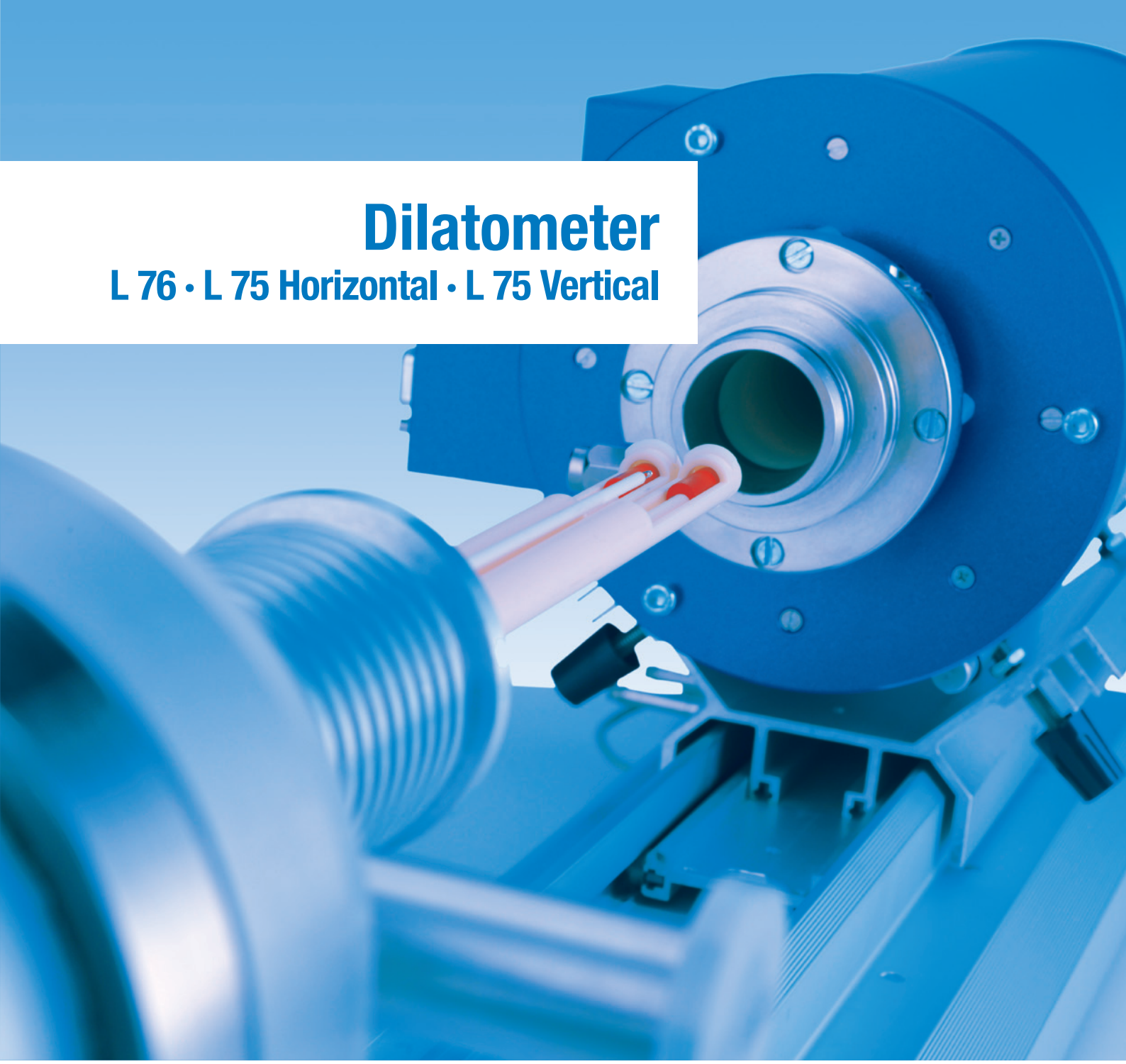
Dilatometer

L 76 • L 75 Horizontal • L 75 Vertical



LINSEIS

General

Dilatometry is a technique which measures the dimensional change of a substance as a function of temperature while the substance is subjected to a controlled temperature program. Many international norms such as DIN 51045, ASTM E831, ASTM E 228 and ASTM D 3386 describe this technique and the exact procedures in detail.

LINSEIS Dilatometers L76, L75H, and L75V provide a powerful tool for the determination of the thermal expansion and expansion coeffi cient (CTE). Further application examples are the evaluation of sintering processes of ceramics, metals and powder metals, the dimensional changes during chemical reactions (Oxidation) and phase changes of solid materials. As a unique feature LINSEIS offers its range of Dilatometers either in horizontal or vertical mode of operation to provide the perfect solution for every application and budget.

Dilatometers are typically used in:
- Glass industry
- Ceramics industry
- Sintering of high tech ceramics
- Aerospace industry
- Metal/powder industry
- New material research
- Automotive industry
- Polymer industry

Dilatometers are frequently used for R&D and Quality Control of solids, liquids, powders and pastes to determine their:
- Linear thermal expansion (ΔL)
- Sinter-temperatures and sintersteps
- Determination of glass transition (Tg)
- Phase changes
- Optimization of burning processes
- Determination of thermal expansion coeffi cient (CTE)
- Volume changes
- Rate controlled sintering (RCS)

The entire range of LINSEIS Dilatometers enables the perfect choice for any application.

LINSEIS L75 series are available in horizontal as well as vertical (Zero – Friction) mode of operation. It offers a broad temperature range, many different sample holders, operation in vacuum or a controlled oxidizing or reducing atmosphere, while maintaining the highest accuracy and ease of use.

The L76 Series was especially developed for quality control and educational purposes. It is an easy to use single push rod model, which does not offer vacuum. Nevertheless for most basic applications it is the perfect solution at an affordable price.

DIL L75 Vertical

DIL L75 Horizontal

DIL L76

Software

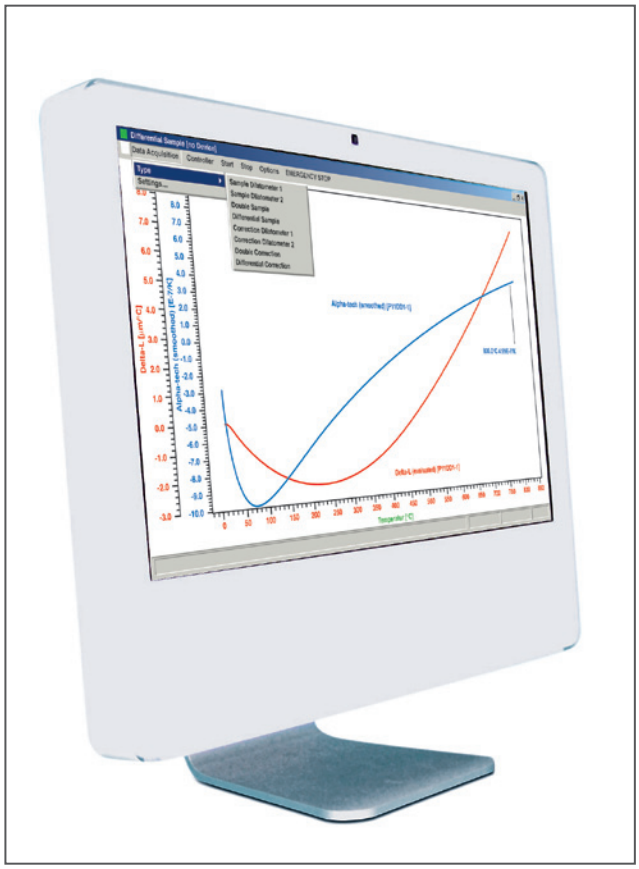
All LINSEIS thermo analytical instruments are PC controlled. The individual software modules exclusively run under Microsoft® Windows® operating systems.

The complete software consists of 3 modules: temperature control, data acquisition and data evaluation. The 32 bit software incorporates all essential features for measurement preparation, execution, and evaluation of a Dilatometer run.

Thanks to our specialists and application experts, LINSEIS was able to develop comprehensive easy to understand user friendly application software.

Software-Features:

- Program capable of text editing
- Data security in case of power failure
- Thermocouple break detection
- Repetition measurements with minimum parameter input
- Evaluation of current measurement
- Curve comparison up to 32 curves



- Storage and export of evaluations
- Export and import of data ASCII
- Data export to MS Excel
- Multi-methods analysis (DSC TG, TMA, DIL, etc.)
- Zoom function
- 1st and 2nd derivation
- Programmable gas control
- Statistical evaluation package
- Automatic axis re-scaling
- Softening point detection

DIL Features:

- Rate Controlled Sintering (RCS) software
- Interchangeable Thermocouples for various atmospheres
- Sinter process evaluation
- Glass transition and softening point evaluation
- Softening point determination and system shut down
- Linear thermal expansion evaluation
- Several system correction features
- Automatic zero point adjustment
- Auto-scheduler for up to 16 sub-sequent runs

Features

Measurement system

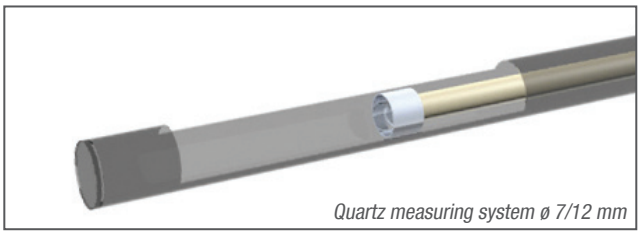
All measuring systems are manufactured to the highest standards and equipped with an LVDT sensor which provides the maximum precision, repeatability, and accuracy. Our Dilatometers have significantly benefited from the extensive research undertaken from the patented LINSEIS LASER Dilatometer.

Automatic pressure control

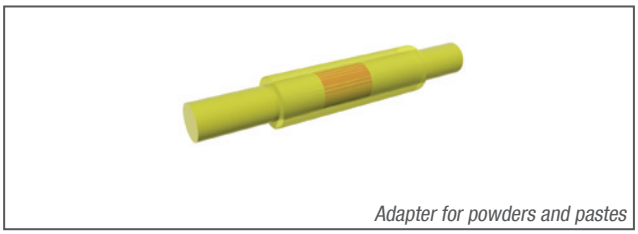
The contact pressure can be continuously varied between 10 and 1000mN, depending on the application. This feature continuously controls the selected contact pressure throughout expansion and/or shrinkage of the sample.

Vacuum atmosphere

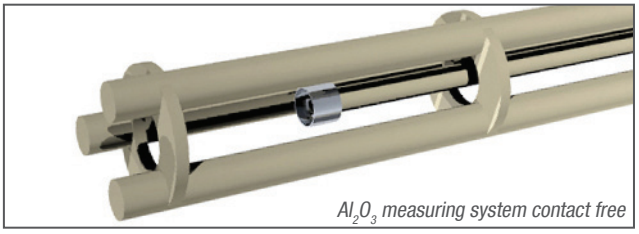
The vacuum tight construction (10^{-5} mbar) of the 75 Series permits measurements in the purest gas atmospheres. This feature is essential in preventing unwanted effects due to sample oxidization.



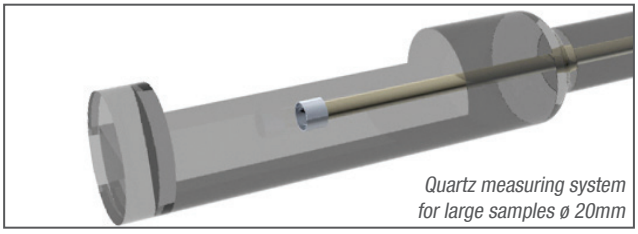
Quartz measuring system ø 7/12 mm



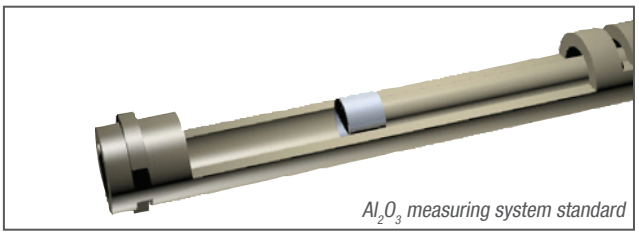
Adapter for powders and pastes



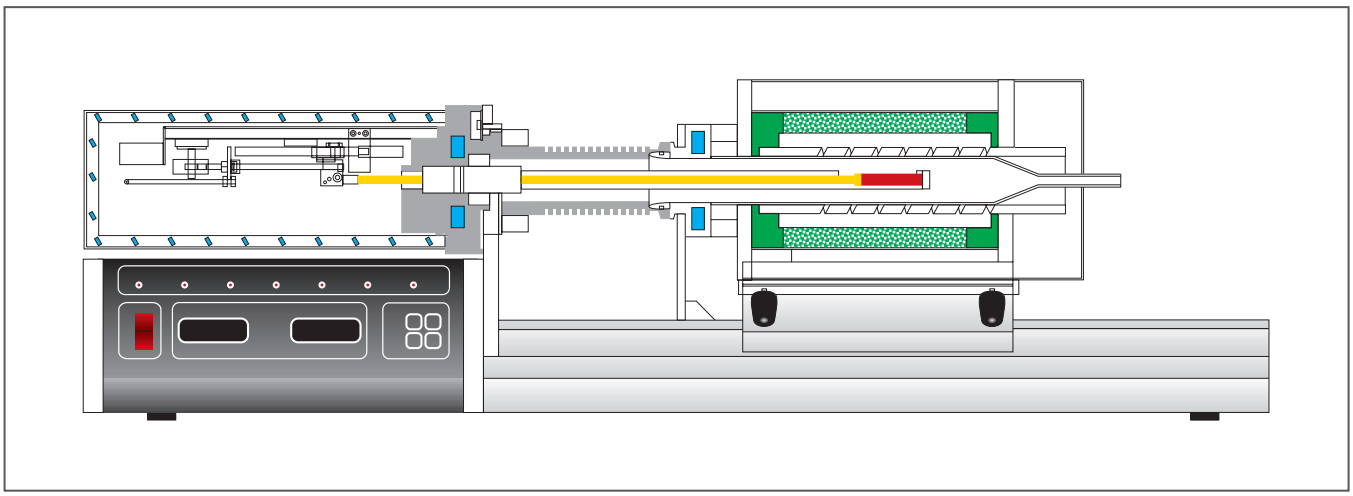
Al_2O_3 measuring system contact free



Quartz measuring system for large samples ø 20mm



Al_2O_3 measuring system standard



Options

Furnaces

Options

Integrated DTA signal

All LINSEIS L75 series dilatometer are optionally equipped with the DTA evaluation feature. This provides the user with valuable additional endo and exothermic sample information.

Special Dilatometers & Accessories

LINSEIS manufactures a broad range of exceptional Dilatometers and accessories. Systems can be specifically designed to meet a broad range of unique applications.
Please call or visit our Webpage for more information!.

Optional Hardware

- Automatic gas control
- Closed loop water cooler
- Water bath thermostat
- Selection of rotary and turbo molecular pumps
- Software controlled LN2 cooling device for low temperature furnace
- Sample preparation machine

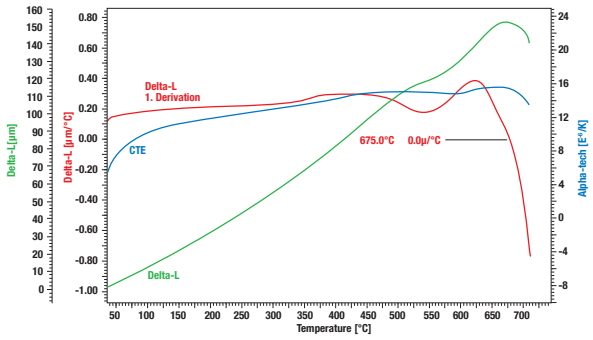
Dilatometer Furnaces

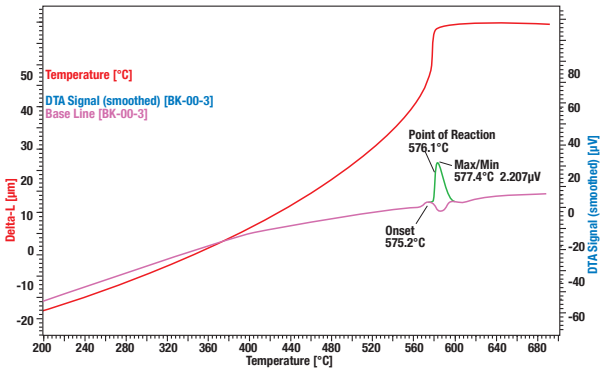
Temperature	Type	Element	Atmosphere	Temperature sensor
		Horizontal		
-180 – 500°C	L75/264	Thermo coax	inert, oxid., red., vac.	Type K
-180 – 700°C	L75/264	Thermo coax	inert, oxid., red., vac.	Type K
RT – 1000°C	L75/220	Kanthal	inert, oxid., red., vac.	Type K
RT – 1400°C	L75/230	Kanthal	inert, oxid., red., vac.	Type S
RT – 1600°C	L75/240	SiC	inert, oxid., red., vac.	Type S
RT – 2000°C	L75/260	Graphite	N_2/Vac.	Type C and/or Pyrometer
		Vertical		
-180 – 500°C	L75/264	Thermo coax	inert, oxid., red., vac.	Type K
-180 – 700°C	L75/264	Thermo coax	inert, oxid., red., vac.	Type K
RT – 1000°C	L75/220	Kanthal	inert, oxid., red., vac.	Type K
RT – 1400°C	L75/230	Kanthal	inert, oxid., red., vac.	Type K
RT – 1600°C	L75/240	SiC	inert, oxid., red., vac.	Type K
RT – 1750°C	L75/250 M	$MoSi_2$	inert, oxid., red., vac.	Type K
RT – 2000°C	L75/260	Graphite	inert, oxid., vac.	Type K
RT – 2400°C	L75/270	Tungsten	N_2/Vac.	Type C and/or Pyrometer
RT – 2800°C	L75/280	Graphite	inert, oxid., vac.	Pyrometer

Applications

Glass Ceramic

The dilatometric method is an excellent method to determine the thermal expansion (CTE) and the softening point of glass ceramic materials. Besides the absolute expansion and the expansion coefficient (CTE) you can find the first derivative of the absolute expansion. Where the first derivative goes through zero you can determine the max. of the thermal expansion and thus the softening point of the material.



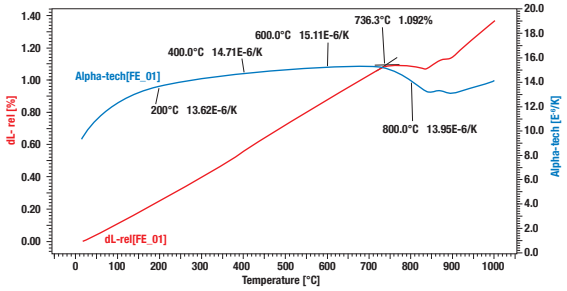


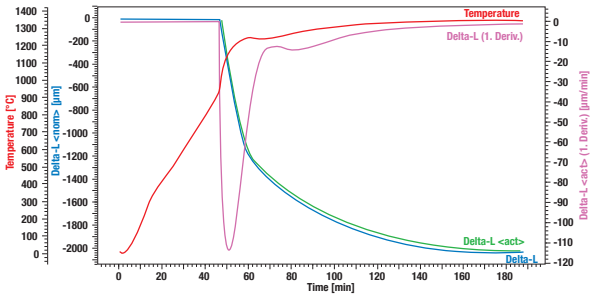
DTA - Feature

The thermal expansion of rock crystal (α-SiO_2) can be easily evaluated with the L75 Dilatometer. The additional DTA feature enables an in depth view of the thermal behavior of the material. The DTA measurement is a mathematical routine based on the sample temperature. Exo- and endothermic effects influence the change of the sample temperature during the dynamic heating or cooling cycle. At app. 575°C the phase transition from α- to β-SiO_2 takes place. The deviation of the measured temperature from the literature value (574°C) can be used for a temperature calibration.

Iron

The linear thermal expansion (ΔL) and the CTE of the iron sample under argon atmosphere are evaluated. The heating rate was 5K/min. After 736.3°C (peak temperature of CTE) shrinkage was detected, which is due to a change in the atomic structure, known as the curie-point. The difference of measured and literature result can be attributed to contamination of the sample.



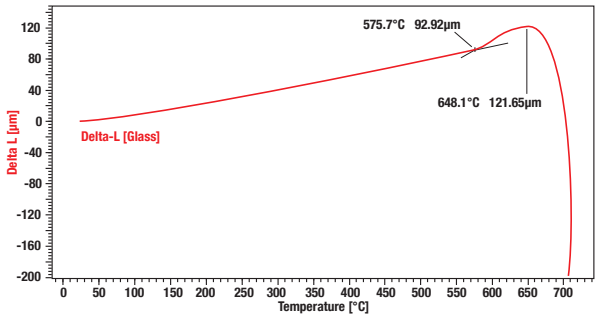


Ceramics / Powder metallurgy

In production processes of high-tech ceramics a simulation of sinter processes is of high interest. When using the optional software package RCS (rate controlled sintering) it is possible to program controlled sintering with a dilatometer as per PALMOUR III theory. The following application is a sintering process of ZrO_2. Here the final density of 100% is achieved. The initial heating rate decreases as the final density is reached.

Glass sample, softening point

The glass sample was measured with the softening-detection feature. In this case, the heating ramp is terminated either if the target temperature set is reached, or if the shrinkage of the sample reaches a given threshold. In the run, the threshold was set to –100µm – when the change in length measured falls 100µm below the maximum value of the actual heating segment, the heating is terminated and the next (cooling) segment will be processed. So, the softening point can be detected in an easy and safe procedure.



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Services: Service Lab, Calibration Service

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