

Dilatometer (Coefficient of Thermal Expansion)

Dilatometry (DIL) is a technique in which a dimension of a substance (such as: ceramics, glasses, metals, composites, polymers and others) under no or negligible load is measured (e.g. expansion or shrinkage measurement) as a function of temperature while the substance is subjected to a controlled temperature program in a specified atmosphere.

Dilatometers are frequently used for R&D and quality control of solids, liquids, powders and pastes to determine their:

- determination of thermal expansion coefficient (CTE)
- linear thermal expansion (ΔL)
- sinter-temperatures and sinter steps
- determination of glass transition (T_g)
- phase changes
- optimization of burning processes
- volume changes
- Rate Controlled Sintering (RCS)
- decomposition
- density change

Depending on the application, we can offer the perfect solution:

Horizontal Dilatometer L76/L75Horizontal:

- multipurpose system
- highest temperature uniformity
- L75H is perfect for research & development

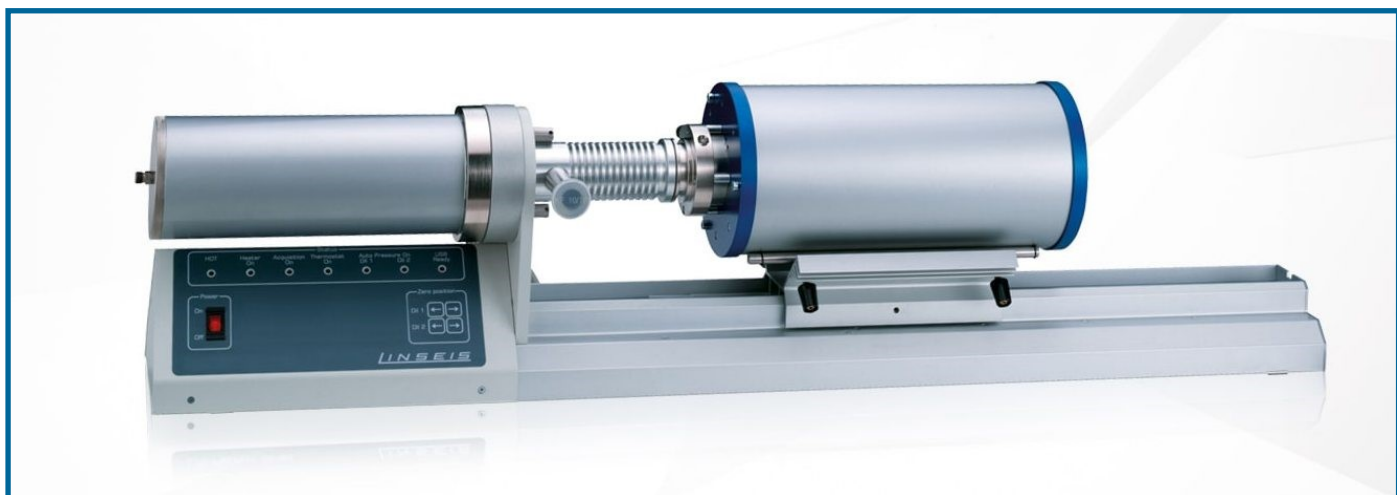
Vertical Dilatometer L75Vertical:

- friction free sample holder
- push-rod contact is always guaranteed
- possible field of application Rate Controlled Sintering (RCS)
- best arrangement for low -263°C and high temperature $>2800^\circ\text{C}$ applications

L76 Platinum Series

Robust Economy Series Dilatometer

The main application field for the LINSEIS L76 Dilatometer series is the CTE measurement of ceramics, brick, tile, porcelain and building materials. Furthermore it is widely used for quality control purposes in ceramics and in metal industries.



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 software incorporates all essential features for measurement preparation, execution, and evaluation of a dilatometer run. Thanks to specialists and application experts, LINSEIS offers 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
- 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 derivative
- programmable gas control
- statistical evaluation package
- automatic axis re-scaling
- softening point detection

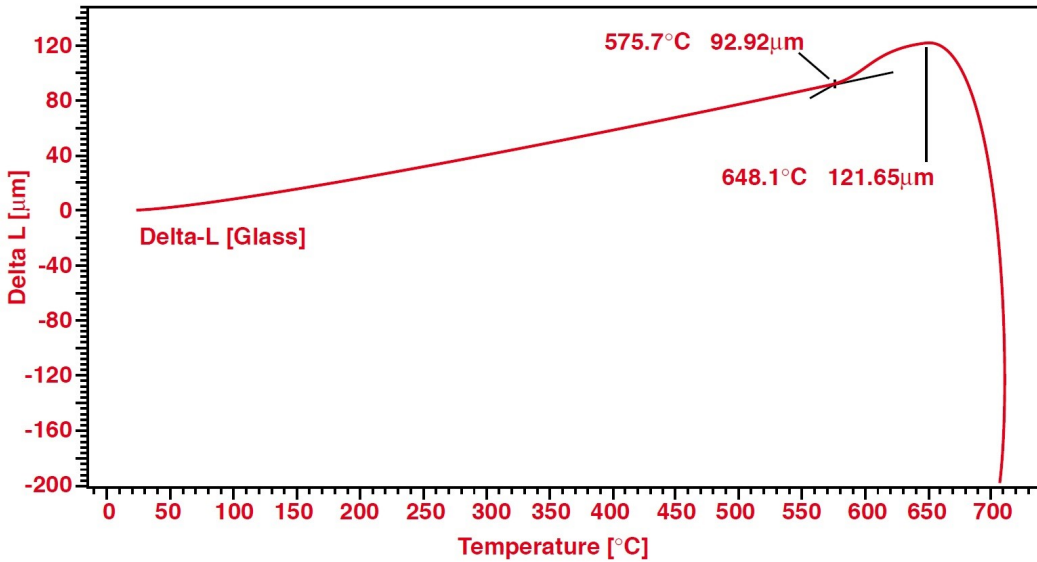
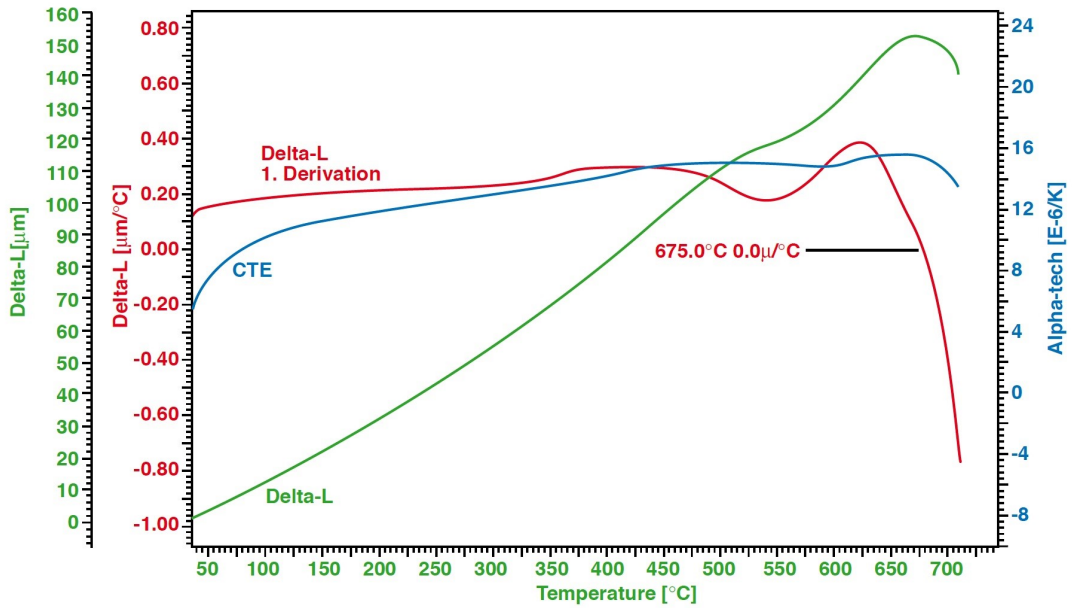
DIL Features:

- Rate Controlled Sintering (RCS) software
- interchangeable thermocouples for various atmospheres
- sinter process evaluation
- glass transition and softening point evaluation
- softening point determination & system shut down
- linear thermal expansion evaluation
- several system correction features
- automatic zero point adjustment
- auto-scheduler for up to 16 subsequent runs
- Display of relative/absolute shrinkage or expansion curves

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.

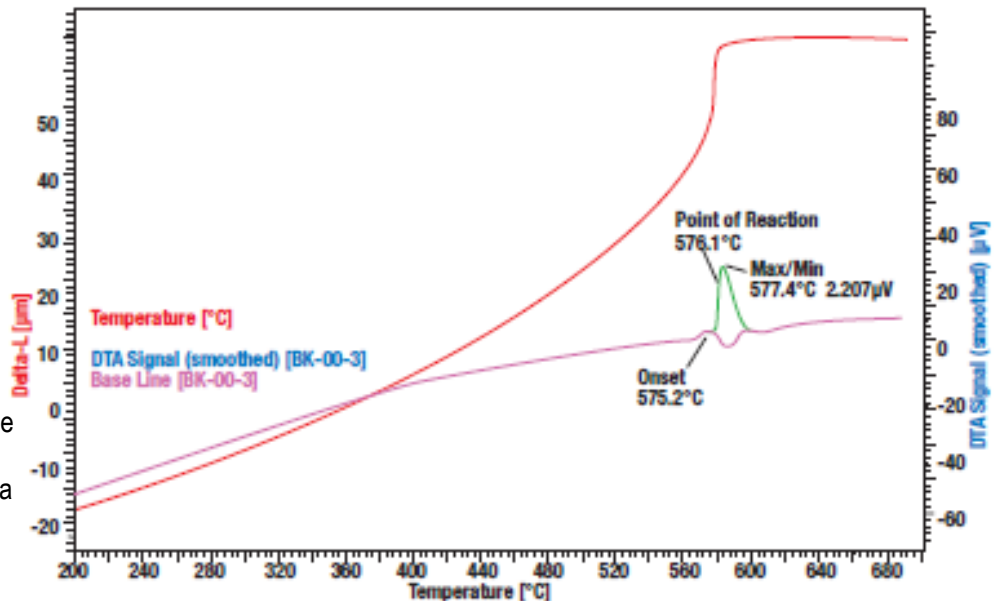


Glass Sample, Softening point

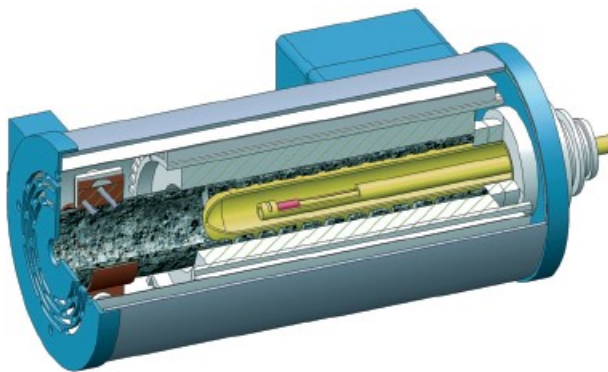
The glass sample was measured with the softening-detection feature. In this case, the heating ramp is terminated either if the target temperature set is reached or if the shrinkage of the sample reaches a given threshold. In the run, the threshold was set to $-100\mu\text{m}$ – when the change in length measured falls $100\mu\text{m}$ 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.

DTA Feature

The thermal expansion of $\alpha\text{-SiO}_2$ can be easily evaluated with the L75 Dilatometer. The additional DTA feature enables an in depth view of the thermal behaviour 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. The phase transition from α - to $\beta\text{-SiO}_2$ takes place at app. 575°C . The deviation of the measured temperature from the literature value (574°C) can be used for a temperature calibration. (Optional extra for L76)



FURNACES



Temperature	Type	Heating Element	Atmosphere	Temp. Sensor
-263 - 300	L75/264 He	Thermo Coax	inert, oxid, red, vac	Pt 100
-180 - 500	L75/264	Thermo Coax	inert, oxid, red, vac	Type K
-180 - 700	L75//264/700	Thermo Coax	inert, oxid, red, vac	Type K
-180 - 1000	L75/264/1000	Thermo Coax	inert, oxid, red, vac	Type K
RT - 1000	L75/220	Kanthal	inert, oxid, red, vac	Type K
RT - 1400	L75/230	Kanthal	inert, oxid, red, vac	Type S
RT - 1600	L75/240	SiC	inert, oxid, red, vac	Type S
RT - 1650	L75/240PT	Platinum	inert, oxid, red, vac	Type S
RT - 1750	L75/240M	MoSi ₂	inert, oxid, red, vac	Type B
RT - 2000	L75/260	Graphite	N ₂ / vac	Type C
RT - 2400	L75/270	Graphite	N ₂ / vac	Pyrometer
RT - 2800	L75/280	Graphite	N ₂ / vac	Pyrometer

MEASURING HEADS

Quartz Measuring System,
7 or 12mm diameter



Al₂O₃ measuring system standard



Al₂O₃ measuring system contactless



SPECIFICATIONS	L76	L75 Horizontal	L75 Vertical
Temperature Range (°C)	RT to 1,600	-180 up to 2,800	-263 up to 2,800
Delta L resolution	0.05nm	0.03nm	0.03nm
Measuring range	±2500 µm	±2500 µm	±2500 µm
Contact Force	-	10nm up to 1N	
Heating rate (Based on furnace)	Steel, copper, fused silica, silicon carbide: 0.001 up to 50K/min Graphite: 0.001 up to 100K/min		
Sample holder	user interchangeable, SiO ₂ , Al ₂ O ₃ , graphite All sample holders available as: single system (one pushrod); system with two pushrods usable in dual or differential mode Al ₂ O ₃ sample holder; SiO ₂ and Al ₂ O ₃ sample holders available as hollow tubes or massive rods		
Temperature / Accuracy / Precision / Resolution	1K / 0.1K / 0.001K		
Thermal stability (isotherm)	± 0.02 K		
ΔL / L0 Repeatability	0.001%		
ΔL / L0 Accuracy	0.002%		
Force Resolution	-	0.001mN	
Gas Atmosphere	Inert, oxidising, reducing	Inert, oxidising, reducing, vacuum	
Software	Latest Windows operating system		
Multiple furnace configuration	Optional	Up to 2 furnaces	Up to 3 furnaces
Gas dosing	manual gas dosing or mass flow controller 1/3 or more gases		
Contact Force Adjustment	-	Included	
Single / Double Dilatometer	-	Optional	
Softening point determination	Included		
Density determination	Optional	Included	
L-DTA	Optional	Included (up to 2,000°C)	
Rate controlled sintering (RCS)	Optional	Included	
Thermal library	Optional	Included	
Electric thermostatisation of measuring head	Included		
Vacuum tight design	-	Yes	