



ALPHA
TECHNOLOGIES

RPA 2000

Rubber Process Analyzer

- Viscoelastic measurements before, during and after cure
- Analysis and control of raw polymers
- Analysis and control of rubber master batches and final compounds
- Versatile test configurations
- Short test cycles, efficient operation
- New Extended Dynamic Range option



Overview

The Rubber Process Analyzer (RPA) is an advanced (dynamic mechanical rheological) test instrument, designed to measure the properties of polymers and rubber compounds before, during and after cure.

The RPA meets the full range of testing requirements of the complete manufacturing process:

- Incoming polymer characterization
- Incoming raw material test
- Master batch testing
- Final compound testing
- Cured compound testing

The RPA measures the viscoelastic properties of polymers and elastomeric compounds providing comprehensive data on key parameters such as:

- Processability
- Cure characteristics
- Final cured properties

The high sensitivity of the RPA enables detection of small changes in types and levels of ingredients and subsequent variations in compound properties, with routine operation by factory personnel.

The overall range and flexibility of the RPA allows rationalization of traditional laboratory tests and equipment, reducing testing complexity, testing time and costs.

RPA 2000 benefits

This advanced system can be configured to determine a wide range of product properties through all stages of rubber production.

Rapid test sequences enable:

- Increased testing frequency compared to traditional techniques
- Faster batch release, improving productivity

The RPA's unique programmable testing capabilities permit much higher and faster discrimination between polymers and compounds than is possible by conventional methods.

Replace numerous traditional techniques:

- Increase test efficiency and quality
- Reduce testing costs

Eliminate many downstream production problems:

- Increase production efficiency
- Significantly reduce scrap and rework

Quality control (& development) of new generation compounds which cannot be effectively analyzed by conventional methods.



Major features

Advanced instrumentation

The RPA is designed with a range of variable test parameters to enable a wide range of physical properties to be measured.

The variable test parameters are:

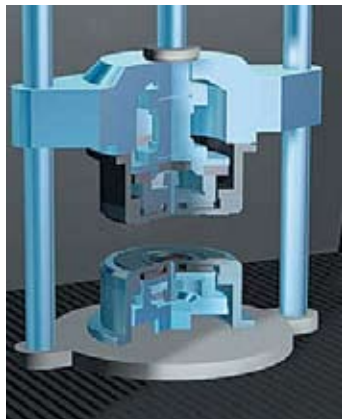
- Temperature
- Oscillation frequency
- Strain/angle of oscillation
- Time

The RPA is delivered with a pre-programmed series of tests allowing the user to rapidly exploit this powerful tool.

This user friendly, flexible system enables the operator to obtain quality control data on processability, curing characteristics and final properties from a single sample. No complex sample preparation is required.

The sample is loaded into a sealed test cavity pioneered by Alpha Technologies. Two directly heated low mass biconical dies give fast, accurate thermal response. The required starting temperature for the test is set automatically and controlled by heating and/or forced air-cooling. The temperature can be varied up or down during a test, or maintained at a constant value to within $\pm 0.3^\circ\text{C}$.

The RPA is equipped with a direct drive servo motor system that can vary the oscillation angle (0.05° to 90° deg arc) and frequency (0.03 to 33 Hz) with high accuracy over a wide range of conditions.



The torque is transmitted via the sample from the oscillating lower die to the highly sensitive torque transducer positioned in the upper die.

The measurements made by the torque transducer are fed into the system computer. This calculates the selected sample properties, displays the results and stores the data for further analysis.

The advanced software control eliminates operator intervention from sample loading until the test sequence is complete and the required data produced.

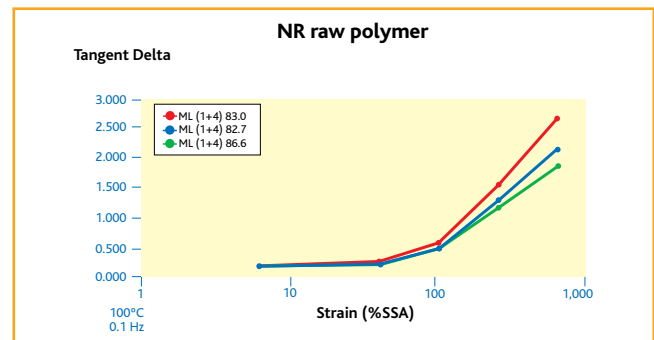
Further productivity increases are obtained when the automation option is fitted. This option allows up to 100 samples to be measured without operator involvement, and consists of a rotary tray staging system; sample loading arm, film transport system and controller. Alpha Technologies has pioneered the use of polyester or polyamide films for sample testing and transport, which give additional benefits in respect of reduced die contamination and increased seal life. The unit comes complete with Alpha Technologies' RPA software, computer, color monitor and color printer.

Enhanced testing

The reaction of the sample to the preset conditions is measured and the sample properties determined as follows.

Variable strain

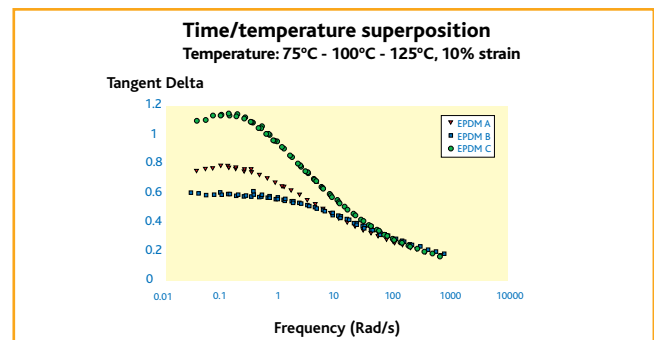
Strain is applied, via the oscillating lower die, under full computer control. The strain angle can be precisely varied between 0.05° and 90° in 0.01° increments. Torque, modulus and viscosity are measured at a pre-programmed frequency and temperature.



Variable strain used to characterize raw natural rubber under realistic processing conditions

Variable frequency

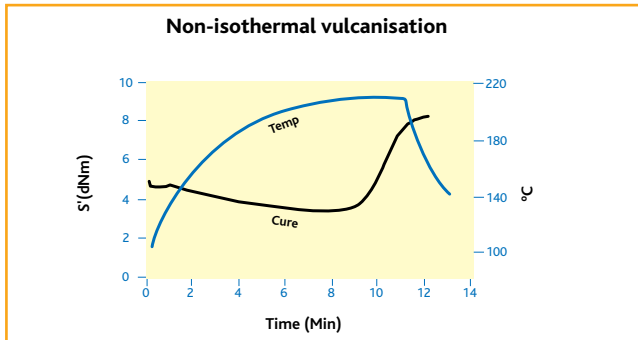
The oscillation frequency of the applied strain can be varied precisely between 0.03 and 33Hz. Torque, modulus and viscosity are measured at a pre-programmed strain and temperature.



Variable frequency used to evaluate different raw EPDM polymers

Variable temperature

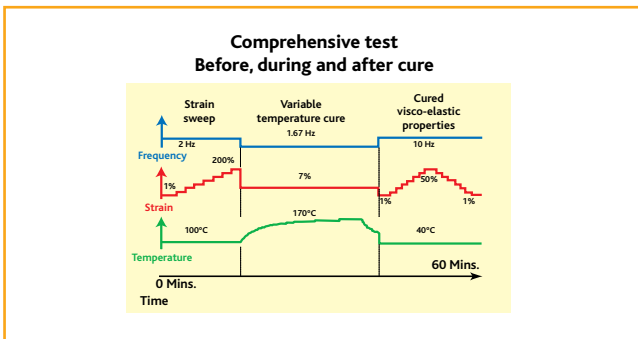
The temperature can be precisely varied during a test between 40°C and 230°C. Torque, modulus, and viscosity are measured under pre-programmed frequency and strain.



Variable temperature cure used to characterize curing reactions under realistic molding conditions

Multiple test sequences

The RPA enables a series of tests to be performed on a single sample in a programmed sequence providing complete data on the viscoelastic and rheological properties of the sample, before during and after cure.



Example – Multi test sequence used to measure processability, cure and final properties

Additional features:

Stress relaxation – Modulus and torque are measured against time after the sample is subjected to pre-programmed strain.

Delay – Sample ageing and conditioning at programmable time, frequency, strain and temperature.

Matrix – Specialist applications. A combination of modulus, torque and viscosity are measured under programmable strain, temperature and frequency.

Cure – Modulus and torque are measured against time under isothermal conditions at pre-programmed strain and frequency.

Sample cutter 2000R

This robust cutter is recommended to minimize sample preparation time and maximize productivity. The dual action pneumatically operated press provides rapid, precise preparation of constant - volume samples for testing, thereby optimizing repeatability and reproducibility.

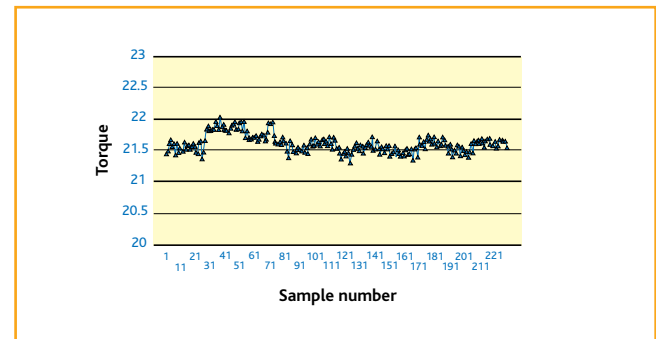


Designed for precision

The RPA design includes

- Unique temperature control system
- Sealed and pressurized test cavity
- High resolution drive motor
- Robust, sensitive torque transducer

These result in unparalleled precision and sensitivity, as required for the demanding applications of the rubber industry.



Cured SBR – SD = 0.14, COV = 0.65%
S' @ 10% strain. Measured at 100° C

System options

- **Automation** - The system is under full computer control allowing different, complex test sequences to be performed on up to 100 different samples, without operator intervention
- **Pressure** - enables the blowing characteristics of sponge materials to be measured at the same time as cure properties
- **Low viscosity** - The RPA is available with a torque transducer specifically designed to measure the characteristics of low viscosity materials, including thermoplastics (PVC, polyolifins, ABS, polystyrene, polyamides) and thermoplastics rubbers (TPR, TPV, TPU, TPE)

Specifications and contract details

Application	Variable	Benefits
Polymer	Strain	Molecular weight distribution
	Frequency	Ageing
	Stress relaxation	Consistent processing
Mixing	Strain	Dispersion
		Optimize cycle times
		Improved efficiency
Calendering/Extrusion	Strain	Reduced scrap
Injection molding	Strain	Gauge control/Die swell
	Frequency	Mold flow, mold fill, shear thinning
Cure	Temp	Optimized cycle times
		Minimized cycle times
		Maximum throughput
Post cure	Temp	Damping
	Strain	Rolling resistance
	Frequency	Heat build up
	Stress relaxation	

Standards	Complies with ASTM D6204, D5289 and D6601
US and World Wide Patents	Nos 5,079,956 – Multi angle and high strain, 4,552,025 – Variable frequency and temperature 5,481,903 – Temperature ramping 4,794,788 – Calculation of data by Discrete Fourier Transform
Test Configuration	Sealed test cavity with biconical dies, Sample volume 4.5cm ³
Temperature	Microprocessor controlled, Computer programmed; 40°C to 230°C (104°F to 446°F) Controlled heating and cooling rates 1°C/sec maximum with 25°C air
Oscillation Strain	+/-0.05° to +/-90° of arc (+/-0.7% to +/-1256%) in 0.14% increments Max strain with film = 50%
Oscillation Frequency	0.03 to 33Hz (2 to 2000 cpm) in 0.02 Hz increments
Frequency/Strain Combinations	Limited to a maximum product of cpm x °of arc = 2,047 (Maximum shear rate = 30s ⁻¹ , correlates to process up to 200 s ⁻¹)
Standard Torque range	10 ⁻² to 225 dN.m (10 ⁻² to 200 lbf.in)
Sample Volume	Approximately 4.5 cm ³
Units of Measure	Torque: S', S'', S* (dN.m, lbf.in, kgf.cm) Shear modulus: G', G'', G* (Pa, dynes/cm ² , psi) Temp: °C, °F Frequency: cpm, Hz, rad/s; Strain °of arc, % Optional calculated results: n, n'', n*, j', j'', j*, tan δ
Subtest Types	Frequency Sweeps, Strain Sweeps, Temperature Sweeps, Cure Tests, Stress Relaxation, Variable Temperature Analysis, Timed Tests, Matrix
Electrical	100/110/120/130VAC +/-10%, 50/60 +/-3Hz, 15amp single phase 200/220/240/260 VAC +/-10% 50/60 +/-3Hz, 7.5 amp single phase Deviations from these may affect performance
Air Pressure	80 psi (5.6 kg/cm ² or 550 kPa) minimum
Dimensions	Width 68cm (27in), Height 132cm (52in), Depth 76cm (30in)
Weight	300 kg (660 lb) Gross 197 kg (430 lb) Net
Suggested Bench Dimensions	Minimum Width 86 cm (34 in), Height 64-86 cm (25-34 in), Depth 71 cm (28 in) not including personal computer or printer
System Options	
Low Viscosity Option	Torque Range 10 ⁻³ dN.m to 56 dN.m
Pressure Option	Maximum Pressure 8300 kPa (1200 lb/in ²) Resolution 5 kPa (1 lb/in ²) Automatic Tare +/- 690 kPa (100 lb/in ²) at test Specimen weight Precision +/- 0.1 grams

Disclaimer of warranty and liability

The information provided herein is believed to be true and correct but no warranty is given to its completeness, accuracy or fitness for use for any particular purpose. Alpha Technologies shall not be liable for any loss or damage arising from the failure to achieve particular result by the application of any route, method or process that is recommended herein.

New RPA 2000 with "Extended Dynamic Range"

RPA 2000 EDR

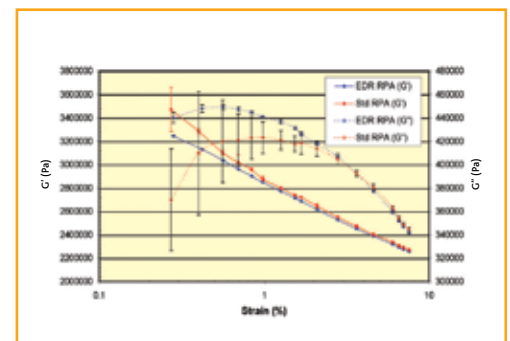
The new EDR (Extended Dynamic Range) option for the RPA has been developed to improve sensitivity at low strains and low frequencies, improving precision on post cure tests and allowing more accurate measurements on low viscosity materials.

Improved Performance

- Increased dynamic range
 - 4.5 decades vs. 3 decades
- Lower Minimum Deformation
 - 0.07% vs. 0.28%
- Increased Maximum Frequency
 - 50Hz vs. 33.33Hz
- Improved Torque resolution
 - 10⁻⁴ dNm vs. 10⁻³ dNm.
- Higher precision for phase angle (δ) measurements
- Lower Inertia
- Improved repeatability
- Improved reproducibility

New Applications:

- Elastomers
- Improved Polymer Characterisation -Tangent δ reliability at low/very low frequency (δ)
- Improved post-cure dynamic property measurements
- Improved compound characterisation at very low strains
- More reliable tangent δ and G'' measurements at low strain
- Retrofit kit available for existing RPA 2000



Post cure dynamic properties

70° C, 2 Hz, 95% conf. limits on 5 oscillations

NEW

Pathfinder Software Option

Pathfinder is a new software operating system for the RPA2000, combining instrument control with effective data management. This system is part of the new Enterprise family of software products that utilize an open structure SQL database for improved user flexibility.

- Comprehensive and user-friendly instrument operating system.
- Integrated software modules incorporate test configurations, specifications, results, statistical analyses and reports as well as instrument control.
- Change languages and rename data points according to local preferences while maintaining databases in accordance with corporate specifications.
- Pathfinder supports Alpha's patented 'single sample, multi-subtest' analysis technology.
- All configurations and results are stored in the SQL database that is included with the product.
- Integrated Pass/Fail judgements provide easy to use quality control tool for the (shop floor) operators.
- Pathfinder has been designed to seamlessly integrate with Eclipse DAISY software.

Reporting

- The package includes a range of embedded reports and statistical analyses in Crystal Reports format. Additional reports can be configured using Crystal Reports software (*not included*).

Structure

Pathfinder has been developed as two complementary parts. The **Online Manager** is the heart of the system, the area where the tests are configured, reports defined and results analyzed. With the Remote Access option it allows access to the machine's control software from any where in your network through a web interface.



The **Workbench** application resides on the instrument computer, which controls the machine and collects the data. It's simple operation allows the 'local software' to be operated by non-specialists making factory floor operation simple.

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