160$  to  $600$  °C with heating rates up to  $60$  °C/min . It can be connected directly to a bulk liquid nitrogen source for subambient temperature control. The ETC features our new camera viewer with remote illumination and focusing. Used in conjunction with the new streaming video and image capture software, real-time images can be displayed in the software and an image is stored with each data point for subsequent viewing. The ETC camera viewer is an ideal tool for data validation.

## ELECTRICALLY HEATED PLATES (EHP)

The EHP is a Smart Swap™ temperature option that provides active heating and cooling of parallel plate and cone and plate geometries. The EHP is perfect for rheological characterization of polymer melts up to a maximum temperature of 400 °C. Other features include an environmental cover, heated purge gas, and integrated low temperature cooling (optional). Additionally, for the AR-G2, the EHP offers patented Smart Swap Geometries and new patented Active Temperature Control, ATC. ATC makes the AR-G2 EHP the only electrically heated plate system capable of direct temperature control of both the upper and lower plates.



# SMART SWAP™ ACCESSORIES

## STARCH PASTING CELL (SPC)

The SPC is a powerful and accurate tool for rheological characterization of the gelatinization process and final properties of starch products. It uses TA's innovative new impeller design for superior mixing and control of sedimentation during testing. A precision temperature controlled chamber, with heating/cooling rates up to 30 °C/min controls and measures actual sample temperature and is designed to minimize water loss during the cooking cycle.

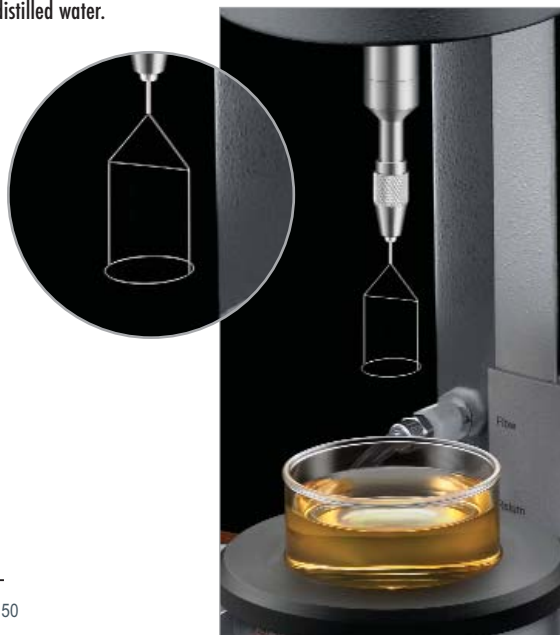
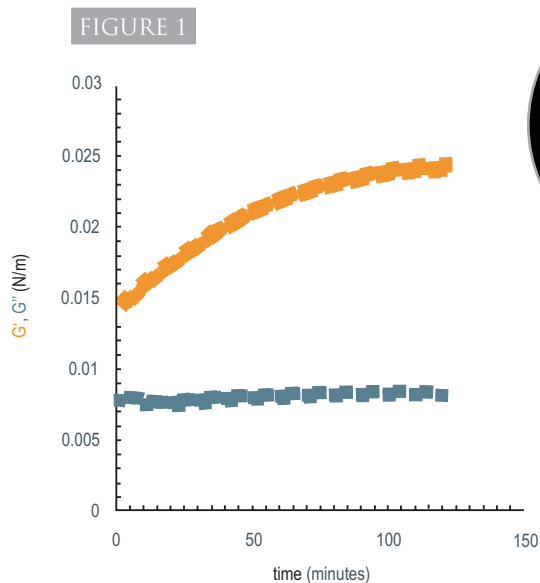


## PRESSURE CELL

The Pressure Cell is an optional accessory for use with the Peltier controlled Smart Swap Concentric Cylinder System. The Pressure Cell is a sealed vessel that can be pressurized to 140 bar (2000 PSI), over a temperature range of -10 °C to 150 °C. The cylinder in the vessel is driven using an innovative high-powered magnetic coupling and low-friction bearing design. The cell is ideal for characterizing materials that volatilize under atmospheric pressure.



Figure 1: Absorption of a 0.05% whey protein solution in distilled water.



## DYNAMIC INTERFACIAL SHEAR RHEOLOGY USING THE AR-G2

The dynamic interfacial shear moduli  $G'$  and  $G''$  are used to monitor the network structure build-up, resulting from the adsorption of proteins at the interface. Proteins unfold at the interface and therefore are crucial to the stability of emulsions and foams. The measurement is done with a Du Noüy Ring, consisting of a Pt-Ir wire, positioned at the interface of two liquids, or a liquid and air in a circular glass dish. The ultra-sensitive, nano-torque range of the AR-G2 rheometer is required to make these measurements. Figure 1 shows the dynamic storage modulus of this material continuously increases as the protein migrates to the surface and forms a network structure.

## INTERFACIAL ACCESSORY

Traditionally, rheometers have been used to characterize the bulk properties of materials. In many materials, such as pharmaceuticals, foods, personal care products and coatings, there is a two-dimensional liquid/liquid or gas/liquid phase with distinct rheological properties. In the past, massive biconical geometries have been used to make limited interfacial measurements in steady shear mode. The ultra-low friction nano-torque sensitivity of the AR-G2 has now been combined with a Pt/Ir Du Noüy Ring system, enabling viscoelastic characterization of interfaces in oscillation and transient modes. This makes the AR-G2 the only rheometer in the world capable of measuring bulk rheology, as well as both steady shear and dynamic interfacial properties of materials.

SALES & SERVICE

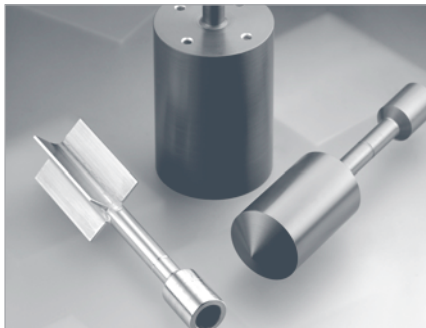
We pride ourselves in the technical competence and professionalism of our sales force, whose only business is rheology and thermal analysis. TA Instruments is recognized worldwide for its prompt, courteous and knowledgeable service staff. Their specialized knowledge and experience are major reasons why current customers increasingly endorse our company and products to their worldwide colleagues.



# GEOMETRIES

TA Instruments offers a wide range of measurement geometries including parallel plate, cone and plate, concentric cylinder, disposable, and torsion solid clamps.

Parallel plate and cone and plate geometries are available for both the ARES and AR Rheometers in an extensive variety of diameters and cone angles. Materials of construction include stainless steel, aluminum, plastic (Acrylic/PPS), or titanium. Disposable plates and cones are also available for applications such as thermoset curing.



A wide selection of concentric cylinder geometries are available for both the ARES and AR Rheometers. Options include conical DIN, recessed, vaned, and double wall. For the ARES rheometers, the geometries are constructed of stainless steel and titanium. For the AR rheometers, stainless steel and anodized aluminum are used.

A variety of other geometries are available for both the ARES and AR Rheometers, including clamps to measure solids in torsion using the high temperature ovens and immersion clamps. The ARES is available with many specialty fixtures including linear tack-testing fixtures, glass plates for optical measurements, and film/fiber fixtures.



# NOTES

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# TECHNICAL SUPPORT

Customers prefer TA Instruments because of our reputation for after-sales support. Our worldwide technical support staff is the largest and most experienced in the industry. They are accessible daily by telephone, email, or via our website. Multiple training opportunities are available including on-site training, seminars in our application labs around the world and convenient web-based courses.



