CEAST

progress in testing

SMART RHEO

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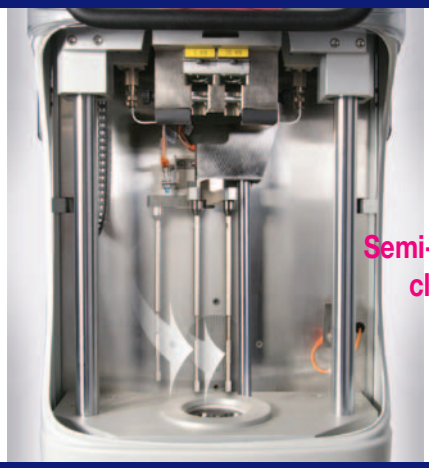
Single and twin bore bench-top Capillary Rheometers

- Single Bore Smart Rheo 1000
- Single/Twin Bore Smart Rheo 2000

Smart Rheo 2000 Twin Bore equipped with Stretching Unit option



Semi-automatic cleaning

Introducing the Smart Rheo

Smart Rheo is CEAST's latest product line for capillary rheometry, meeting market demands for a compact reliable and advanced instrument.
It offers the same high quality construction and working flexibility of the top-range Rheologic Line. The Smart Rheo 1000, with a maximum force range of 10 kN, is the best solution for Quality Control, with compact single bore barrel and a simplified die design and handling system.
Optional features include die swell detection and a system for feeding a nitrogen blanket (to test materials like PET).
The Smart Rheo 2000, with a maximum force range of 20 kN and a higher capacity barrel for wider characterization, is available with single bore or twin bore barrel, representing a powerful tool for Research & Development as well as for Quality Control. More optional devices can be added according to CEAST "modular" philosophy, including a stretching unit and a PVT system.
All Smart Rheo instruments are equipped with brushless servomotors driving pistons with a speed range reaching a 200,000:1 ratio, two PT100 temperature sensors and **advanced user-friendly software for full monitoring and management of tests through a PC.**
The modern and compact design comes together with a rigid frame and accurate temperature control, and a special commitment to operator safety and instrument durability. Also included are high powered heaters for minimum delay in reaching test temperature, and rapid recovery of temperature after loading the sample.
For the operator safety and comfort, a fume extractor circuit is provided.

Semi-automatic cleaning device

This unique pneumatic cleaning device allows a quick and easy cleaning of the barrel. It is self-contained into the instrument body, totally safe and always ready to use. Even unskilled operators can perfectly clean the barrel with few movements and no efforts.
The device is available for all the Smart Rheo models.

Standards

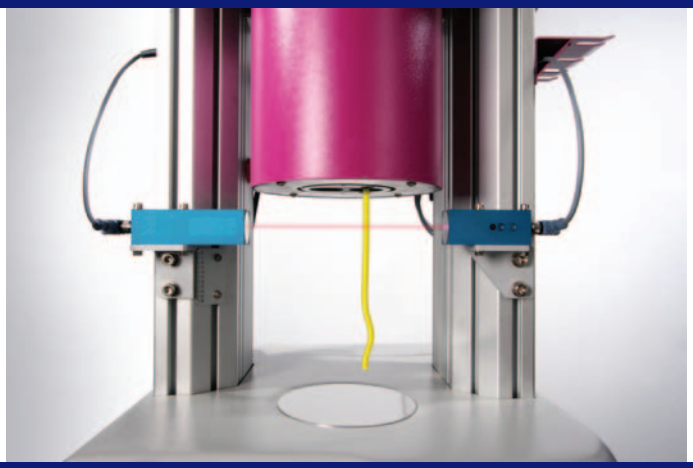
The Smart Rheo line is designed to meet the following international standards, concerning rheological characterization of plastics using capillary rheometers:

- ISO 11443
- ASTM D 3835
- DIN 54811

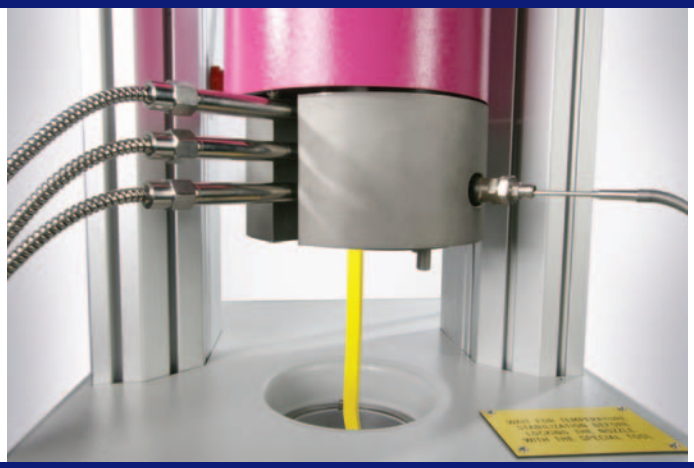
and other equivalents.

code 7040.000, 7041.000, 7042.000

Detail of Die-Swell system



Detail of Slit-Die system



Capillaries and shear rates

We offer a wide range of capillary dies for testing any thermoplastic polymer/ compound/ composite/ elastomer under process conditions.
The minimum capillary diameter is 0.25 mm, various lengths are available including the option for “zero length” capillaries. It is possible to choose conical or flat die inlet types, with special dimensions and shapes available on request.
Shear rates ranging from 0.01 to more than 4,000,000 1/s are obtainable, depending upon instrument configuration, test parameters and material response.

Instrument configuration

Smart Rheo instruments can be equipped with pressure transducers and/or load transducers (load cells) for accurate data acquisition during rheological tests. All transducers can be easily removed and replaced to carry out tests in the best working range; the choice of bore diameter, force range and suitable capillaries completes the definition of the most effective tool for QC and R&D purposes for your materials.
If needed we will suggest the best configuration for your applications!

Running tests

Smart Rheo instruments are controlled by computer (through RS232 or USB port) and come together with comprehensive user-friendly software for test management and data storage.
Standard rheological tests can be run at constant speed or constant shear rate steps, setting an unlimited number of increasing or decreasing steps with customisable preheating and intermediate stages.
Special procedures like the NNI (Non-Newtonian Index) evaluation are already implemented, more can be achieved by parameter settings and data elaboration.
A number of software-managed and built-in safety measures ensure operator safety and instrument durability.

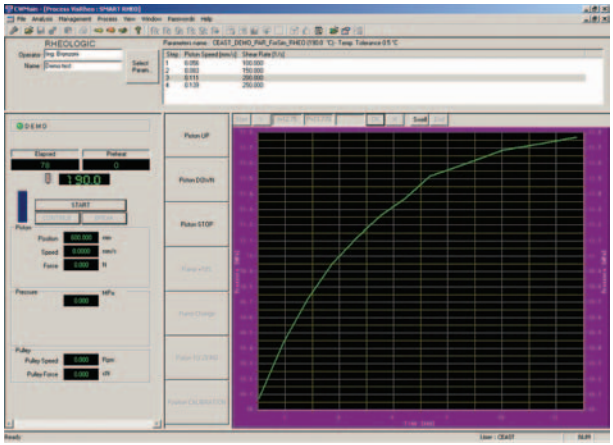
Smart Rheo characteristics

Model	Smart Rheo 1000 single bore	Smart Rheo 2000 single bore	Smart Rheo 2000 twin bore
Code	7040.000	7041.000	7042.000
Field of application	Quality Control	Quality Control, Research & Development	
Force range	Max 10 kN	Max 20 kN	
Piston speed	Max 1200 mm/min	Min 0.006 mm/min (range 200,000:1)	
Type of barrel	Single bore	Single bore	Twin bore
Bore(s) diameter	Standard 9.55 mm (optional 10, 12 mm)	Standard 15 mm (optional 9.55, 10, 12, 20 mm)	
Barrel working length	160 mm	290 mm	
Barrel material	Nitrided hardened steel		
Optional barrel material	Corrosion and wear resistant special stainless steel (Stavax)		
Main frame	Two-column rigid frame		
Piston drive	Brushless servomotor, frequency-driven digital control		
Temperature range	50 to 450°C (50 to 400°C with pressure transducer[s])		
Temperature sensors	n. 2 PT100 sensors		
Temperature accuracy	Stability ±0.2°C uniformity along the barrel according to ISO 11443		
Capillary Dies type (interchangeable, with various L/D ratios)	Simplified capillary dies (capillary inlet is at a variable distance from pressure transducer location)	Same as Rheologic line (capillary inlet is at a fixed distance from pressure transducer location)	
Load cells (not a compulsory option)	Assembled on quick change support, range from 1 to 20 kN		
Pressure transducers (not a compulsory option)	Rigid rod configuration for easy and quick installation, range from 3.5 to 200 MPa		
Semi-automatic cleaning (optional)	Pneumatic cylinder with automatic up-down movement fitted on the instrument frame, for single and twin bore barrels		
Fume extractor circuit	Ventilating grid over the barrel and adjustable air duct below the barrel. Vent port for the connection of an external exhaust fan		
Nitrogen blanket feed	●	●	
Die Swell	●	●	
MFR (MI) option	●●	●●	
PVT system	–	●	
Melt Stretching Unit	–	●	
Slit Dies system	–	●●●	
Thermal Conductivity	–	●●●	
Instrument control and data elaboration	PC-mastered (through RS232 or USB port)		
Software	VisualRHEO (CeastVIEW platform – Windows® 95, 98, NT, 2000, ME and XP compatible)		
Power supply	230 V, 50/60 Hz - 2150 W	230 V, 50/60 Hz - 2700 W	
Overall dimensions (WxDxH)	560x530x1480 mm	560x530x1590 mm	
Weight	110 kg	130 kg	

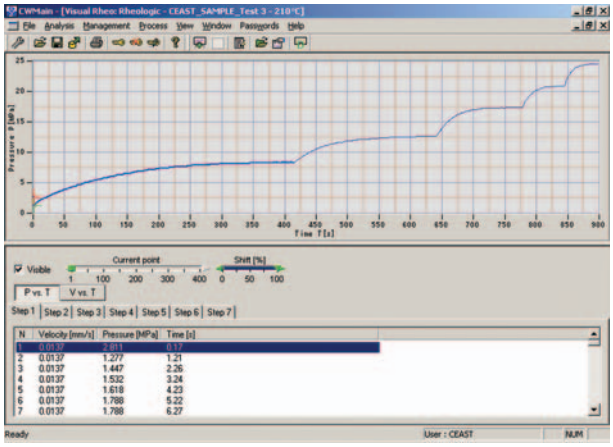
– Not Available
● Optional
●● Only for 9.55 mm bore diameter
●●● Option available on request, only for 15 mm bore diameter

VisualRHEO software for Smart Rheo

Real-time test window as displayed by VisualRHEO



Example of Raw Rheological Data



The VisualRHEO software (see also the dedicated VisualRHEO leaflet)

Developed for the Rheologic line, this modular and user-friendly software is based on the CeastVIEW platform – designed to manage all CEAST instruments in your lab. Its basic capabilities deal with rheological tests in manual or automatic mode, with data elaboration (including Rabinowitsch and Bagley corrections) and display. Raw and elaborated data can be shown, stored, exported. The unique ESP (Equilibrium Stress Prediction) algorithm is used to run tests in a special automatic time-saving mode: the software elaborates a prediction of the steady state pressure for every step before it is actually reached, thus reducing test time and possible material degradation concerns.
The prediction is based on a multi-step recursive procedure to ensure reliable results with many materials.

Optional modules

can perform advanced analysis on experimental data and manage special tests for a deeper characterization of polymer melts:

- the Operator and Transfer modules allow password-protected access levels and data exchange
- the Advanced Fitting module uses several different equations to interpolate acquired data
- the Elongational Viscosity module estimates the elongational (extensional) viscosity through the Cogswell method
- the Wall Slip module estimates the speed at the wall related to plug flow (e.g. with lubricants) other than the classic shear capillary flow
- the Thermal Degradation analysis module runs tests with different preliminary residence times in the barrel to see possible changes in rheological properties of the material
- the Viscosity Dependence on Temperature module analyses rheological curves at different temperatures calculating the relationship between temperature and viscosity (using different equations: Arrhenius, modified Arrhenius, Williams-Landel-Ferry WLF). This module has been enriched by the Flow/No-Flow analysis, designed to find the limiting conditions of temperature for flowing
- the Stress Relaxation module monitors the transient stage after a stop in the extrusion process
- the SQC module allows comparisons, database sampling and filtering for Statistic Quality Control purposes. It now includes an advanced utility to create a reference rheological curve and set automatic "pass-fail" tolerance
- dedicated modules to manage tests with optional equipments
- **The advanced integrative VisualRHEO modules, developed for the Smart Rheo instrument, include:** Shear Sensitivity (ratio between flow rates under different stress conditions), Molecular Weight Distribution (MWD) evaluation from rheological data according to Malkin's theory, Melt Fracture analysis (to investigate the upper limit for processing in terms of gross melt fracture occurrence).

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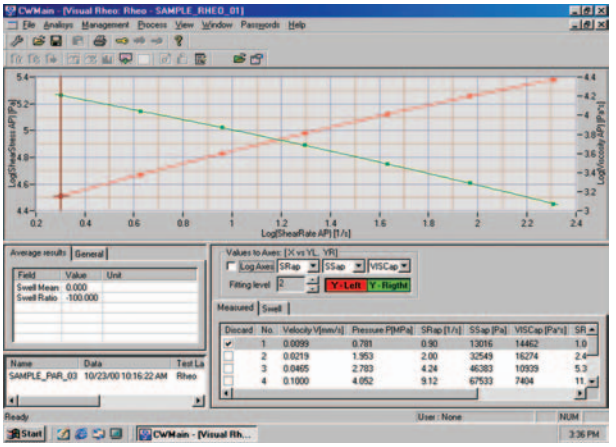
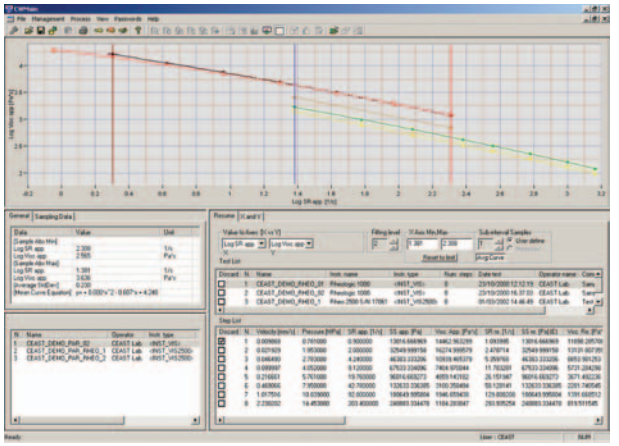
Example of Flow Curve
(Shear Stress vs Shear Rate and Viscosity vs Shear Rate)



SQC comparison of Flow Curves



Optional equipment and dedicated software (see Smart Rheo characteristics table)

- Die Swell: a laser detector controlled by the software measures the change in diameter of the extrudate at different shear rates
- Nitrogen Blanket: a special device blows dry nitrogen gas inside the barrel protecting the tested material from moisture (recommended for PET, PBT, PA[Nylons])
- Melt Stretching: a motorized unit equipped with pulleys stretches the extrudate at constant speed or with constant acceleration until it breaks, recording the melt strength (also called: haul-off test, drawdown, drawing test)
- PVT system: a special die and piston allow tests that reveal the relationship between Pressure, Volume and Temperature for the tested material; the software checks and accounts for possible frame deformation at high loads
- Melt Flow Rate (Melt Index) evaluation: set of die, piston and weights to carry out tests according to ISO and ASTM standards for MFR, method A
- Thermal Conductivity system: based on a special piston bearing a high sensitivity probe, capable of tests at different temperatures and pressures to determine the thermal conductivity of the melt.

CEAST LABORATORY is fully equipped for any type of rheologic, impact and HDT/Vicat test.
Should you be interest in running a feasibility test please call telephone: +39.011.966.40.38
or access our website: www.ceast.com\support\laboratory

"Due to the continuous development policy of CEAST's Research and Development Department, changes may be introduced without notice"

Xuanyang M&E Equipment (Shanghai) Co.,Ltd
Address:Room1010,Lujiabang Road 1011,Huangpu District,Shanghai,Zip:200011
Tel:+86-21-63761198
Mobleÿ+86-13918494243
Fax:+86-21-63760778
E-mail: hsy@xytec.net
Website:www.xytec.net

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