LINSEIS

pushing boundaries

TMA L71
TMA L72

Thermo **Mechanical Analysis**

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Since 1957 LINSEIS Corporation has been delivering outstanding service, know-how and leading innovative products in the field of thermal analysis and thermo-physical properties.

Customer satisfaction, innovation, flexibility, and high quality are what LINSEIS represents. Thanks to these fundamentals, our company enjoys an exceptional reputation among the leading scientific and industrial organizations. LINSEIS has been offering highly innovative benchmark products for many years.

The LINSEIS business unit of thermal analysis is involved in the complete range of thermoanalytical equipment for R&D as well as quality control. We support applications in sectors such as polymers, chemical industry, inorganic building materials, and environmental analytics. In addition, thermophysical properties of solids, liquids, and melts can be analyzed.

Rooted in a strong family tradition, LINSEIS is proudly steered into its third generation, maintaining its core values and commitment to excellence, which have been passed down through the family leadership. This generational continuity strengthens our dedication to innovation and quality, embodying the essence of a true family-run business.

LINSEIS provides technological leadership. We develop and manufacture thermoanalytic and thermophysical testing equipment to the highest standards and precision. Due to our innovative drive and precision, we are a leading manufacturer of thermal analysis equipment.

The development of thermoanalytical testing machines requires significant research and a high degree of precision. LINSEIS Corp. invests in this research to the benefit of our customers.

CLAUS LINSEIS

CEO DIPL. PHYS.

To strive for the best due diligence and accountability is part of our DNA. Our history is affected by German engineering and strict quality control.

We want to deliver the latest and best technology for our customers. LINSEIS continues to innovate and enhance our existing thermal analyzers. Our goal is to constantly develop new technologies to enable continued discovery in Science.

Enginering & Innovation

Linseis **Service**

Customized Solutions - The Linseis Advantage

At Linseis, we believe that every measurement challenge is unique — and so should be your instrument.
While many suppliers rely on standardized configurations, Linseis distinguishes itself through exceptional flexibility and the capability to deliver customer-specific adaptations in record time.

Our experienced engineering teams work hand in hand with you to design and implement fully customized solutions that meet your precise application requirements — whether that means a unique sensor configuration, an extended temperature range, or a specialized software integration.

With decades of experience and a modular product architecture, we turn customization into a standard service — fast, efficient, and reliable.
Choose Linseis and experience what true flexibility in thermal analysis and material characterization means.

Contact form

Service & Support

Redefining Ownership

When investing in analytical instrumentation, long-term value matters just as much as precision. That's why Linseis systems are engineered to deliver the lowest Total Cost of Ownership in their class — combining reliability, efficiency, and flexibility in every detail.

Our instruments are built with robust, high-quality components designed for longevity and minimal maintenance. This means fewer service interventions, shorter downtimes, and reduced operating costs over the entire product lifetime. Intelligent software updates and remote support further ensure that your system remains state-of-the-art, even years after installation.

Thermomechanical **Analysis**

Thermo Mechanical Analysis (TMA) provides a precise and efficient way to measure dimensional changes such as expansion, shrinkage or deformation of a material as a function of temperature, time and applied force.
By applying a controlled load while varying the temperature, TMA allows the accurate characterization of thermal and mechanical behavior, including linear expansion, glass transitions, softening points and viscoelastic responses.

With advanced features such as high-resolution displacement detection, dynamic load capability for elasticity measurements and a wide operating range from **–150 °C to 1600 °C**, LINSEIS TMA systems deliver excellent precision and flexibility.

The modular design, gas-tight cell and compatibility with hyphenated techniques like evolved gas analysis ensure that the instrument can grow with future analytical needs—making it an indispensable tool for comprehensive material characterization.

Application areas

- Tension studies of the stress/strain properties of films and fibers
- Determination of softening behavior
- Determination of Young's modulus
- Glass transition temperatures and secondary transitions
- Determination of mechanical behavior under applied force
- Phase change determination
- Determination of expansion coefficient (dilatometry)
- Sintering behavior
- Volumetric expansion
- Slipping and friction resistance

Furnaces

The various furnace systems of the Linseis TMA enable precise temperature control and maximum stability for a wide range of application; from low-temperature to high-temperature measurements.

TMA L71

Temperature	Type	Element	Atmosphere	Temperature sensor
-150 °C* – 1000 °C	L75/220	Kanthal	inert, oxid., red., vac.	Type K

*low temperature option

TMA L72

Temperature	Type	Element	Atmosphere	Temperature sensor
-180 °C – 500 °C	L75/264	Thermo coax	inert, oxid., red., vac.	Type K
-180 °C – 700 °C	L75/264 L75/220	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

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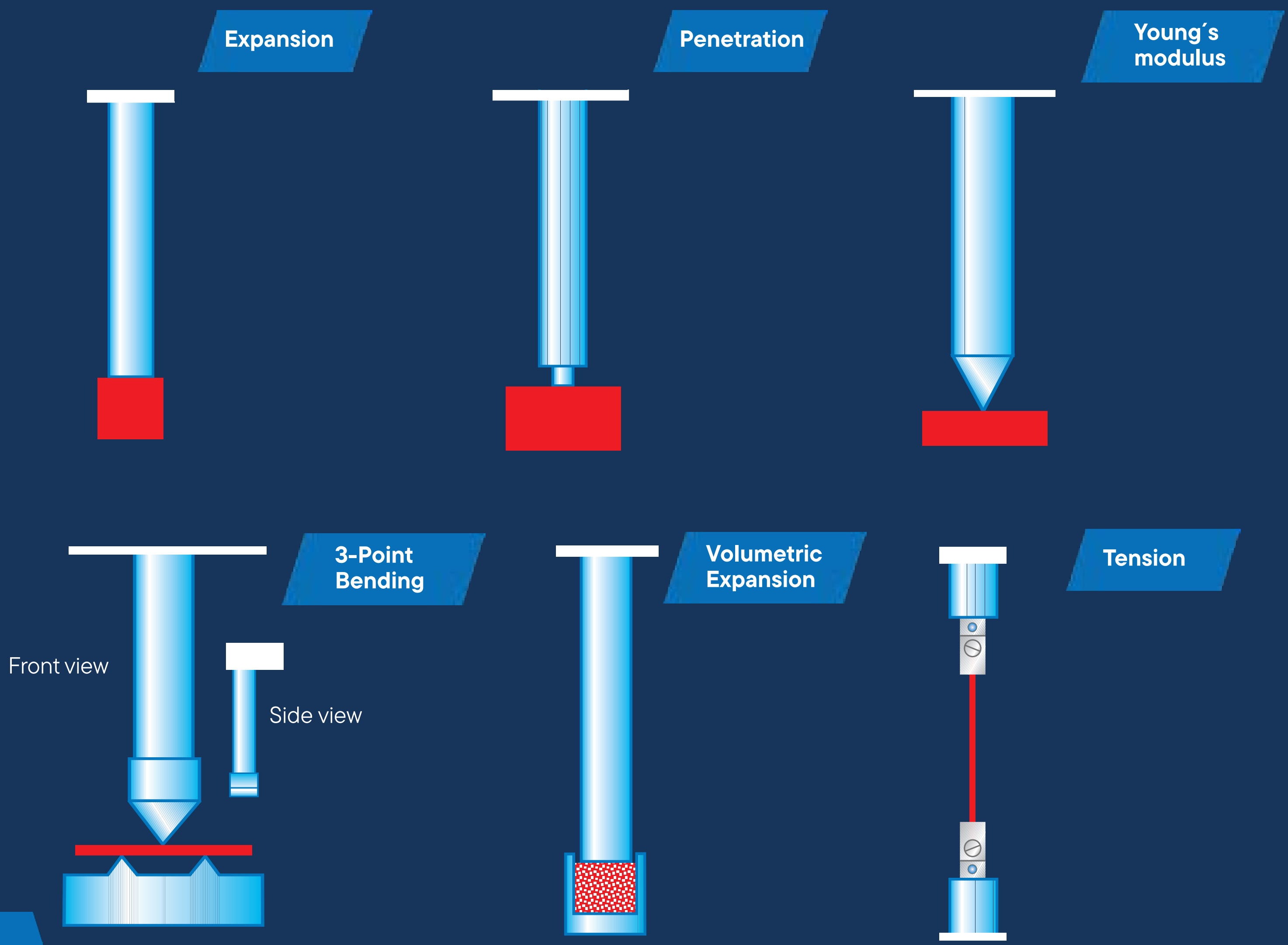
TMA/DTMA
Features

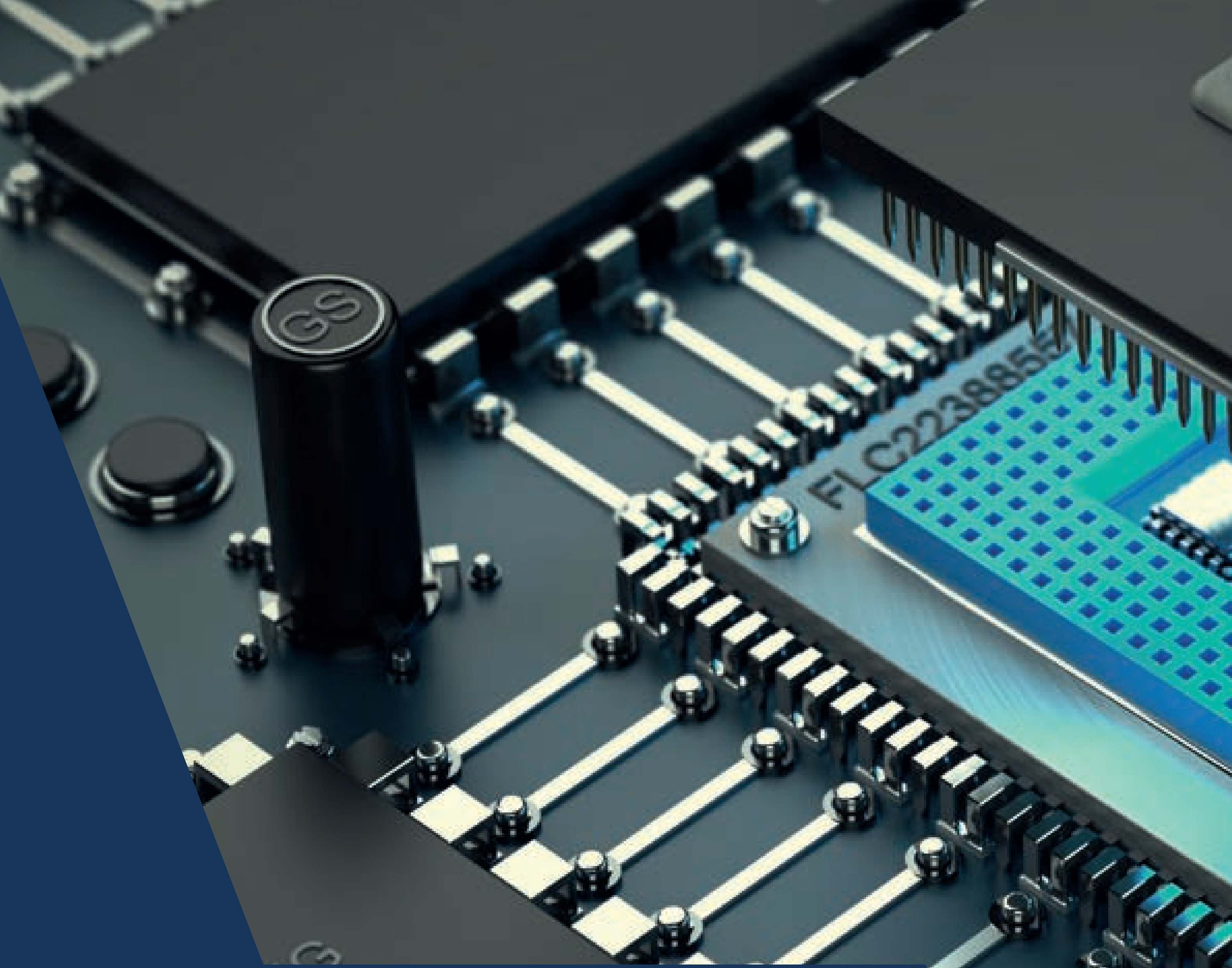
With low constant load

- Linear thermal expansion evaluation
- Change of volume
- Phase transformation
- Sinter process evaluation
- Softening point determination
- Transformation points
- Swelling behavior
- Tension

With increased contant load

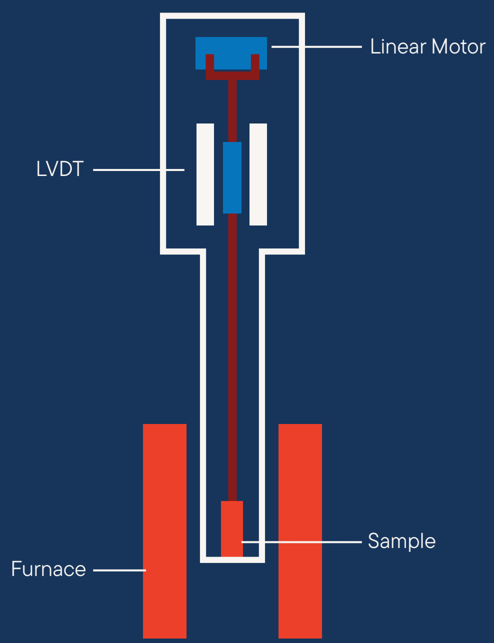
- Penetration
- Transition and comparison tests
- Three point bending test



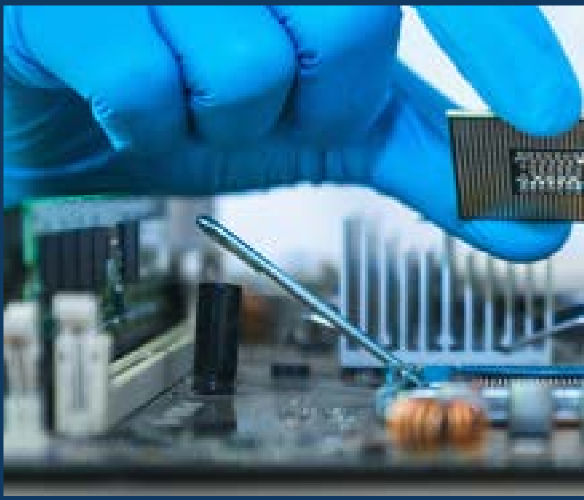


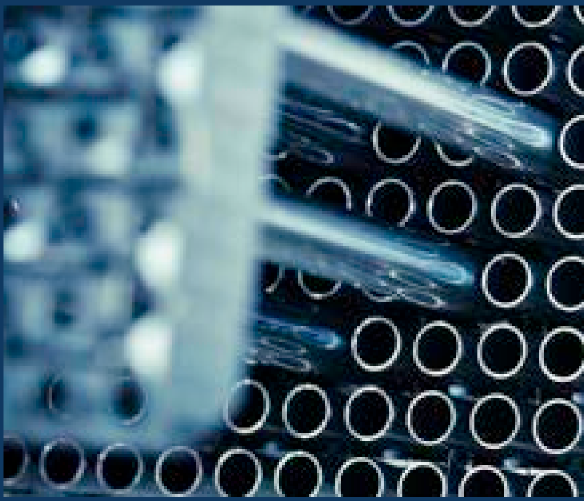
Additional optional features

- DTA evaluation
- (RCS) Rate controlled sintering software



Measuring Concept





Sample chamber

The easily accessible chamber is located in the center of the furnace. Both temperature and atmosphere can be controlled. In addition an optional mass flow controller is available for purge gas regulation. The gas tight cell can be evacuated and allows you to measure under a defined atmosphere. Only such a system can provide definitive information concerning the samples sensitivity to oxidation.

Furnace

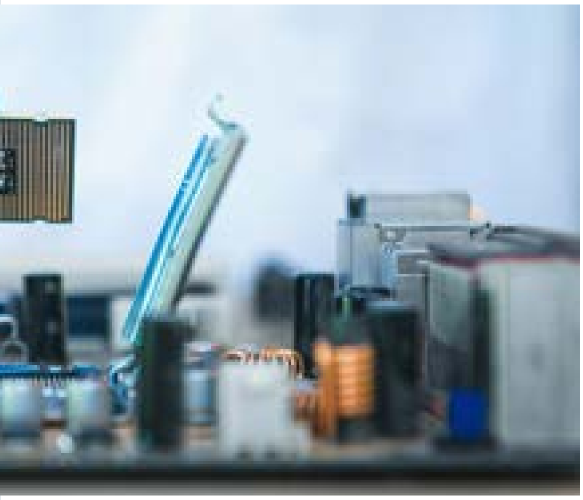
The TMA Platinum Series comes with a robust and reliable furnace. Its customized design enables rapid heat up and cool down times and an excellent heating rate control over the entire temperature range.

Expansion and temperature sensor

Every dimensional change of the sample is transmitted via the pushrod to the highly precise inductive transducer (LVDT sensor). Its precise and reliable response over the entire temperature range guarantees highest reproducibility of the TMA results. The temperature sensor is located right beside the sample leading to the high accuracy.

Dynamic TMA mode

This feature allows you to study the visco-elastic behavior of materials. In D-TMA the force exerted on the probe alternates automatically by the given frequency.



Sample Holders

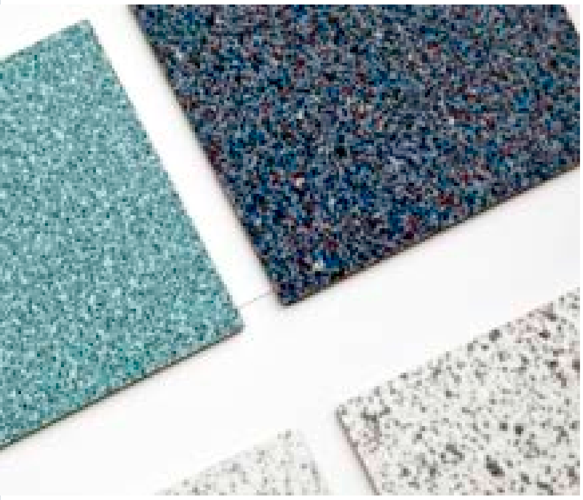
A broad range of sample holders is available for the TMA. Hence the best method for testing can be selected for every application. Furthermore LINSEIS can certainly provide aid for special customer requirements.

Automatic pressure control

The contact pressure can be continuously varied between 10mN and 20 N depending on the system. This feature continuously adjusts the contact pressure throughout expansion and/or shrinkage of the sample.

Cooling system

The liquid nitrogen cooling system has been completely automated; manual refilling is not necessary. This simplifies operation, improves reproducibility and allows measurements to be performed over a long period of time.



Intergrated DTA signal

All LINSEIS TMA models are optionally equipped with the DTA evaluation feature. This provides the user with valuable additional endo- and exothermic sample information

Equipment for gas control and safety (H_2, CO, CO_2, etc...)

All Linseis instruments can be prepared for the use in hydrogen atmosphere with just minor adjustments. The most important thing is a safety system that can ensure that there is no leakage and no explosive atmosphere generated outside of the instrument. Therefore, the Linseis safety system uses hydrogen sensors that are coupled to an automatic gas control panel. If there is a leakage or unwanted hydrogen release, the instrument is automatically flooded with inert gas and the hydrogen valves are closed. This ensures a minimum risk level during operation. Besides that, the system contains an optional burn off unit where the gas outlet is connected to, to ensure that also the used gas of the measurement chamber is not just released into the environment. The system can also be operated with several combinations of inert gases and even water vapor besides hydrogen.

In summary, the Linseis safety system comes with the following benefits:

- Automatic evacuation function
- Gas flow control for multiple gases including water vapor and hydrogen
- Emergency shutdown function
- Gas detector system (H_2, CO, CO_2, etc...
- optional burn off unit
- Continuous monitoring to ensure safe operating conditions

Linseis equipment for operation under water vapor and controlled relative humidity

For many applications in thermal analysis, the atmosphere plays an important role as it may affect the sample behavior or activate reactions. Humidity influence on building materials, storage time of pharmaceuticals and foods or influence on mechanical properties of polymers are just some of the most common examples. Of course, the Linseis instruments are suitable for such experiments, however there is one fact that is often causing confusing and must be considered carefully:
The difference between water vapor and relative humidty.

Relative Humidity Generators are most commonly used for experiments around room temperature, while water vapor applications are most often at higher temperatures. When water is heated to its boiling point or higher than that, the water changes its aggregate form from liquid to gaseous. It is then existing as water vapor (steam). If this steam is introduced into any kind of reaction chamber or instrument, it is called water vapor application. In contrast, every gas can transport and contain a certain amount of water at a given temperature. This is called humidity. Considering air as an example, there is always an amount of water contained in the air, even below the boiling point of water, which is defined as grade of humidity or relative humidity.

Software

All LINSEIS thermo analytical instruments are software controlled. The individual software modules run exclusively under Microsoft® Windows®operating systems. The complete software consists of a data acquisition, data evaluation and administration module and incooperates all essentials: features for measurement preparation, execution and evaluation of a thermoanalytical measurement.

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

Features-Software:

- Data security in case of power failure
- Thermocouple break protection
- Repetition measurements with minimum parameter input
- Evaluation of current measurement
- Curve comparison of up to 50 curves
- Storage and export of evaluations
- Export and import in ASCII format
- Data export to MS Excel
- Multi-methods analysis (DSC, TG, TMA, DIL, etc.)
- Zoom function
- 1st and 2nd derivation
- Programmable gas control
- Curve arithmethics
- Statistical evaluation package
- Free scaling
- Automatic calibration
- Optional Kinetic and Lifetime Prediction
- Software packages
- Interface to MS and FTIR

The **LINSEIS Thermal Library** software package comes as an option for the well-known, user friendly LINSEIS LiEAP (Linseis Evaluation and Acquisition Platform) software that is integrated in almost all our instruments.
The Thermal Library allows the sample material identfication by comparing the measurement curve with a data base providing thousands of references and standard materials within only 1-2 seconds.

Multi-Instrument

LINSEIS instruments such as DSC, STA, TGA & LFA can be controlled with the same powerful LiEAP software platform.

Multi-User

The administrator can generate different user levels providing different rights to operate the instrument. A optional Log file is also available.

Report Generator

Convenient template selection to generate customized measurement reports.

Database

State of the art database design enables easy data handling.

Kinetic software

Kinetic analysis of DSC, DTA, TGA, EGA (TG-MS, TG-FTIR) data for the study of the thermal behavior of raw materials and products.

Technical **Specifications**

	TMA L71 EM	TMA L71	TMA L72
Temperature range	-150 up to 1000°C	-150 up to 1000°C	-180 up to 500°C RT up to 1400/1600/ 1750 /2000/2400°C
Force modulus	0.001 N 5.7 N	0.001 N 5.7 N 20 N	0.001 N 5.7 N
Frequency	1 or 5Hz	-	0.05 to 1 or 50Hz
Resolution	0.125 nm/digit	0.125 nm/digit	0.125 nm/digit
Sample size	30/50mm	30/50mm	30/50mm
Atmosphere	inert, reduced react. gas	inert, reduced react. gas	inert, reduced react. gas
Temperature precision	± 1 °C	± 1 °C	± 1 °C
Heating rate	0.1 to 100°C	0.1 to 100°C	0.1 to 100°C
Isothermal temperature control	± 0.1 °C	± 0.1 °C	± 0.1 °C
Measurement precision for (CTE)	± 0.1 % or better	± 0.1 % or better	± 0.1 % or better
Sensitivity	1.25 nm	1.25 nm	1.25 nm
Dynamic baseline drift	≤ 1 µm	≤ 1 µm	≤ 1 µm
Operation of the system	The system supports both standard and advanced operation modes such as temperature or force ramps, isostrain, creep, stress relaxation, and dynamic TMA.	The system supports both standard and advanced operation modes such as temperature or force ramps, isostrain, creep, stress relaxation, and dynamic TMA.	The system supports both standard and advanced operation modes such as temperature or force ramps, isostrain, creep, stress relaxation, and dynamic TMA.
Frequency range	0.01 to 1 Hz	0.01 to 1 Hz	0.01 to 1 Hz

	TMA L71 EM	TMA L71	TMA L72
Purge gas control	digital mass flow controller must be provided for purge gas Option: L40/2051/MFC	digital mass flow controller must be provided for purge gas Option: L40/2051/MFC	digital mass flow controller must be provided for purge gas Option: L40/2051/MFC
Sample size (solid)	min. length 20mm max. length up to 50mm diameter up to 10 mm	min. length 20mm max. length up to 50mm diameter up to 10 mm	min. length 20mm max. length up to 50mm diameter up to 10 mm
Sample size (film/fibre)	up to 25mm(L), 0.4-0.6mm(T), up to 5 mm(W)	up to 25mm(L), 0.4-0.6mm(T), up to 5 mm(W)	up to 25mm(L), 0.4-0.6mm(T), up to 5 mm(W)
Measurement mode	1. Standard expansion/shrinkage measurement: L77/150 2. Stress/Strain L77/130 3. Creep L77/130 or L77/150 4. Stress Relaxation L77/150 Dynamic TMA-storage modulul (E'), loss modulus (E") and tan (E"/E') are calculated as functions of temperature, time or stress	1. Standard expansion/shrinkage measurement: L77/150 2. Stress/Strain L77/130 3. Creep L77/130 or L77/150 4. Stress Relaxation L77/150 Dynamic TMA-storage modulul (E'), loss modulus (E") and tan (E"/E') are calculated as functions of temperature, time or stress	1. Standard expansion/shrinkage measurement: L77/150 2. Stress/Strain L77/130 3. Creep L77/130 or L77/150 4. Stress Relaxation L77/150 Dynamic TMA-storage modulul (E'), loss modulus (E") and tan (E"/E') are calculated as functions of temperature, time or stress

Contract Testing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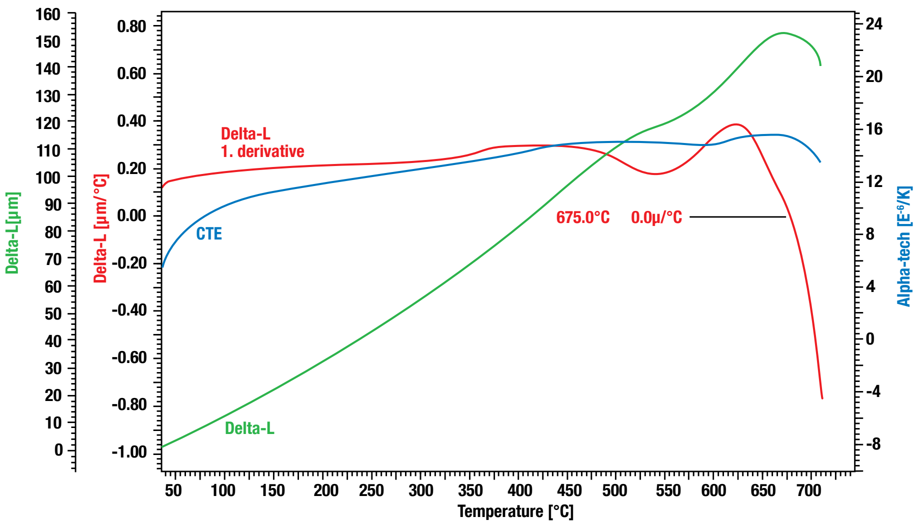
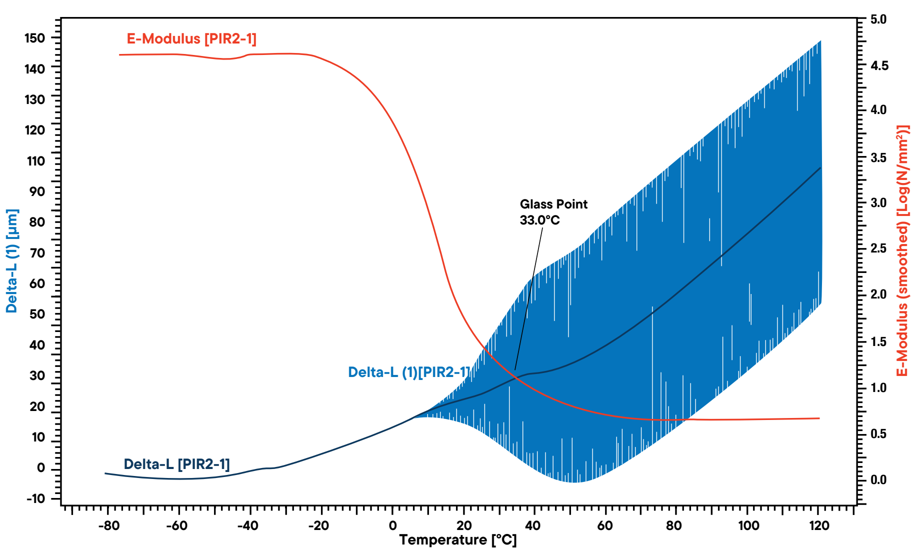
Applications

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.

Evaluation of Elastromer

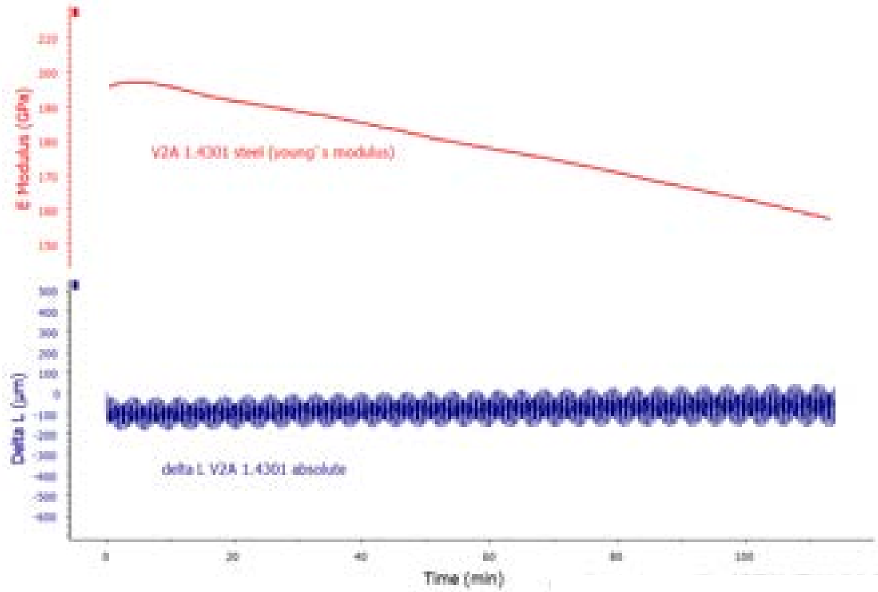


An elastomer sample was measured using a Linseis TMA in three-point bending mode. The dimensional change (ΔL) and E-Modulus were recorded as a function of temperature. A distinct glass transition at 33 °C is observed, characterized by a sharp decrease in the E-Modulus and a change in expansion behavior. Below Tg, the material shows glassy rigidity, while above Tg it transitions into the rubbery state.

This experiment demonstrates the capability of TMA to precisely determine mechanical and thermal transitions in elastomeric materials.

More Applications

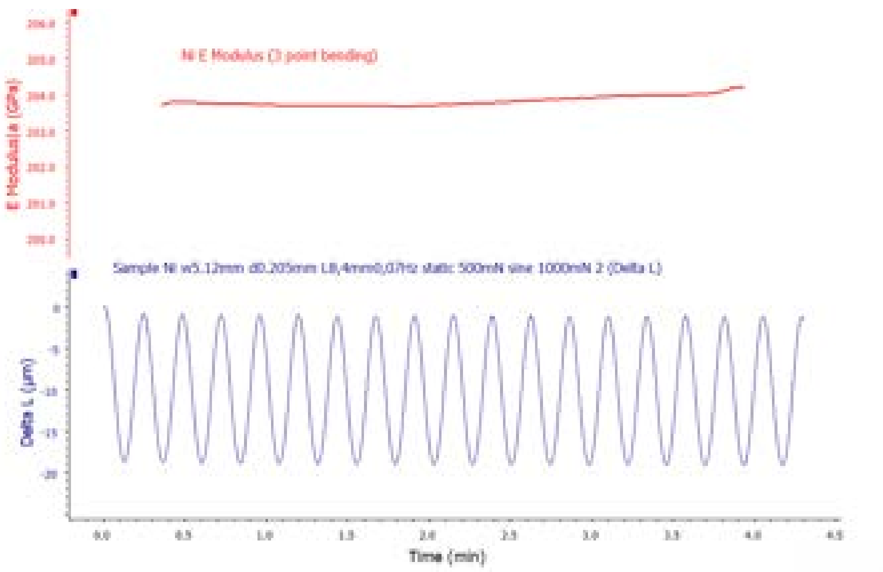
Determination of Young's Modulus of stainless steel



The determination of the Young's modulus by a three-point-bending experiment requires relatively high forces or large sample dimensions. The Linseis TMA L72, equipped with a 20 N actuator, is therefore ideal for measuring polymers and softer materials.
For harder materials, where thin samples are not feasible, the Linseis MACRO TMA provides the solution. This special setup allows sample lengths up to 100 mm and the use of a molybdenum sample holder, enabling precise modulus determination of metals and other stiff materials.

In the presented application, a stainless-steel sample (V2A 1.4301) with 80 mm length, 8 mm diameter, and 2 mm thickness was tested under a static force of 300 mN and a sinusoidal load of 19.5 N. The measurement was performed from room temperature to 600 °C at 10 K/min under forming gas (N_2/H_2 95/5). The resulting data show excellent agreement with literature values and high reproducibility, with deviations below 1 GPa across multiple runs.

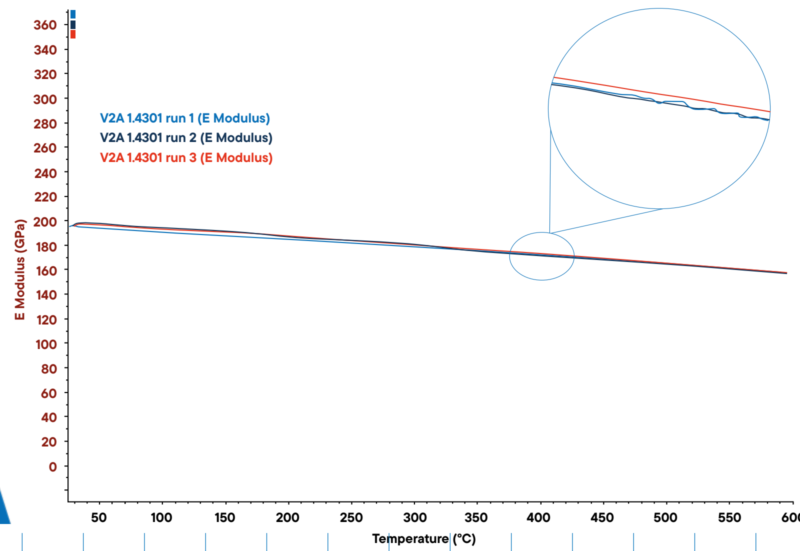
Determination of Young´s Modulus



The Linseis TMA L72 allows the application of sinusoidal force programs to a wide variety of samples, enabling precise determination of bending behavior and Young's modulus for nearly any material. While originally developed for polymer characterization, the TMA L72 has been enhanced to accommodate harder materials such as metal alloys and pure metals. With force ranges up to 20 N and an extended sample geometry capability, the system provides exceptional versatility for mechanical testing.

A nickel specimen (8.4 mm in length, 5.12 mm in diameter, 0.2 mm in thickness) was analyzed using a static load of 500 mN combined with a superimposed sinusoidal force of 1 N. The purple curve represents the sample displacement (change in length) resulting from the applied load, while the red curve indicates the calculated Young's modulus obtained from a three-point bending configuration. The measurement, performed at 50 °C, shows excellent agreement with literature values. Furthermore, this method can be extended to any accessible temperature range, enabling comprehensive studies of temperature-dependent elastic properties.

Reproducibility of Young´s Modulus Measurement



The reproducibility of the Young's modulus determination was verified by repeating the three-point-bending experiment with three separate stainless-steel samples (V2A 1.4301).

The results show excellent agreement between all runs, with deviations below 1 GPa over the entire temperature range up to 600 °C. This confirms the high precision and stability of the Linseis MACRO TMA setup for mechanical analysis of metallic materials under elevated temperatures.

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