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
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 ±/− 0.3°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 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 frequency used to evaluate different raw EPDM polymers

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.

Specifications

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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 4.5 cm³

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 = 30 s⁻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 cm³

Units of Measure

Torque: S', S'', S* (dN.m, lbf.in, kgf.cm)
Shear modulus: G', G'', G* (Pa, dynes/cm², 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 Hz, 15amp single phase

Air Pressure

80 psi (56 kg/cm² or 550 kPa) minimum

Dimensions

Width 68cm (27 in), Height 132 cm (52 in), Depth 76 cm (20 in)

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 lbf/in²)
Resolution 5 kPa (1 lbf/in²)
Automatic Tare +/- 690 kPa (100 lbf/in²) at test
Specimen weight Precision +/- 0.1 grams

Disclaimer of warranty and liability

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For additional information on Alpha Technologies products please contact:

**Alpha Technologies US LP**  
2689 Wingate Avenue  
Akron, Ohio 44314, USA  
Tel +1 330 745 1641  
Fax +1 330 848 7326

**Alpha Technologies UK**  
Unit 2B Crowood House  
Gipsy Lane, Swindon SN2 8YY, UK  
Tel +44 1793 601 100  
Fax +44 1793 615 214

**Alpha Technologies Japan**  
2nd Floor-Bancho Kaikan  
12-1 Goban-Cho, Chiyoda-Ku  
Tokyo 102 - 0076, Japan  
Tel +81 3 5275 7117  
Fax +81 3 3221 6235

[www.alpha-technologies.com](http://www.alpha-technologies.com)