

Elastomer-Testing

Determination of the processing behavior of reactive materials



- + Mooney-Viscosimeter
- + Moving Die Rheometer
- + Rubber Process Analyzer
- + Rubber Capillary Rheometer
- + Sample Preparation

Elastomer-Testing

Determination of the processing behavior of reactive materials



Quality and reliability for your requirements

To meet the constantly increasing demands on the quality and consistency of rubber products, a comprehensive characterization of the raw compound with regard to its processing behavior is essential.

Elastomer compounds are complex multi-component mixtures consisting mainly of polymers, fillers, plasticizers, additives, and crosslinking agents.

Due to the interaction of the various substances, compounding leads to more or less pronounced changes in the property profile, while at the same time allowing the properties to be adjusted over a wide range.

The most important criteria for processing and for the final product are flow behavior, **vulcanization behavior, and filler distribution**. When testing these characteristics, a fundamental distinction must be made between process-related testing and development testing, for example to simulate process engineering operations.

Process-related testing primarily serves **quality control** and requires statistical evaluation. Increasingly, computer-aided process models for screw and component design are also being applied in the rubber industry.



Learn more goettfert.com/elastomer-testing

Complete solutions from one source

A complete rheological characterization of elastomer compounds is already necessary during the development stage of elastomer products. The testing instruments shown here are suitable for both fields of application.

Our systems are always developed and manufactured according to **the latest state of the art** and are subject to continuous monitoring by our certified quality management system from the very beginning.

Creative ideas and many years of experience allow our systems to continuously mature. State-of-the-art 3D workstations support the design process in transforming this expertise into marketable products. GÖTTFERT not only supplies customized special machines, but also provides a **high level of professional support**, comprehensive training, fast and uncomplicated service, as well as sound knowledge transfer in all questions of rheology.

ADDITIONAL INFORMATION



GÖTTFERT RheoInfos

With our white papers, we provide you with a comprehensive pool of knowledge – freely accessible and practice-oriented.



GÖTTFERT ROUNDTABLE

Fundamentals, applications, and current developments clearly explained in our YouTube series.

Mooney Viscosimeter

Shear disk viscometer – standardized method for reliable test results

Acc. to standards:

ISO 289 1-4
ASTM D1646
DIN 53523 1-4

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MOONEY
VISCOSIMETER

HIGHLIGHTS

- Standard and dynamic viscosity testing
- Universal operation with a multifunction button that changes color depending on operating status
- Highly sensitive and precise torque measurement unit with up to 200 ME
- Constant rotational speed of 2 min⁻¹ (optional 0.1 to 5 min⁻¹ or 0.1 to 50 min⁻¹, particularly important for relaxation measurements)
- Rotational speed increase in steps or linear
- Rotor stop in less than 20 ms for precise relaxation measurements
- Variable test chamber with profiled standardized bottom, top, and wall surfaces
- Variable shear disk diameters (38.1 mm / 30.48 mm)
- Pneumatic closing unit of the test chamber with max. closing force of 12.7 kN
- Temperature control up to 200 °C, resolution ±0.1 °C
- High measurement accuracy due to optimized temperature control of the test chamber and rotor
- Durable seals

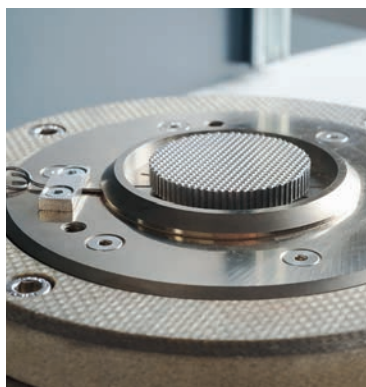


Learn more goettfert.com/mooney-viscosimeter



MOONEY-VISCOSIMETER 91.22

This is a **shear disk viscometer** with a closed chamber and a rotor, used to determine the Mooney viscosity, scorch behavior, and stress relaxation of rubber compounds as well as samples of pure natural or synthetic rubber.



The test specimen consists of two round blanks (formed by a punch), one of which has a central hole to allow passage of the rotor. The punched test specimens are homogeneous. The specimen is sheared in the closed test chamber under the rotating rotor at constant speed. With constant values of pressure, temperature, and rotational speed, the resulting torque is recorded and evaluated.

MEASUREMENT PROCEDURES

- Mooney Viscosity (Plasticity)
- Mooney Scorch
- Mooney Relaxation
- Delta Mooney
- Dynamic testing by variable speed option

OPTIONS

- Free definable speed from 0.1 to 5 min⁻¹
- Free definable speed from 0.1 to 50 min⁻¹
- Rotor detection
- Chamber cooling/-tempering (Air- or Liquid tempering)
- Torque calibration device
- Volume punch

Moving Die Rheometer

MDR-EL

Acc. to standards:

ISO 6502
ASTM D5289
DIN 53529

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MOVING DIE
RHEOMETER

HIGHLIGHTS

- Measurements at 50 min^{-1} (0.833 Hz) / 100 min^{-1} (1.66 Hz)
- Two frequencies at fixed or variable strain rate
- Wide selection of test chambers for different materials (quasi and hermetically sealed: Shore, paste, biconical)
- Very fast temperature control and homogeneous temperature distribution
- Recording of deflection
- Built-in Ethernet interface for data transfer to a PC



Learn more goettfert.com/mdr-elastograph



ELASTOGRAPH

Deformation amplitude: Standard $\pm 0.5^\circ$ (optionally selectable additional angle between $\pm 0.1^\circ$ and $\pm 1^\circ$)

A **rotorless rotational shear vulcameter system** with different test chambers, used for the characterization and vulcanization of rubber compounds in the plasticized state, during the vulcanization phase, and in the fully vulcanized specimen.



ELASTOGRAPH-S

Direct drive system with variable deformation amplitude: from $\pm 0.1^\circ$ to $\pm 10^\circ$

Strain rate: from 1.4% to 55.8%



Open test die



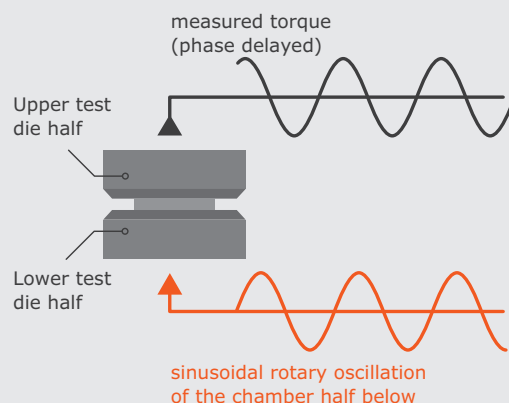
Closed test die

OPTIONS

- Normal force measurement
- Air cooling
- Torque calibration device (torsion bar)
- Volume punch
- Autoloader (Automatic sample feeder)

The test sample consists of one round blanks (formed using a punch). The sample is being forced in the lower test die half by a sine rotation oscillation.

Torque and phase angle are determined as a function of the measuring time.



MEASUREMENT PROCEDURES

- Vulcanization
- Isothermal & Non-isothermal measurement procedures

Rubber Process Analyzer

RPA-VE

Acc. to standards:

ISO 6502
ASTM D5289
ASTM D6601
ASTM D6204
DIN 53529
ISO 13145
ASTM D7050
ASTM 6048
ASTM D7605



HIGHLIGHTS

- Standardized and customer-specific test chambers
- Deformation- or stress-controlled operation
- Temperature up to 230 °C with extremely fast temperature control and homogeneous temperature distribution in the reaction chamber
- Deformation frequency from 0.01 to 120 Hz
- Amplitude from 0 to $\pm 360^\circ$, angular resolution of the drive 0.001°
- Torque measurement range up to 25 Nm
- Normal force measurement range up to 10 kN for the investigation of sponge and cellular rubber compounds and the effect of the blowing agents contained therein
- Cooling rate up to 1 °C/s (optional)



Learn more goettfert.com/rpa



RPA VISCO-ELASTOGRAPH

The Rubber Process Analyzer is used for the **characterization of rubber compounds in the plasticized state**, during vulcanization, and in fully vulcanized specimens. During the measurement with the rotorless torsional vulcameter, the lower die half is deflected with a sinusoidal angular displacement. A torque transducer on the upper die half records the torque transmitted through the specimen as well as the phase angle.

The RPA VISCO-ELASTOGRAPH has been developed based on many years of experience in the testing of rubber compounds and is characterized by accurate, **repeatable, and reliable test results**.

Depending on the standard and material used, the vulcameter can be equipped with different chamber systems. Both quasi and hermetically sealed test chambers are available in biconical, Shore, and paste designs.

Compared to the MDR, the RPA offers **significantly more flexibility in test design**. Both oscillation frequency and amplitude can be program-controlled over a very wide adjustment range. In combination with the very fast temperature control, this allows not only frequency, amplitude, and temperature sweeps, but also ramp or relaxation tests to be carried out fully automatically.

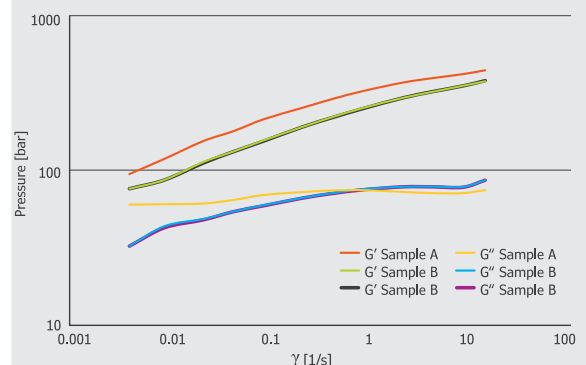
MEASUREMENT PROCEDURES

- LAOS by using FFT
- Transient viscosity
- Isothermal / non-isothermal curve
- Frequency sweep
- Amplitudes sweep
- Temperature sweep
- Ramp function up to a gradient angle of 720°
- Relaxation test up to a deflection angle of 360°

OPTIONS

- Autoloader for 5 and 30 specimens
- Volume punch
- Normal force measurement
- Torque calibration

STORAGE AND LOSS MODE



The diagram shows storage modulus (G') and loss modulus (G'') of two NBR compounds with different base polymers. This evaluation serves to compare the elastic and viscous material behavior.

Rubber Prozess Analyzer

RPA rotational



Acc. to standards:

ISO 6502
ASTM D5289
ASTM D6601
ASTM D6204
DIN 53529
ISO 13145
ASTM D7050
ASTM 6048
ASTM D7605

HIGHLIGHTS

- Continuous rotation for maximum accuracy in dynamic mechanical analysis
- Simulation-capable data for representing real processing conditions
- Measurement of transient viscosity for reliable process and product optimization
- Stable and reproducible results, even with demanding test protocols
- Extended range of applications from the development of new polymer blends to quality control in production



Learn more goettfert.com/rpa-rotational



RPA rotational

The RPA rotational, with its **continuously rotating measurement method**, represents an advancement of the conventional RPA with extended material characterization.

Thanks to the innovative rotating measurement principle, the RPA rotational is capable of measuring the **transient viscosity** of the test materials.

This makes it possible not only to represent complex material behavior under realistic processing conditions with high shear rates, but also to provide data that are indispensable for the simulation of rubber processing operations.

With this RPA you obtain a powerful tool that enhances your material research and processing – fast, reliable, and future-oriented.

MEASUREMENT PROCEDURES

- Transient viscosity
- Large Amplitude Oscillatory Shear (LAOS)
- LAOS evaluation using FFT
- Determination of transient viscosity
- Isothermal / non-isothermal curve
- Frequency sweep
- Amplitude sweep
- Temperature sweep

Rubber Capillary Rheometer

RCR 75



Acc. to standards:
ASTM D5099 (Gummi)
ISO 11443 (Visko)
GFT 014-02

HIGHLIGHTS

- Testing under production and processing conditions
- Pressure- or speed-controlled operation
- Plunger force up to 75 kN
- Plunger diameter selectable: 20, 30, or 35 mm
- Short test intervals of less than 3 min
- Wide dynamic speed range: 1:800,000
- Fast plunger acceleration: 0–15 mm/s in 0.35 s
- Position detection: high-resolution rotary encoder: 0.00000064 mm
- Test mode “constant speed” (3 stages)
- Both versions, including the well-known RHEOVULKAMETER functions of the previous generation, operate in speed- and stress-controlled mode



Learn more goettfert.com/rcr-75



RCR75

The RCR is an innovative capillary rheometer for determining the flow behavior of rubbers under specific physical processing conditions.

The RCR operates in two test modes:

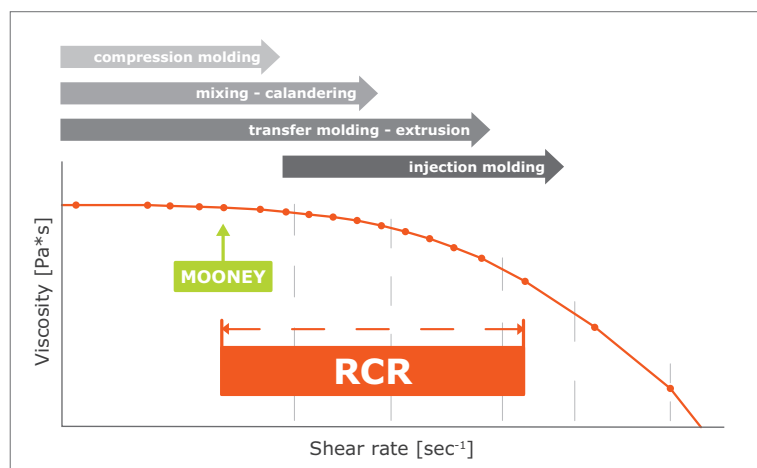
- Extrusion mode (flow behavior)
- Injection mode (with branching and/or spiral design)



Extrusion



Injection



ADD-ON

- + Various molds (injection mode)
- + Test die with thermal insulation (injection mode)
- + Split capillaries (extrusion mode)
- + Die swell measurement
- + Volume punch



Ramification Mold



Spiral Mold

RHEOGRAPH 120

User-friendly high-pressure capillary rheometers with an extended shear rate range and high test force



HIGHLIGHTS

- Single-, dual-, or triple-barrel system with various test barrel diameters
- Constant high test force up to 120 kN
- Speed range 0.00004 – 40 mm/s (= 1:1,000,000)
- High dynamic plunger acceleration from 0 to 40 mm/s in 0.6 seconds
- Position detection with a high-resolution rotary encoder (step size 0.0000016 mm)
- Temperature range up to 400 °C (500 °C optional), display resolution 0.01 °C
- Automatic pressure transducer detection and identification ("Plug & Test")
- Adaptive signal resolution of 0.005% of the pressure transducer's rated value
- Pressure transducer measuring range up to 2500 bar per barrel
- Timer function
- Special "Extrude mode"
- High shutdown safety
- Multiple monitoring of overload drive, force, pressure, heating unit
- Automated script file functionality



Learn more goettfert.com/rg120

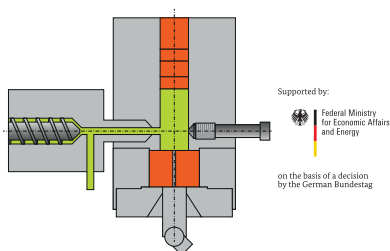
RHEOGRAPH 120

Not only suitable for high polymers, but also for elastomer testing!

The entire multifunctional RHEOGRAPH family is suitable, among other things, for determining the flow and viscosity functions of rubber compounds.

In addition, it serves as a tool for **optimization in compound development**. The system allows extensive process-oriented simulations for material characterization.

Expressive evaluations such as Mooney correction (wall slip) or flow instabilities (shark skin effect) can be carried out without difficulty.



+ ADD-ON CONTIFEED

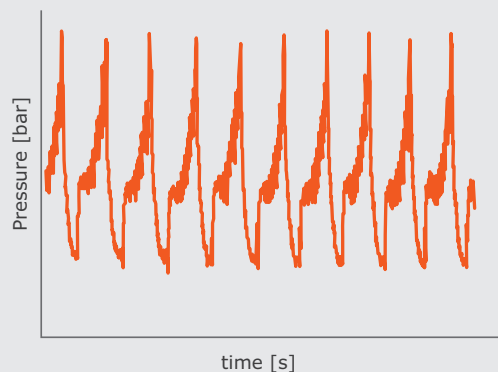
Bubble-free filling and automatic specimen feeding ensure easy handling, even with bulky materials. The reduced heating and residence time allows time savings of up to 50%.

In addition, process-relevant data for injection molding are recorded, and the integrated pre-plasticization enables reliable measurement of powder materials such as PVC dry blends.

ADD-ON

- + Determination of flow instabilities (Shark Skin effect)
- + Thermal conductivity
- + PVT, isothermal or isobaric
- + Die swell measurement, static and dynamic
- + Counter pressure chamber
- + Slit die
- + Corrosion resistant and wear resistant test barrel design
- + RHEOTENS and HAUL-OFF-System to determine the melt tensile
- + CONTIFEED

SHARK SKIN MEASURING DATA



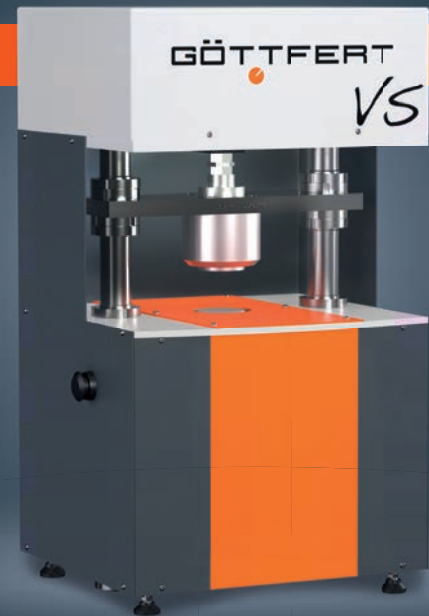
Sample preparation

Volume Punches

For reproducible testing, specimens with a constant volume are essential.

The following volume punches always press uniform specimens from a sheet of varying thickness. Precision components ensure optimal measurement values, with two-hand operation for operator safety.

The punching process of all volume punches is initiated via two-hand operation for operator safety. First, the sheet is compressed, allowing excess material to flow off or be expelled, after which the actual punching process is carried out. The specimen volume can be adjusted precisely, and the compression time can also be varied.



Our two types of Volume Punches

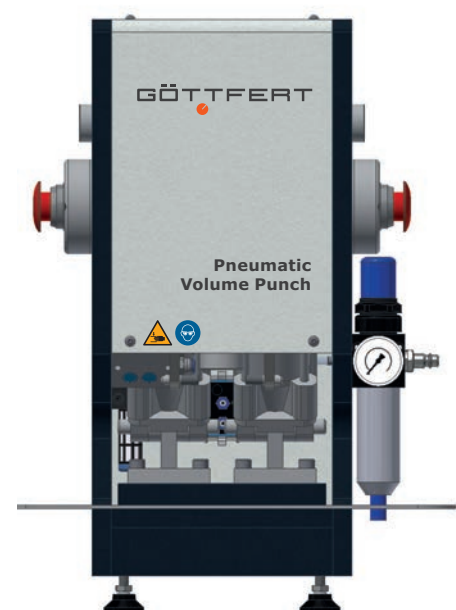
The Hand-operated Volume Punch and the Pneumatic Volume Punch. The Pneumatic Volume Punch additionally requires a compressed air connection.

Pneumatic volume punch

- 1.7 kN at 6 bar
- 17 kN at 6 bar

Hand-operated Volume Punch

- MDR, RPA, RCR
- Mooney





Learn more goettfert.com/volume-punches

Automatic sample feeder

With the retrofittable “Autoloader” option, 5 linear specimens or up to 30 test specimens can be sequentially taken from the specimen tray and transported into the test chamber between two heat-resistant foil sheets.

The system detects the filling level as well as the specimen position in the magazine.

The tested specimen is also removed after completion. During the test, free positions can be reloaded with new specimens for continuous operation.

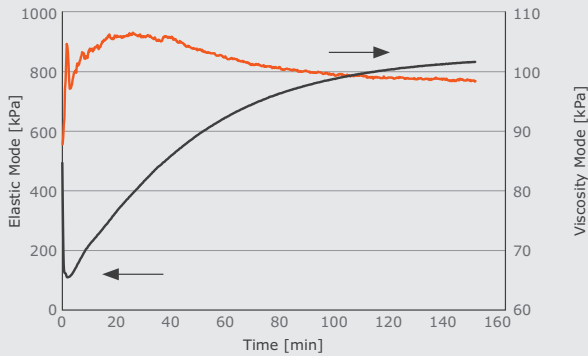
The “RubberView” software provides the possibility to define variable sequences.

In addition, running test plans can be interrupted and then resumed.



LAOS and transient viscosity

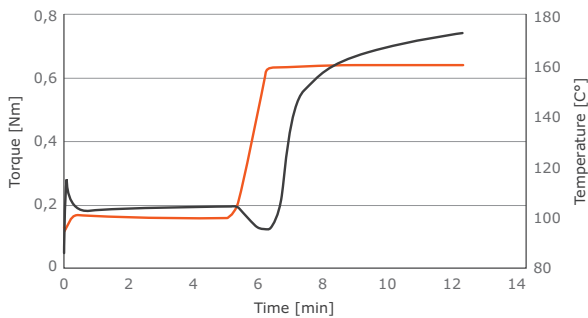
Evaluation methods



VARIABLE TIME

Comparable with the usual Vulkameter test here the module and the viscosity via the time are being captured at constant amplitude and frequency.

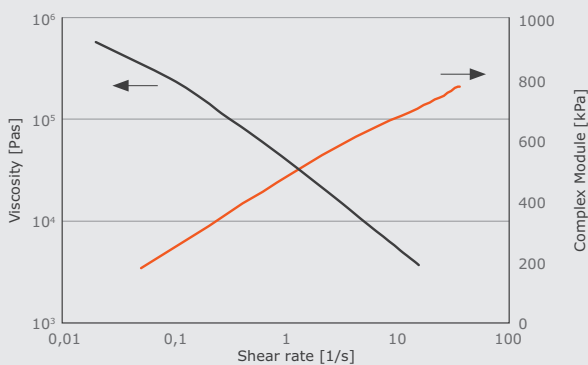
- ELASTOGRAPH
- VISCO-ELASTOGRAPH



TEMPERATURE SWEEP

Via an integrated temperature program definable temperature steps can be individually realized. The example here shows a non-isothermal vulcanization.

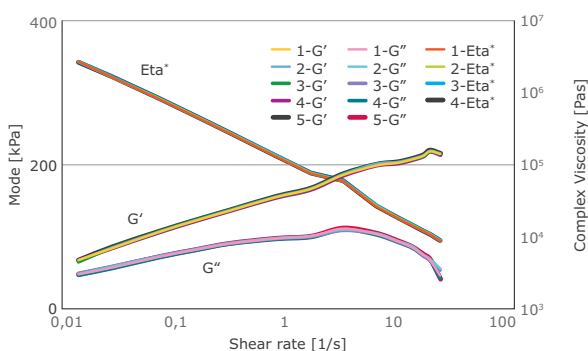
- ELASTOGRAPH
- VISCO-ELASTOGRAPH



FREQUENCY SWEEP

The swinging deformation of the lower chamber half can be controlled exactly between 0.1 to 50 Hz. Torque, module and viscosity are being measured at preselected amplitude. Classic test to determine the flow curve.

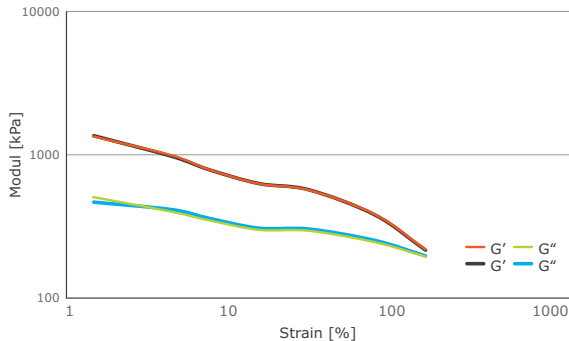
- VISCO-ELASTOGRAPH



MULTIPLE REPRODUCTION

Frequency sweep of a flour elastomer compound, 5 times reproduced.

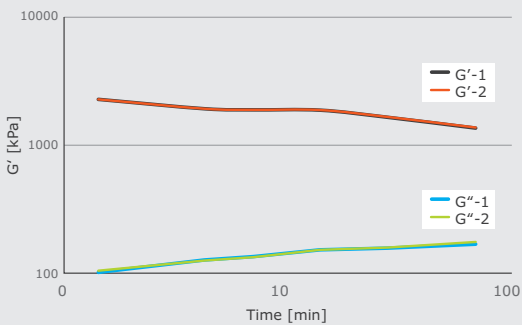
- VISCO-ELASTOGRAPH



AMPLITUDE SWEEP NON VULCANIZED

With this measurement variable ramified polymers can be differentiated to various active filling additives (here at an example of a flour elastomer compound).

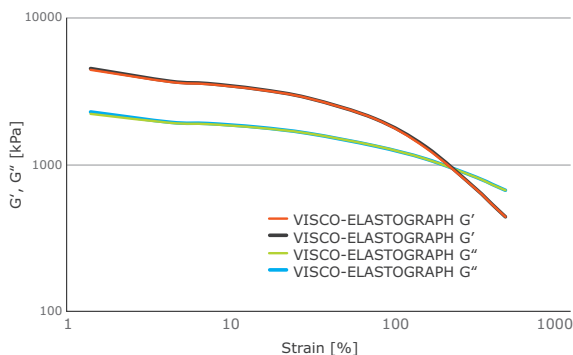
- VISCO-ELASTOGRAPH



AMPLITUDE SWEEP VULCANIZED

Is being used to judge the network which is raised during the vulcanization.

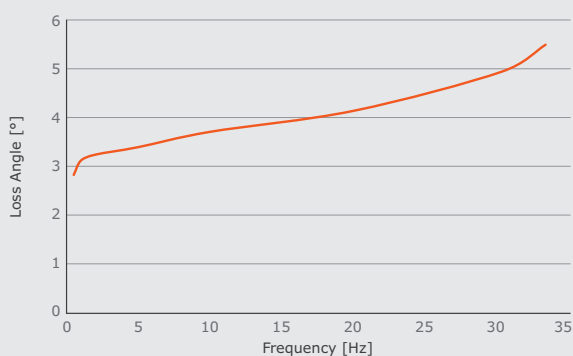
- VISCO-ELASTOGRAPH



PAYNE-EFFECT

An amplitude sweep at an non vulcanized compound shows the Payne effect. The crossing point of G' and G'' helps judging the filler medium network.

- VISCO-ELASTOGRAPH



FREQUENCY DEPENDENCE OF THE PHASE ANGLE

On the basis of the trend of the phase angle a conclusion about the damping behavior of the compound can be given (the test here at a completely vulcanized compound)

- VISCO-ELASTOGRAPH



GÖTTFERT Werkstoff-Prüfmaschinen GmbH

Siemensstraße 2 • 74722 Buchen

Tel: +49 (0) 6281 408-0 • info@goettfert.de



GOETTERT Inc.

Rock Hill, SC 29730, USA

Tel: +1 803 324 3883 • info@goettfert.com



GOETTERT (China) Ltd.

Beijing 100027, CHINA

Tel: +86 10 848 320 51 • info@goettfert-china.com