NETZSCH

Proven Excellence.

Rosand RH2000

Capillary Rheometer Backed with Rheological Experience

Analyzing & Testing

Rosand RH2000

Advanced Benchtop Capillary Rheometers for Research, Product Development and Quality Control

Wide range of shear rates for correlation with real material processing conditions

The Rosand RH2000 series of benchtop capillary rheometers are compact systems capable of most testing requirements encountered in capillary rheometry.

The series is available in both single bore or twin bore configurations, the RH2100 and RH2200 respectively. Both versions incorporate many of the features and attributes found in the floor standing models (Rosand RH7/RH10).

A digital drive system gives the RH2000 series unsurpassed speed control, accuracy, and dynamic operating range.

This hardware is supported by the latest generation of Windows™ based software, Flowmaster™, offering many experimental possibilities.

Rosand Twin Bore Principle (RH2200 Model)

Rosand capillary rheometers were the first to introduce the twin bore measurement principle to the commercial market. Simultaneous measurements can be made on both long and short dies to determine the inlet pressure drop at the die and, therefore, absolute viscosity, using the Bagley method. More commonly, Rosand *zero length* dies are used to directly measure the inlet pressure drop and measure the extensional viscosity using the Cogswell method.

The twin bore technique gives obvious experimental advantages including improved throughput, since both experiments are preheated simultaneously. Alternatively, the software can be configured to run a two material test which allows measurement of the viscosity of two different materials simultaneously.

Rigid Frame Design

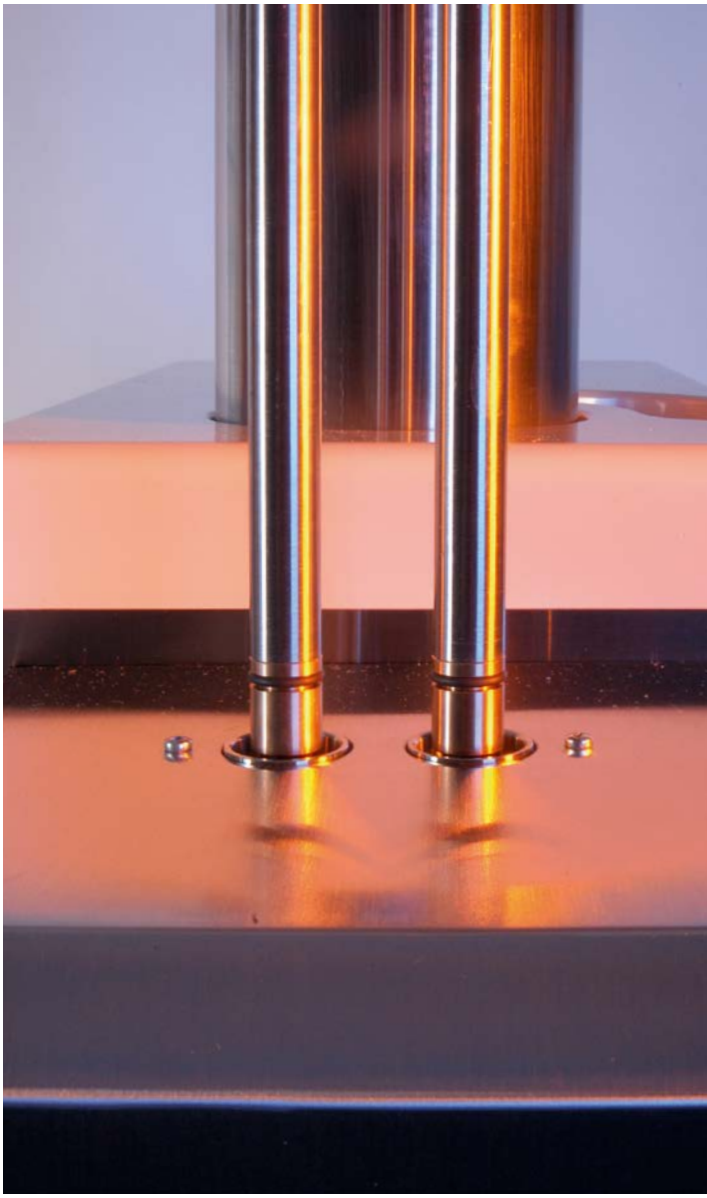
Rigid one-piece cantilever frame design provides extreme mechanical strength and stiffness for a compact benchtop unit.

Swivel Head Design

A unique, safety interlock protected, swivel design means that the actuated part of the rheometer can be moved to one side affording ease of access for cleaning and sample loading.

Bi-Modal Speed Control

Bi-modal digital speed control technology has been developed for the latest generation of capillary rheometers. The technology uses different speed control algorithms suited to high and low speed operation to optimize performance. This gives the rheometer an impressive dynamic range in speed control. In practice, the lower limit is determined only by long experimental times at low shear rates but a dynamic range in speed of in excess of 200,000:1 is available if required. This greatly enhances the system's flexibility and means that a wider range of shear rates can be covered using any particular die.



Controlled extrusion (by volumetric flow) of a sample through a high precision die of known dimensions

HOW THE SYSTEM WORKS

The Rosand RH2000 capillary rheometer system enables controlled extrusion (by volumetric flow) of a sample through a high precision die of known dimensions, to characterize material flow properties typically under conditions of high force (or pressure) and/or high shear rate. Using the twin bore barrel option and a *zero length* die configuration allows simultaneous determination of shear viscosity and extensional (elongational) viscosity as a function of shear (or deformation) rate.

A capillary rheometer system comprises several key components to enable robust, reliable and accessible rheological measurements for a particular sample or application:

Capillary Rheometer Base Unit

Includes the barrel with bore(s) to load the sample – the bore diameter and barrel material must be compatible with the material(s) under test. The base unit also includes a head unit, which has a mechanical connection to the pistons which are used to extrude the sample. Key system functions of drive force and piston speed range are controlled by the base unit.

Die and Pressure Transducer Combination

The die is mounted at the bottom of the barrel bore, and its dimensions define the applied shear field. A melt pressure transducer is mounted in the barrel to measure the resultant pressure at the die entrance as the material is extruded. The die dimensions and pressure transducer range must be appropriate to the sample type and test under consideration.

Temperature and/or Environmental Control Options

Accurate control of barrel temperature is essential since rheological properties are a strong function of temperature. For thermally-sensitive materials, thermal equilibrium times and inert test environments are critical considerations to ensure reliable data.

OPTIONS

The Rosand RH2000 capillary rheometers can be configured with a variety of options to provide complete measurement solutions across all applications.

High Force

Extends the maximum force (summed over both barrels if applicable) to 20 kN.

High Speed

Extends the upper speed limit of the unit to 1200 mm/min for high shear rate measurement with no loss in speed sensitivity or available force. The high speed option is fully compatible with the high force option.

Several accessories are available to suit particular applications or enhance the testing capability of the base units.

Main Accessories:

- Alternative test dies
- Alternative pressure transducers
- Nitrogen purge
- Die and melt cutters
- Laser die swell measurement

Accessories

Barrel Materials and Dimensions

For aqueous or aggressive materials, stainless steel or Hastelloy barrels are available in place of the standard Nitrided steel version. The wide dynamic range in speed means that the standard 15 mm diameter barrel is suitable for the vast majority of testing applications. However, barrels are available with 9.5 mm, 12 mm, 19 mm and 24 mm bores as an option.

Low Temperature

For applications that require sub-ambient measurements, a special cooling coil option is available.

Capillary and *zero-length* orifice dies for the Rosand RH 2000

Continuous development of the Rosand Flowmaster™ software has produced a comprehensive data acquisition and analysis package with a wide range of measurement options and an extensive help system.

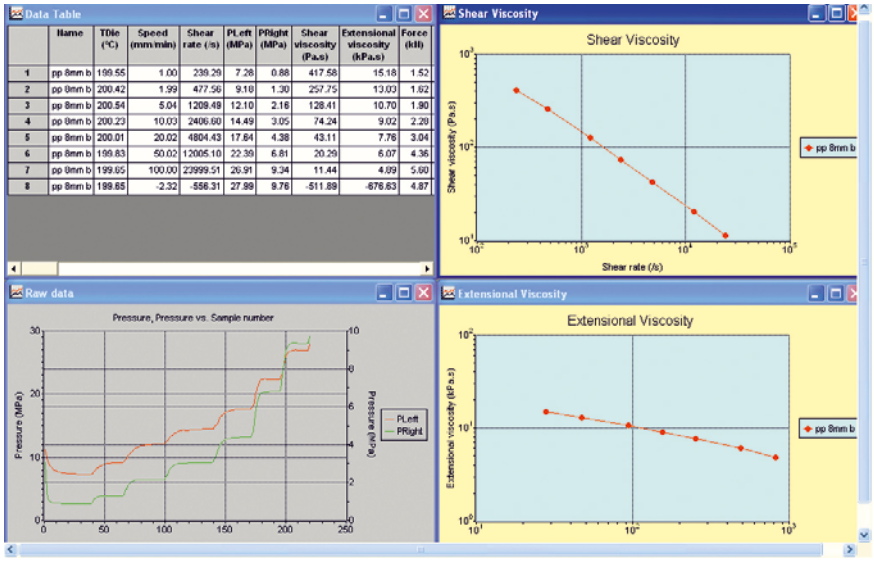
FLOWMASTER™ SOFTWARE

Software Modules and Analysis Functions Included

- Constant shear test
- Extensional test
- Manual control
- Flow/no flow
- Non-Newtonian index
- Bagley correction by orifice die and extrapolation methods
- Rabinowitsch correction
- Hagenbach correction for fluid inertia
- Cogswell convergent flow model and extensional viscosity assessment
- Extensive plot and print options
- Data export

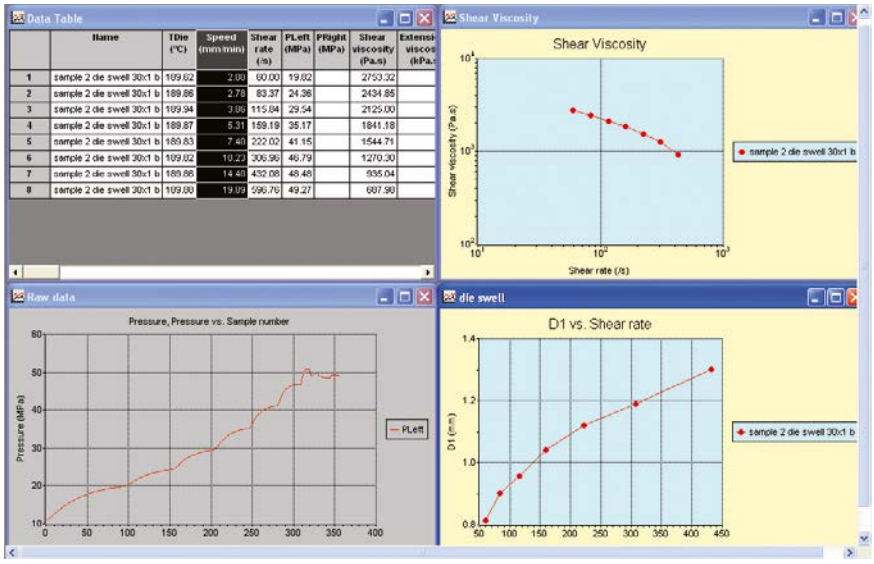
Software Options

- Wall slip analysis
- Melt fracture/flow instability
- Die swell
- Material degradation/ thermal stability
- Low-speed degradation
- Eta-0 (Intrinsic Melt Viscosity)
- Stress relaxation
- Low-level scripting



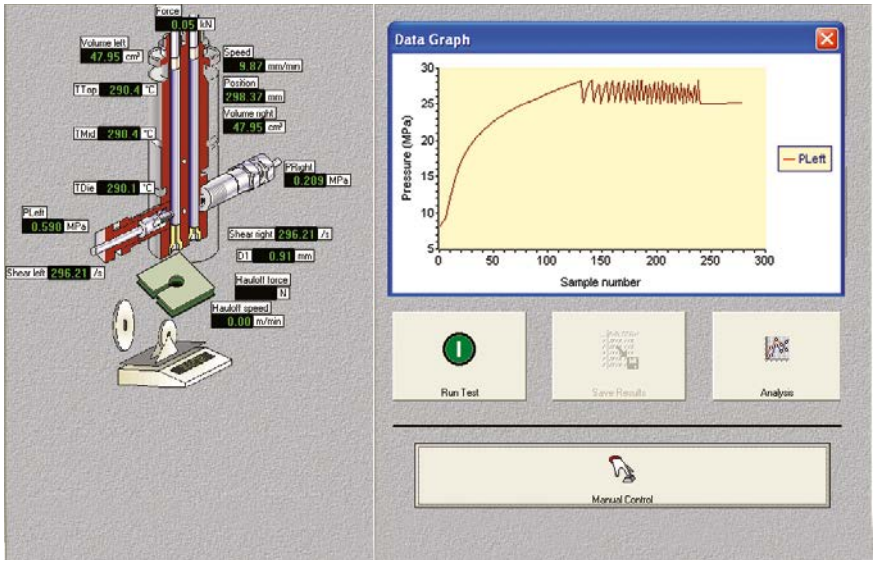
Constant Shear and Extensional Tests

Measurement of shear or extensional stress and shear or extensional viscosity as a function of shear rate. Extensional tests are carried out with an orifice die.



Die Swell

Measurement of the extrudate diameter close to the die exit. Directly interfaced with the control software and die swell is stored as part of the measurement data file.



Melt Fracture/Flow Instability

Accelerated shear rate ramp with continuous monitoring of the pressure to detect flow instabilities, such as melt fracture which may occur during flow through a capillary die.

APPLICATIONS

- Characterization of the flow behavior of polymer melts and suspensions across a range of shear rates and temperatures
- Simulation of extensional viscosity dominated processes such as fibre spinning, blow molding, film blowing and thermoforming
- Assessment of extrusion behaviour for processes such as injection molding and hot melt extrusion
- Evaluation of material behaviour at process relevant shear rates such as high speed coating and printing applications
- Detection of polymer instabilities such as melt fracture and thermal degradation
- Measurement of material elasticity and related properties such as die swell

POLYMERS

COATINGS

CERAMICS

METALS

PHARMA-
CEUTICALS

SEALANTS

FOODS

Rosand RH2000	
Number of bores	▪ RH2100: single ▪ RH2200: double
Maximum force	12 kN standard (20 kN option)
Frame stiffness	100 kN
Maximum speed	600 mm/min standard (1200 mm/min high-speed option)
Dynamic range in speed	200,000:1 (400,000:1 with high speed option)
Speed uncertainty	< 0.1 %
Temperature range	Ambient to 400°C (500°C option) 5°C to 300°C (low-temperature cooling coil option)
Temperature control	< ± 0.1°C
Bore diameter	15 mm standard (9.5, 12, 19 and 24 mm bore options)
Barrel bore length	250 mm
Barrel material	Nitrided steel standard (Hastelloy or stainless steel options)
Pressure transducer ranges	30000, 20000, 10000, 5000, 1500 or 500 psi
Pressure transducer accuracy	< 0.5 %
Dies	Tungsten carbide, precision ± 5µm
Die diameter	0.5 to 2 mm (in 0.5 mm increments) and 3 mm standard (other diameters, including fine bore dies, available to special order)
Height	Rheometer 1.1 m Electronics box 0.65 m
Width	Rheometer 0.55 m (without accessories) Electronics box 0.34 m
Depth	Rheometer 0.65 m (without accessories) Electronics box 0.53 m
Weight	Rheometer 120 kg (without accessories) Electronics box 30 kg
Power requirements	Single phase, AC, 230 V, 50 Hz, 16 A

Technical Specifications

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The NETZSCH Group is an owner-managed, international technology company with headquarters in Germany. The Business Units Analyzing & Testing, Grinding & Dispersing and Pumps & Systems represent customized solutions at the highest level. More than 3,800 employees in 36 countries and a worldwide sales and service network ensure customer proximity and competent service.

Our performance standards are high. We promise our customers Proven Excellence – exceptional performance in everything we do, proven time and again since 1873.

When it comes to Thermal Analysis, Calorimetry (adiabatic & reaction), the determination of Thermophysical Properties, Rheology and Fire Testing, NETZSCH has it covered. Our 50 years of applications experience, broad state-of-the-art product line and comprehensive service offerings ensure that our solutions will not only meet your every requirement but also exceed your every expectation.

Proven Excellence.

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