

Bohlin

Gemini



Gemini

Rheological instruments backed with  
rheological experience

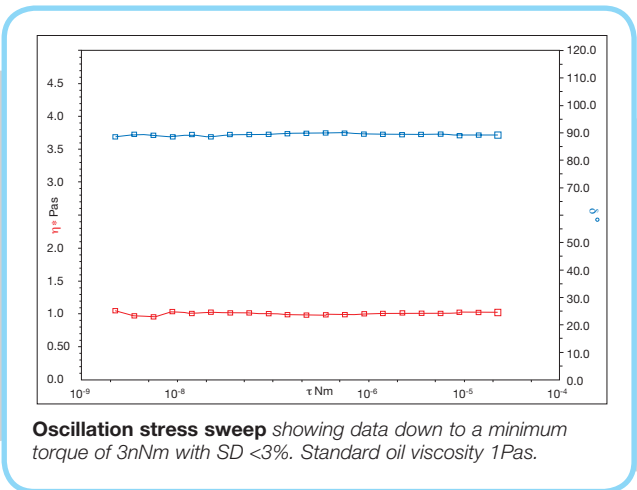
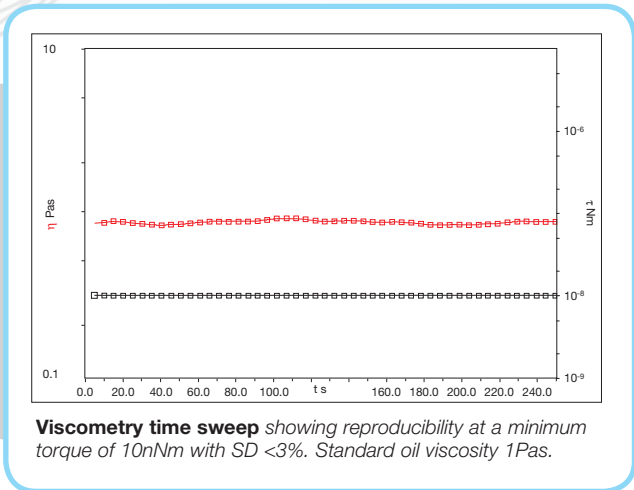
The Bohlin Gemini rheometers are an advanced range of compact research level instruments with 'fluids to solids' capability. They are optimized for both strain controlled and stress controlled operation. A Bohlin Gemini is the centerpiece of a complete, high performance, modular rheometer system, including a wide range of measurement geometries and accessories. EasySwap™ temperature controllers include Peltier devices, a forced gas oven with optional liquid nitrogen cooling, electrical heating and a range of fluids circulators. The Gemini can be quickly and easily configured to allow testing across a full range of materials and applications.



### Bohlin Gemini HR<sup>nano</sup>

The Gemini HR<sup>nano</sup> offers the ultimate in instrument capabilities for rheological characterization of low viscosity, low volume and weakly-structured systems.

- Unrivalled state-of-the-art High Resolution air bearing design and performance
- Continuous torque control range from 3nNm to 200mNm
- Low inertia motor and bearing design offering uncompromised dynamic response
- High sensitivity (0.001N), low compliance and axially symmetric normal force measurement over the entire torque range
- Integrated Peltier Temperature Control Unit electronics for a complete and compact rheometer system



**Nano-torque level control and measurement accessible in all flow and dynamic control modes.**

## Bohlin Gemini II

The Gemini II offers complete rheological assessment with the flexibility to configure and optimize test conditions for all materials and application areas.

- Powerful specification, research level rheometer based on renowned and proven Malvern air bearing and inductive motor technology
- Unique, enhanced Rotonetic™ 2 DSP control technology optimized for rheological testing in all operating modes
- Full range of EasySwap™ temperature controllers
- Modular system with a wide range of standard sensor systems and specialist measurement cells
- Integrated Peltier Temperature Control Unit electronics for a complete and compact rheometer system



## Rotonetic™ 2 Drive – unique technology



At the heart of the Bohlin Gemini lies the patent protected DSP Rotonetic™ 2 drive technology which brings an unsurpassed range and sensitivity to control torque and speed across all steady, dynamic and transient modes. This enables Gemini to perform perfect strain controlled tests, as well as all stress controlled tests.

- **Rotonetic™ drive**  
unique to the Bohlin Gemini and specifically optimised and enhanced for rheological testing
- **Wide torque measurement range**  
adaptive Rotonetic™ technology provides working torque range beyond that of any conventional controlled strain rheometer
- **Direct strain controlled oscillation**  
directly driven oscillation at instructed strain amplitude without iteratively adjusting the stress cycle by cycle which accurately controls the sample's strain history and reduces experimental time
- **Step strain testing**  
stress relaxation tests with a rise time of a few milliseconds and Rotonetic™ drive technology which perfectly maintains target strain during the stress decay whilst adaptively adjusting torque sensitivity
- **Steady shear experiments**  
Rotonetic™ drive effectively allows instantaneous changes in speed, including rapid flow reversals, whilst adaptively adjusting the torque sensitivity for measurement of even the most weakly structured samples



## Complete rheology – total control

- **Proven Inductive motor technology**  
powerful yet low inertia motor design enables adjustment of position or speed more rapidly than conventional motors with permanent magnets, and optimum dynamic response necessary to perform transient and dynamic test protocols with excellent low torque response. Combining this motor technology with a high sensitivity air bearing creates a wide and continuous dynamic torque range in excess of 1:1 million, which means that large variations in modulus during material transitions can be properly followed.
- **Air bearing with torque mapping**  
renowned air bearing design and technology is inherently sensitive with extremely low torque errors around 360° without compromising stiffness and strength. A continuous high resolution digital torque map allows the Gemini to further improve upon these characteristics and set low measurement torques extremely accurately, to a minimum of just 3nNm. This ensures perfect low viscosity data and the ability to investigate even the most weakly structured viscoelastic dispersions.
- **Exceptional position and speed sensing**  
proprietary hybrid position sensing technology with perfectly linear output ensures extreme position sensitivity for low strain measurements and unsurpassed dynamic range in speed measurement. Sub micro-strain position sensing complemented by the low torque response of the motor allows for extremely sensitive creep and recovery measurements. An upper speed of 600rad s<sup>-1</sup> can achieve shear rates in excess of 5 x 10<sup>5</sup>s<sup>-1</sup> which is applicable to coating processes for example.
- **High resolution normal force sensor**  
high sensitivity sensor acts independently of the air bearing spindle thus ensuring the normal force output is axially symmetric around 360°. Capable of measuring just 0.1g, data for the first normal stress difference can be generated even at low values of thrust. In oscillation, the sensor can be used to compress or tension a sample with a pre-defined force using Autotension mode.
- **Automated gap setting and control**  
set from PC or instrument touch pad and can be adjusted and controlled during measurement by either temperature or normal force (Autotension).



## Applications – from fluids to solids

- Coatings
- Adhesives
- Cosmetics
- Personal care products
- Foods
- Composites
- Petrochemicals
- Polymers
- Pharmaceuticals
- Solids
- Asphalt
- Low viscosity fluids



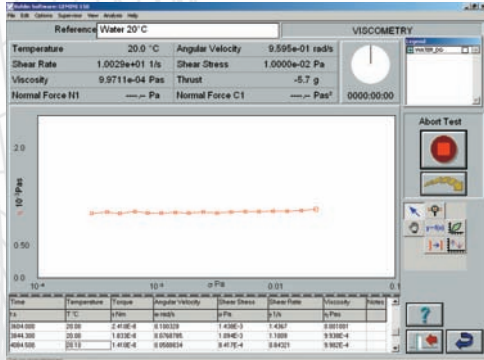
## Software to make it happen

The latest Windows™ based operating software allows the Gemini rheometer to be quickly and easily programmed for even the most complex test protocols. A user-friendly interface provides highly flexible test customisation and analysis to individual requirements.

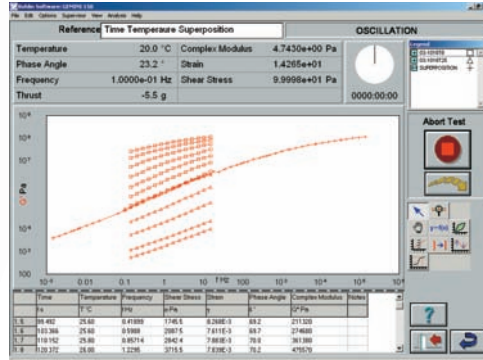
The Bohlin software package is equally suitable for advanced research or QC/QA use. A built-in context sensitive help system features a rheology ‘textbook’ as well as a topic search feature. The extensive measurement modes can be integrated by Job Streams for performing linked tests.

The Gemini is provided with a range of dedicated analysis software as standard including, Time Temperature Superposition (WLF), Advanced data processing and Multiwave. There is also an extensive range of optional software that can be provided including Advanced Model Fitting, advanced viscoelastic analysis (VE data conversion) and molecular weight determination.

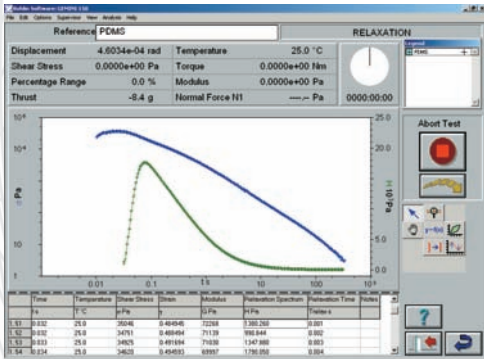
Comprehensive range of operating modes



**Viscometry** measures viscosity as a function of shear stress or shear rate. Measurements include single value of shear rate (or stress), table of shear rates (or stresses), continuous shear rate (or stress) ramp (including yield stress) and complex shear rate (or stress) profile. Temperature control can be isothermal (time sweep), or follow defined gradients or step changes.



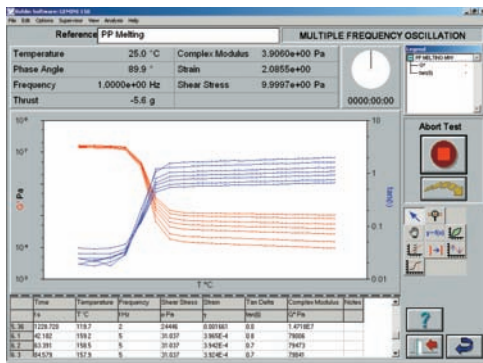
**Oscillation** measures the dynamic viscoelastic properties as a function of frequency. Measurements include single frequency, frequency sweep, amplitude sweep, time sweep and temperature sweep (gradient, step change or profile). Tests can be performed at constant stress or constant strain amplitude (under direct control). Oscillation measurements can be superimposed on steady shear. Partial wave sampling is available.



**Relaxation** measures relaxation modulus as a function of time following a step change in strain. The relaxation spectrum and zero shear viscosity can be determined.



**Creep and Creep Recovery** measures the creep compliance and recoverable compliance as a function of time. User defined sampling modes can be set. Zero shear viscosity and yield stress can be determined.

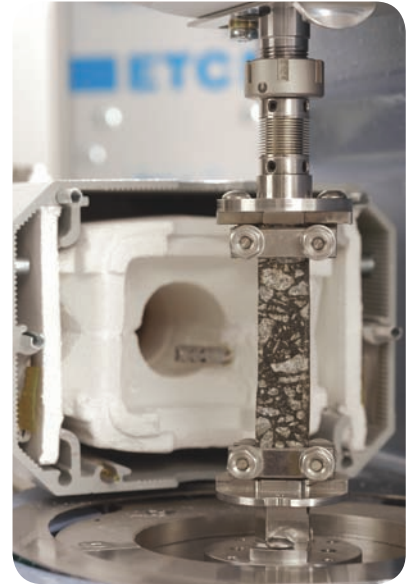


**Multiwave** measures the dynamic response by applying multiple oscillatory frequencies for faster testing. Especially useful for studying rapidly changing systems such as thermosetting resins and for gel point determination.



## EasySwap™ Temperature control units

Accurate temperature measurement and control is a fundamental requirement for almost all rheological measurements. The Gemini can be configured with a variety of temperature control units using EasySwap™ technology, to cover all applications. Available units include Peltier devices (plate and cylinders), a forced gas oven with liquid nitrogen cooling option, electrically heated plates and a range of fluids circulators. Bohlin temperature control units are fully controlled by the software and the instrument detects which type of unit is installed considerably simplifying installation. By virtue of the mounting system used, space and access for sample loading and trimming are not compromised when changing the temperature control system.



## Building on the system

**A wide range of standard sensor systems and measurement cells is available for the Gemini providing complete measurement solutions across all applications**

- **Parallel plate, cone and plate**
- **Coaxial cylinders (DIN)**
- **Double gap**
- **Small sample cell**
- **Roughened and serrated systems**
- **Vane tool**
- **Solids and fibre film fixtures**
- **Vacuum disposable systems for thermosets**
- **Optical UV curing cell**
- **Optical analysis cell**
- **High pressure cells**
- **Electro-rheology cell**
- **Humidity enclosure**

## Overview

## Bohlin Gemini

### Comprehensive rheological analysis

#### Torque range:

Gemini II 200

0.05 $\mu$ Nm to 200mNm in controlled stress & rate viscometry  
0.05 $\mu$ Nm to 200mNm in controlled stress & strain oscillation

Gemini HR<sup>nano</sup>

10nNm to 200mNm in controlled stress & rate viscometry  
3nNm to 200mNm in controlled stress & strain oscillation

#### Torque resolution:

Better than 1nNm

#### Position resolution:

50nrad

#### Frequency range:

1 $\mu$ Hz to 150Hz

#### Controlled speed range (CR mode):

0.01mrad s<sup>-1</sup> to 600rad s<sup>-1</sup>

#### Measurable speed range (CS mode):

10nrad s<sup>-1</sup> to 600rad s<sup>-1</sup>

#### Normal force N1 measurement range:

0.001N to 20N (50N optional)

#### Step change in strain:

<10ms

#### Temperature range (dependent on control used):

-150°C to 550°C

### Temperature controls

#### Fluids Circulator:

-40°C to 250°C

#### ETO (Extended Temperature Option):

-15°C to 300°C

#### Melts Oven:

ambient to 450°C

#### Peltier Plate:

-30°C to 200°C

#### Peltier Cylinder:

-20°C to 180°C

#### Universal Peltier Option – Coaxial Cylinder or Cone/Plate Geometries

#### ETC (Extended Temperature Cell):

ambient to 550°C

#### ETC with optional LTU (Low Temperature Unit):

-150°C to 550°C

### Nominal operating voltage

110 or 220V

#### Size (with Peltier plate)

52cm (H) x 33cm (W) x 37cm (D)

#### Weight (with Peltier plate)

28kg

### Optional equipment

#### Measuring Systems

#### Vacuum Disposable Plates:

Peltier Plate, Melts Oven or ETO

#### High Pressure (Sealed Cell):

40bar pressure, 30°C to 150°C

#### High Pressure/High Temperature Cell:

300bar pressure, ambient to 300°C

#### Optical UV Curing Cell

#### Optical Analysis Cell

#### Immobilisation Cell

#### Electro-rheology Cell:

DC voltage up to c.10kV

Every Bohlin Gemini from Malvern is backed with the technical and sales support of Malvern Instruments, the only material characterization company with the resources and equipment to measure particle size and shape, zeta potential and molecular weight as well as the expertise to advise on how these parameters influence rheological properties.

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