

POLYESTER, NYLON, PVC & OTHER PLASTICS AUTOMATIC SAMPLE PREPARATION & VISCOSITY MEASUREMENT SYSTEM

- Materials resistant to Phenol/TCE, Formic Acid, Cyclohexanone, Acetone and most other chemicals

- Automatic “safe vacuum” in-situ cleaning and drying of viscometer

- Small sample volume

- Automatic sample preparation (option)

- Automatic heating and stirring of samples (option)

- Simultaneous measurement of multiple samples

- High precision

- Auto sampler (option)

- Automatic calculations (IV, RV, K-value)

- Reduced operator contact with chemicals

- Reduced operator time required for analysis



**PSL – a world leader in
Viscosity Measurement**



The RHEOTEK Polymer Viscometer (RPV-1) provides a proven and precise method for determining the inherent and intrinsic viscosity of poly(ethylene terephthalate) PET, the relative viscosity or viscosity number of polyamides (nylon) and the K-value of poly vinyl chloride.

The system is also suitable for fully automating viscosity measurements of most other types of polymer solutions dissolved in acids, organic solvents and aqueous solutions.

In this very “operator sensitive” test, automation using the RHEOTEK RPV-1 reduces the variability of results.

This is achieved by reducing the operator influence on the test and ensuring compliance with the test method.

Several optional modules, including heater stirrer, auto sampler and sample preparation, can provide a fully automated system for polymer analysis.

A comprehensive set of ASTM and ISO standard methods are pre-programmed in the viscometer system’s software.



Applications

- Polyester**
 - automatic determination of the Inherent Viscosity and Intrinsic Viscosity of PET dissolved in Phenol Tetrachloroethane (ASTM D 4603), Phenol/Dichlorobenzene, Orthochlorophenol and DCA.
- Nylon**
 - automatic determination of the Relative Viscosity of nylon dissolved in formic acid, m-cresol or sulphuric acid.
- PVC**
 - automatic determination of K-value of PVC dissolved in THF and cyclohexanone.

The results obtained can be used to control the processability and end properties of the polymer.

Modular Design

The RHEOTEK Polymer Viscometer (RPV-1) consists of several modules, enabling a system to be configured to a customer's application requirements and budget. Options include:

- Sample Preparation Module**

The Sample Preparation Module automates sample preparation on a weight/weight basis eliminating sources of sample preparation error. The module is supplied complete with a single position (solvent) syringe pump and 4 d.p. balance.
- Heater Magnetic Stirrer Module (PET)**

PET is sensitive to heating during the dissolution stage. If the PET solution is heated for too long, or at too high a temperature, a reduction in the molecular weight occurs. The Heater Stirrer Module can heat multiple samples, each position has a magnetic stirrer, and temperature is controlled to $\pm 0.5^{\circ}\text{C}$.
- Auto sampler module**

Automatic safe loading of samples, minimizes operator exposures to handling the samples and allows the operator to perform other tasks while the samples are measured automatically.

RPV-1 AUTOpet

The **RPV-1 AUTOpet** viscometer is a fully integrated automatic viscometer for polyester. The system automates sample preparation, sample loading, sample heating and stirring, viscosity measurement and cleaning.

Outstanding Features

- High Precision**

The RPV-1 uses a choice of ASTM Ubbelohde, Cannon-Fenske or low volume RPVm Ubbelohde viscometers. Viscometers are supplied with ISO 17025 certificates of calibration, issued by the PSL Calibration Laboratory, accredited by UKAS.
- Outstanding software**

The RPV WINDOWS software program is pre-programmed with ISO and ASTM test methods. The RPV software automatically calculates the Relative Viscosity, Inherent Viscosity, Intrinsic Viscosity, Viscosity Number, Molecular weight, K-value and Kinematic Viscosity. Results can be adjusted for moisture or ash content before or after measurement. Results are printed and stored in the user configurable results database for review at a later date. Results can also be exported automatically for use by a LIMS system.
- Easy to Use**

The operator pours a sample into the viscometer filling station and presses the "START TEST" button. With an auto-sampler module, the sample is loaded automatically. Additional samples can be added to the auto-sampler at any time.
- Automatic "Safe-Vac" Cleaning**

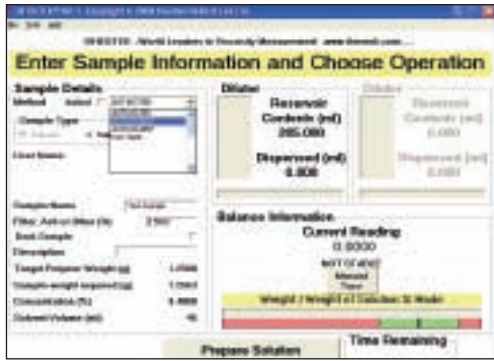
Viscometer tubes are cleaned in-situ after the measurement process has been completed. The RPV uses a "safe-vac" closed loop solvent and vacuum system. A cleaning routine is set up using two (or optionally three) solvents. The RPV-1 software optimizes the cleaning and drying cycles. This ensures that each viscometer tube is properly cleaned and dried, eliminating the risks of sample or solvent contamination.
- Chemically resistant materials**

The RPV-1 modules are assembled using components which are highly chemically resistant – all wetted parts are manufactured out of PTFE or glass.
- Multi language**

The RPV-1 WINDOWS software is available in several languages (including English, French, Finnish, Spanish and Norwegian). Other languages are available on request.
- Service & diagnostics**

The RPV modules have been designed with reliability in mind. The modular configuration allows for easy replacement or upgrading. Software diagnostic screens assist in identifying system or component faults.





○ Principle of Operation – Automatic Polymer Measurement

Sample preparation

A sample of polymer is placed into a vial and weighed. Solvent is dispensed automatically onto the sample. For PET applications the sample is then stirred and heated until it is fully dissolved. Once ready, the viscometer loading needle is lowered into the sample.

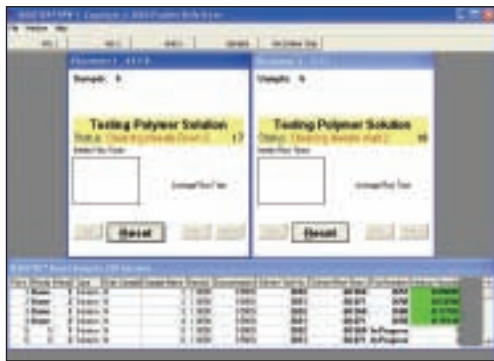
Viscosity Measurement

The viscometer bath is maintained at the required temperature set-point. Samples are then loaded into the viscometer tubes automatically through the unique RPV funnel filling station (if required, an in-line filtration system will filter the samples prior to loading).

After a short thermal equilibrium period, the flow times of the solvent and polymer solution are measured automatically, viscometers are cleaned and dried automatically after each test.

Calculation of results

The RPV software automatically calculates the desired result. This may include the Inherent Viscosity and Intrinsic Viscosity, using the Billmeyer Equation for PET applications, or the Relative Viscosity for polyamide solutions. For research purposes, the Intrinsic Viscosity can also be determined by extrapolation using different concentrations of the sample solution.



○ Application Testing and Data

The PSL Polymer Testing Laboratory is on hand to evaluate the total variability of customer's samples. A report prepared by our specialist technicians can often be used as the basis for discussion on how customers can improve their measurement accuracy.

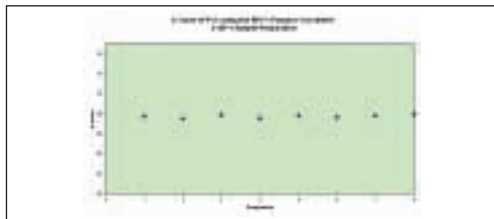
The graphical representation of IV results shows that instrument variability is minimal, giving excellent repeatability and reproducibility.

The PSL Testing laboratory is available to all RHEOTEK customers to assist customers to calculate sample variability.

○ Polymer Reference Standards

The PSL Calibration Laboratory offers a range of traceable and certified polymer standards. Standards are designed to verify the user's ability to determine common values such as relative, inherent, specific and intrinsic viscosity.

Standards are supplied complete with certificate, instructions and calculation CD.



Catalogue #	Description	Test Method
20502/3	PET Standard with certificate	ASTM D 4603
20503/3	POLYAMIDE Standard with certificate	ISO 307
20504/3	POLYAMIDE Standard with certificate	ASTM D 789
Standards are supplied in packs of 3 or 10 (Catalogue # 20502,3,4/10)		



Proven measurement capability in the most advanced viscosity system

Test Methods

PET	POLYAMIDES	PVC	GENERAL
ASTM D 4603	ASTM D 789	ASTM D 1243	ASTM D 2857
	ISO 307		ASTM D 871
			ISO 1628
			USP<911>viscosity

Models

Model Name	RPV-1 Polymer	RPV-1 Polymer RSS	RPV-1 AUTOpet
Description	RPV-1 Viscometer	RPV-1 Viscometer with auto sampler	RPV-1 Viscometer with auto-sampler, integrated sample preparation & heater stirrer
Description of Automation	Viscosity measurement & cleaning	Sample loading, viscosity measurement & cleaning	Sample preparation, sample loading, viscosity measurement & cleaning
Viscosity measurement	√	√	√
Cleaning	√	√	√
Sample loading	Future upgrade option	√	√
Sample Preparation	option	option	√
Sample heating & stirring	option	option	√
No. of simultaneous measurements	1,2 or 4	1 or 2	1 or 2
Sample positions	n/a	68	22
Samples per hour	5–20	6-8	6-8

Operator Time

	Preparation time	Measurement	Daily
Standard RPV-1 Viscometer with optional Sample Preparation Module	2 minutes	<90 s per sample	7.5 minutes
RPV-1 with RSS auto-sampler & optional Sample Preparation Module	2 minutes	<30 s per sample	7.5 minutes
RPV-1 AUTOpet with auto-sampler, integrated sample preparation & heater stirrer	1 minute per sample	<30 s per sample	10 minutes

Specifications

Measurements		Instrument Precision*	
Efflux times	Inherent viscosity	Flow time determinability	< 0.1%
Kinematic viscosity	K-value	Standard deviation:	
Relative viscosity	Intrinsic viscosity	PVC (ASTM D 1243) –K-value	< 0.15%
Specific viscosity	Viscosity number	Nylon dissolved in sulphuric acid (ISO 307)	< 0.03%
Reduced viscosity	Molecular weight	Nylon dissolved in formic acid (ASTM D 789)	< 0.1%
		PET (ASTM D 4603)	< 0.26%

*figures for guidance only, please note overall precision is sample dependent

Ordering Information

FUNCTION

Single position RPV-1 Viscosity system
 Dual position RPV-1 Viscosity system
 Four position RPV-1 Viscosity system
 Dual position RPV-1 with auto-sampler

Dual position RPV-1 with auto-sampler, integrated sample preparation, heating & stirring

Automatic Sample preparation option

Catalogue

RPV-1 Polymer (1)
 RPV-1 Polymer (2)
 RPV-1 Polymer (4)
 RPV-1 RSS

RPV-1 AUTOpet

SP-1 (single)

Local Agent:

The RPV-1 Viscometer is CE compliant