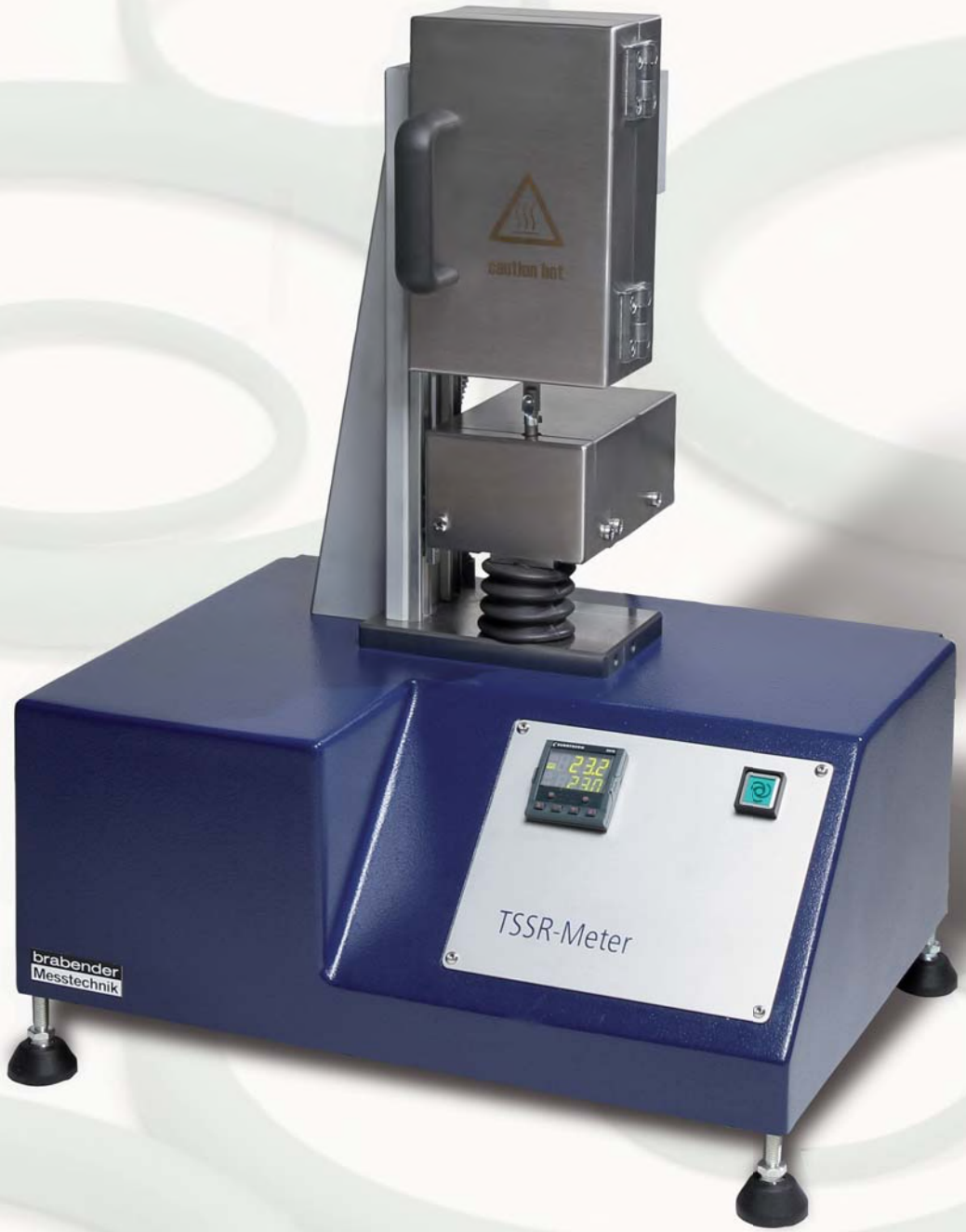
More than 50 years experience

brabender Messtechnik®



Anisothermal stress relaxation test

TSSR-Meter

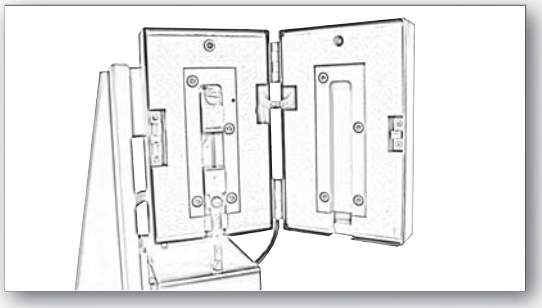
Brabender Messtechnik® GmbH & Co. KG

TSSR-Meter

Anisothermal stress relaxation test for characterizing TPE, elastomers and polymers

With the **TSSR-Meter** conventional isothermal relaxation experiments can be performed as well as the temperature scanning stress relaxation (TSSR), an anisothermal stress relaxation method (AISR method). Using this method the mechanical and thermal properties of TPE, plastics and elastomers can be characterized.

The **TSSR-Meter** is suitable for the development of materials for production support and quality control. With the increasing importance of TPE an important factor, especially in the automotive industry.



TSSR-Meter test chamber

Advantages

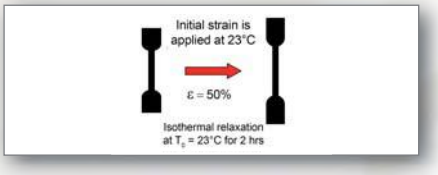
- Reduced testing time and effort (4h TSSR vs. 72h compression set)
- Very good reproducibility
- Rapid determination of crosslink density
- Information about relaxation behavior and structure

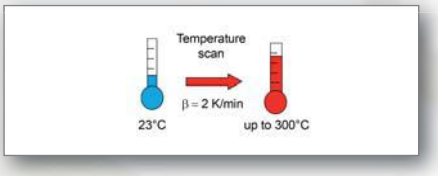
Test sequence

Two different measurement methods are possible with the **TSSR-Meter**: the conventional isothermal relaxation measurement or the use of the TSSR method. The sequence of the measurement with the **TSSR-Meter** takes place in two steps:

After placing the sample in the electrical heated test chamber, the initial strain (e.g. 50%) is applied. During a free selectable time period (e.g. 2h) at a constant temperature (e.g. 23°C), most of the short time relaxation processes appear.

In a second step the anisothermal phase follows. The sample is heated up at a constant, adjustable heating rate (e.g. 2 K/min) to the predetermined temperature (up to 300°C). During both test phases, the instrument records the tensile stress as a basis for the evaluation. The software calculates the maximum operating temperature and the relaxation spectrum of the test material.





Software

The comfortable measuring and evaluation software for Windows® allows automatic test execution, logs the data, puts them online in a clear colour chart and evaluates the measured data automatically.

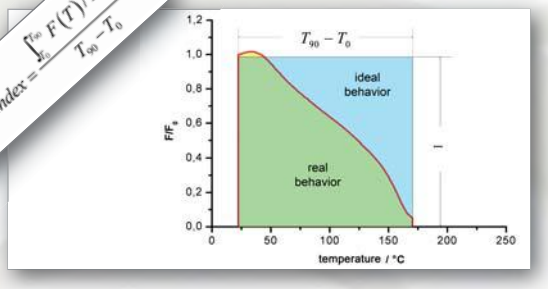
The data can be exported for further analysis from the application directly, for example in an Excel spreadsheet.

TSSR-Meter

TSSR-Index

During the anisothermal stress relaxation, the area of the curve under the normalized force (F/F_0) is determined with respect to the temperature and set in relation to the area of the idealized elastomer material. This relation is the TSSR-Index and a relative measure of the rubber like behavior of a TPE or elastomer material.

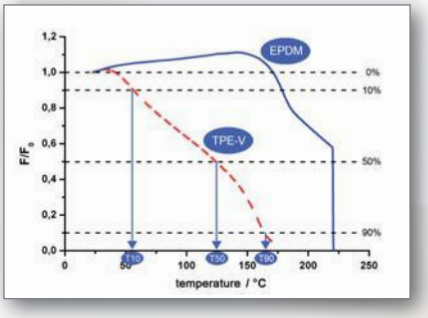
$$TSSR-Index = \frac{\int_{T_0}^{T_{90}} F(T)/F_0 \, dT}{T_{90} - T_0}$$



Relaxation behavior

Temperature limits

Within the relaxation spectrum three distinct temperature limits are set, T_{10}, T_{50}, and T_{90}. The temperature T_x stands for the temperature at which the force ratio F/F_0 has decreased about x% referring to the initial force F_0. Each value represents a specific characteristic of the sample.

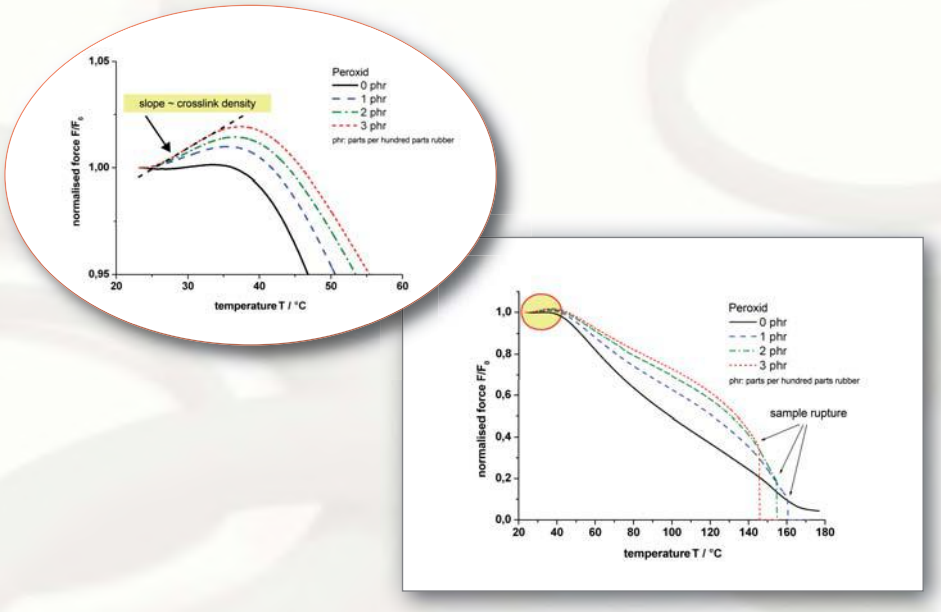


Normalised force as a function of temperature

Crosslink density

The crosslink density of TPV or conventional elastomers can be identified from the relaxation spectrum without great effort, quickly and well reproducible.

The **TSSR-Meter** can also be used to demonstrate the effects of different concentrations of crosslink agent on the degree of crosslink density.



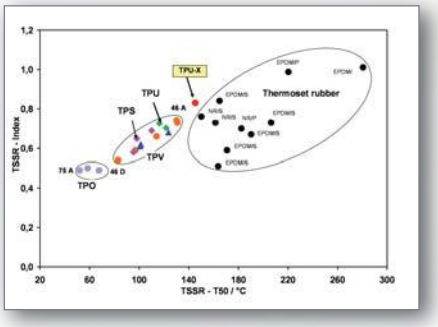
Crosslink density

Applications

The **TSSR-Meter** is used for many applications, where mechanical and thermal properties are measured. The compression set can be predicted using a temperature limit by means of a linear correlation. Applications of TPE compared to carbon black filled elastomers can clearly be defined. For carbon black filled EPDM compounds additional information can be obtained by anisothermal stress relaxation curves. These characterize the interactions between polymers and carbon black.

In addition, the thermal limits of commercial TPE materials can be displayed with the meter TSSR and the various TPE blends can be characterized with the different relaxation spectra.

With the TSSR-Index, determined by the **TSSR-Meter**, materials can be assigned to individual product groups.



Application areas

Cooperation

The **TSSR-Meter** is based on a patented procedure, which was developed at the University of Osnabrück under the direction of Prof. Dr. Vennemann. There is a close cooperation in the fields of development and application engineering.

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Technical Data

Measuring system	• Heating/cooling chamber with electric heating and air cooling • Temperature range 20 - 300°C • Heating rate 0 - 4 K/min • Running traverse parallel and without backlash • Tensile stress 0 - 100% • Load cell 0 - 200 N • Isotherme relaxation time 0 - 1000h
Test specimen	Standard bar type S2 DIN 53504 Standard bar type 5 A EN ISO 527
Connections	• PC via USB • Compressed air 5 - 6 bar • Mains
Environmental conditions	• Storage: temperature -25°C to +55°C • Operation: temperature +5°C to +45°C
Heating rate	2 x 220 W
Mains connection	1 X 230 V, 50/60 Hz, 16 A + N + PE
Dimensions (W x D x H)	490 * 610 * 450 mm
Weight	approx. 29 kg

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