

**LINSEIS**

T H E R M A L   A N A L Y S I S

**CRYO TMA** | Thermomechanical  
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.

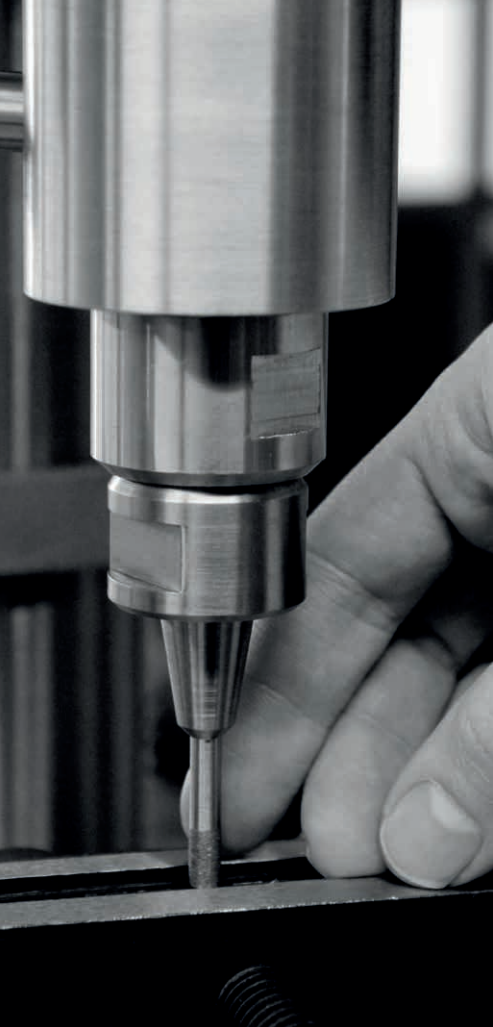
The LINSEIS business unit of thermal analysis is involved in the complete range of thermo analytical equipment for R&D as well as quality control. We support applications in sectors such as polymers, chemical industry, inorganic building materials and environmental analytics. In addition, thermo physical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

LINSEIS provides technological leadership. We develop and manufacture thermo analytic and thermo physical 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 thermo analytical testing machines requires significant research and a high degree of precision. LINSEIS Corp. invests in this research to the benefit of our customers.

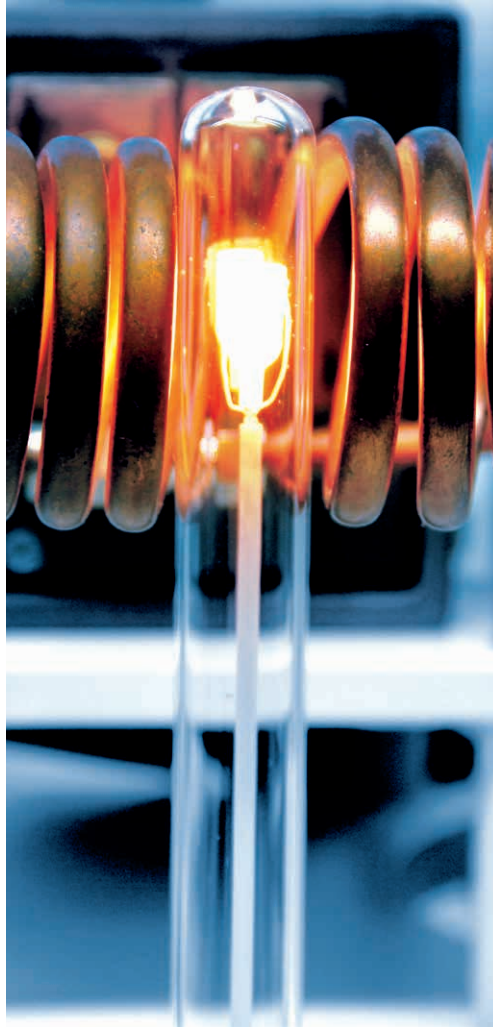


Claus Linseis  
Managing Director



## German engineering

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



## Innovation

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 constantly develop new technologies to enable continued discovery in Science.



Temperature	Type	Element	Atmosphere	Temperature sensor
-260° up to 220°C	Cryo TMA	Thermo coax	inert, oxid., red., vac.	diode or L71
		Helium cryostat		

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# THE INSTRUMENT

## TMA / DTMA the Method

Thermo mechanical analysis (TMA) easily and rapidly measures sample displacement (growth, shrinkage, movement, etc.) as a function of temperature, time, and applied force. Traditionally, TMA is used to characterize linear expansion, glass transitions, and softening points of materials by applying a constant force to a specimen while varying temperature. For expansion measurements, a probe rests on a sample on a stage with minimal downward pressure. Other constant force experiments include measurement of penetration, bending, tension, shrinkage, swelling, and creep (sample motion measured as a function of time under an applied load).

## Typical Applications

- Tension studies of the stress/strain properties of films and fibers
- Determination of softening behavior
- Glass transition temperatures and secondary transitions
- Phase change determination
- Determination of mechanical behavior under applied force
- Determination of expansion coefficient (dilatometry)
- Sintering behavior
- Volumetric expansion
- E modulus
- Slipping and friction resistance
- Highest Resolution
  - allows to measure smallest nanometer changes
- Dynamic Load TMA
  - measures weak transitions and elasticity
- Ultra low temperature
  - from - 260°C to 220°C\*
- Calculated DTA
  - simultaneous measurements of thermal effects
- Modular design
  - allows future expansion of instrument
- Gas tight cell
  - controlled measurement environment

\* Different furnaces (TMA PT1600)

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# 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.

## The 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.

## The 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 helium crystat 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.

## Integrated DTA signal:

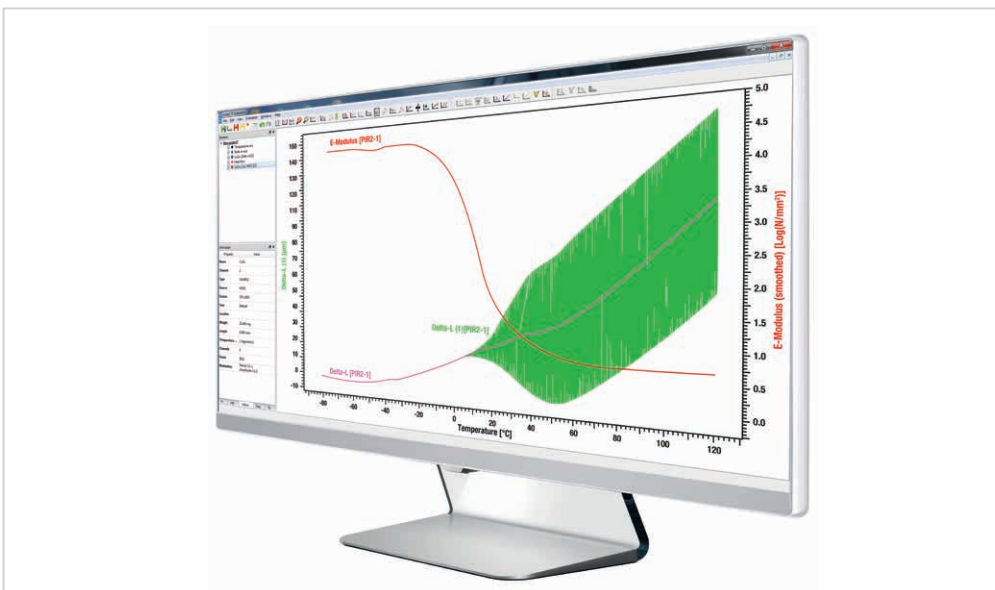
All LINSEIS TMA models are optionally equipped with the DTA evaluation feature. This provides the user with valuable additional endo- and exothermic sample information

# 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 TMA/DTMA run. Thanks to our specialists and application experts, LINSEIS was able to develop comprehensive easy to understand user friendly application software.

## Features -Software

- Program capable of text editing
- Data security in case of powerfailure
- Thermocouple break protection
- 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
- E-Modulus
- Several system correction features
- Automatic zero point adjustment
- Auto-scheduler for up to 16 uninterrupted runs



# FEATURES

## 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 constant load

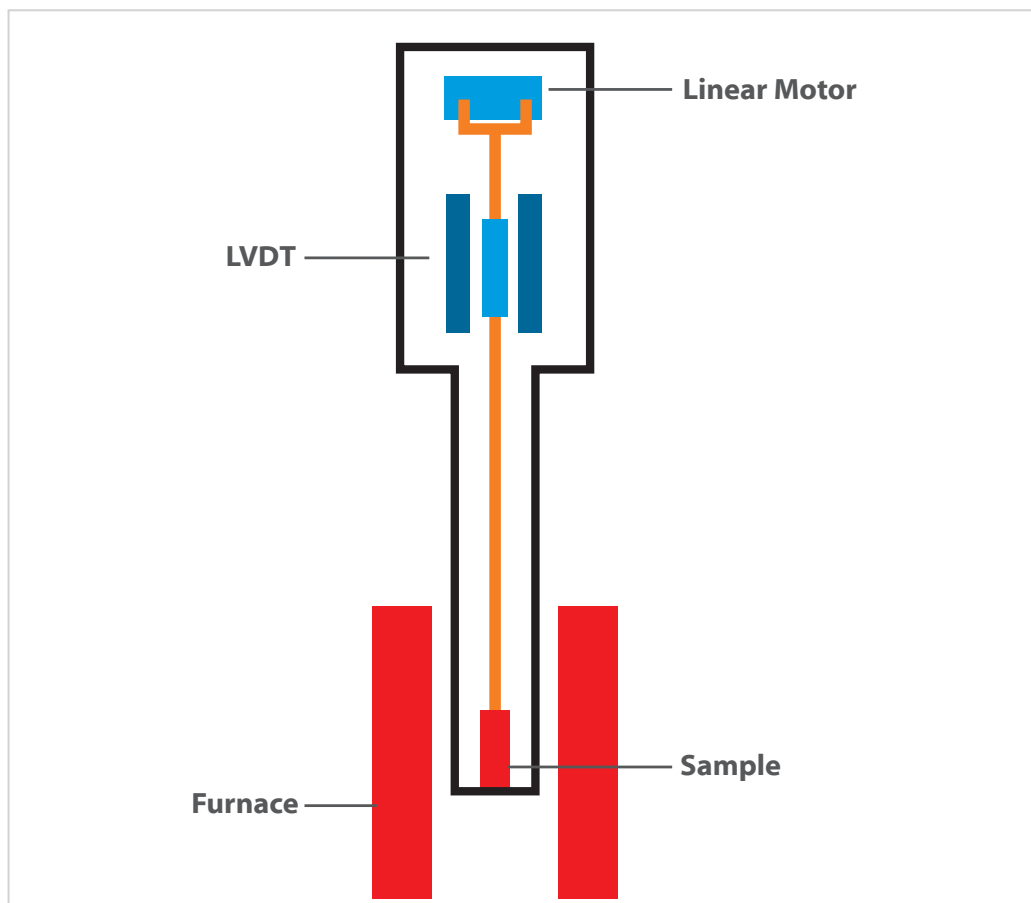
- Penetration
- Transition and comparison tests
- 3 point bending test

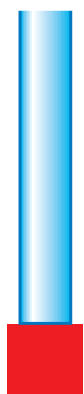
### With dynamic load

- Visco-elastic behavior

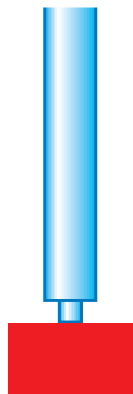
### Additional optional features

- DTA evaluation
- (RCS) Rate controlled sintering software

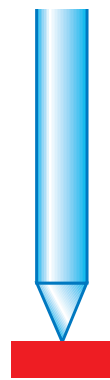




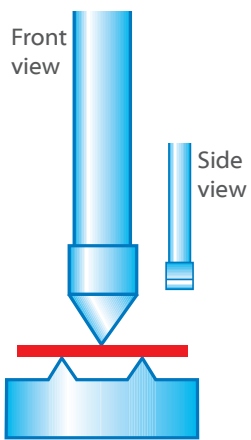
Expansion



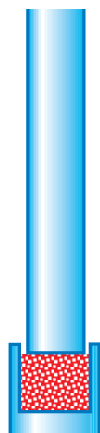
Penetration



E-Modulus



3-Point Bending



Volumetric Expansion



Tension



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