

**LINSEIS**

*pushing boundaries*

**TGA L81**

Thermo  
**Gravimetric  
Analyzer**



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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 thermoanalytical 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.

C L A U S   L I N S E I S  
C E O   D I P L .   P H Y S .



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.



engineering  
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.



# Thermogravimetric Analyzer

Thermogravimetry measures the weight change of a sample as a function of temperature or time under controlled atmosphere. The precise measurement of mass changes with the TGA L81 improves productivity and provides clear insights into material behavior.

The **LINSEIS TGA L81** is a reliable thermogravimetric analyzer designed for robust performance and high accuracy. Its precision microgram balance provides exceptional sensitivity and resolution, making it an ideal choice for routine laboratory quality control and academic applications.



## Advantages of LINSEIS TGA L81

- Precise temperature control
- Fast heating/cooling rates
- Atmosphere control
- High sensitivity
- Automation options
- Expanded analysis

## Features of the TGA L81 Furnace

- Innovative top-loading system
- Enhanced heating and cooling performance
- Precise thermal management
- Adaptable sample handling
- Rapid cooling capability

# Sensors

The Linseis TGA can be equipped with an unmatched amount of different user exchangeable TG sensors. Each sensor is available with different thermocouples to provide the highest sensitivity for the desired temperature range and application. Additionally, there are multiple crucible types available that enables the user to find the matching combination for his application.

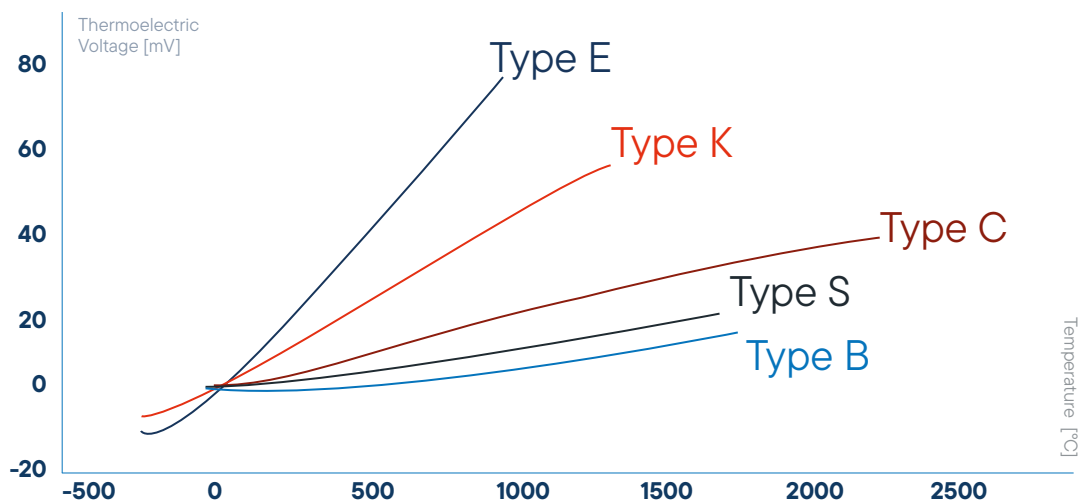
## TGA

- Al<sub>2</sub>O<sub>3</sub>
- Platinum
- Aluminium
- others

The diagram illustrates various TGA sensors and crucibles. Each sensor is accompanied by a color-coded dot indicating its material composition: green for Al<sub>2</sub>O<sub>3</sub>, yellow for Platinum, red for Aluminium, and grey for others.

- TG-hang-down wire:** A vertical wire with a blue rectangular sensor element. Material: Al<sub>2</sub>O<sub>3</sub> (green dot).
- Wheel:** A circular sensor with a radial pattern on a stem. Material: Al<sub>2</sub>O<sub>3</sub> (green dot).
- 0.14 ml:** A small cylindrical crucible. Materials: Al<sub>2</sub>O<sub>3</sub> (green), Platinum (yellow), Aluminium (red), others (grey).
- custom volume:** A group of three cylindrical crucibles of varying heights. Materials: Al<sub>2</sub>O<sub>3</sub> (green), Platinum (yellow), Aluminium (red), others (grey).
- 0.12 ml:** A small cylindrical crucible. Materials: Al<sub>2</sub>O<sub>3</sub> (green), Platinum (yellow), Aluminium (red), others (grey).
- Mesh:** A cylindrical sensor made of a wire mesh. Material: others (grey dot).
- 12.0 ml:** A large, wide crucible. Materials: Al<sub>2</sub>O<sub>3</sub> (green), Platinum (yellow), others (grey).
- 3.0 / 5.0 ml:** A medium-sized crucible. Materials: Al<sub>2</sub>O<sub>3</sub> (green), Platinum (yellow), others (grey).
- 0.3 ml:** A small, narrow crucible. Materials: Al<sub>2</sub>O<sub>3</sub> (green), Platinum (yellow), others (grey).
- TGA - plate Sensors:** Two circular plate sensors on stems, one with a central hole and the other with a central well. Materials: Al<sub>2</sub>O<sub>3</sub> (green), Platinum (yellow), others (grey).

# Best possible sensitivity for every application



## Thermocouple types:

- Type E** (Chromel)  
Constantan: -50 °C up to 900 °C
- Type K** (Chromel)  
Alumel: -180 °C up to 1100 °C
- Type S** (Platinum-Rhodium/10%)  
Platinum: 0 °C up to 1600 °C
- Type B** (Platinum-Rhodium/30%)  
Platinum-Rhodium (6%): 25 °C up to 1800 °C
- Type C** (Tungsten/5%)  
Rhenium: Tungsten (26%)  
Rhenium: 20 °C up to 2300 °C

All sensors available with the thermocouples illustrated. LINSEIS sensor combinations cover the broadest temperature range in the market (-180 °C up to 2400 °C).

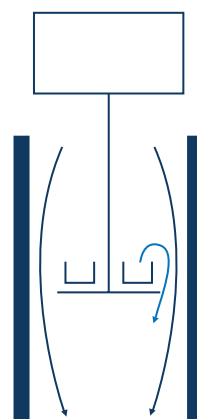
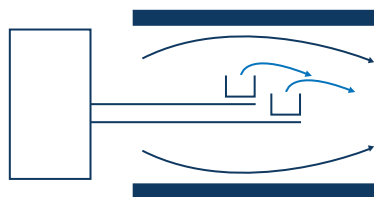
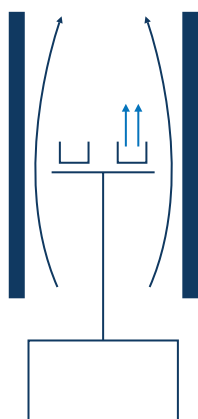
## Furnace Programm

Temperature	Type	Element	Atmosphere	TC-Type
-70°C - 400°C	L81/264/RCF	HangDown only Intracooler / Kanthal	inert, oxid., red., vac.	K
-150°C - 500°C	L81/264/500	Kanthal	inert, oxid., red., vac.	K
-150°C - 700°C	L81/264/700	Kanthal	inert, oxid., red., vac.	K
-150°C - 1000°C	L81/264/1000	Kanthal	inert, oxid., red., vac.	K
RT - 1000°C	L81/220 AC	SiC	inert, oxid., red., vac.	K
RT - 1600°C	L81/240 AC	SiC	inert, oxid., red., vac.	S
RT - 1750°C	L81/250	MoSi <sub>2</sub>	inert, oxid., red., vac.	B
RT - 2000°C	L81/260/G/2000	Graphite	inert, red., vac.	C
RT - 2400°C	L81/260/G/2400	Graphite	inert, red., vac.	Pyrometer
RT - 2800°C	L81/260/G/2800	Graphite	inert, red., vac.	Pyrometer
RT - 2400°C	L81/260/T	Tungsten	inert, red.	C
RT - 1000°C	L81/200	Glow igniter	inert, oxid., red., vac.	S/K

# Benefits of the vertical top loading design

The vertical “sample on top” design of the LINSEIS thermo-balance provides highest possible accuracy due to a stable position of the sample and easy sample handling.

TGA/ STA PT 1000/1600



## Vertical system (sample on top) LINSEIS configuration

### Advantages:

- Easy sample handling
- Easy exchange of sample holder
- Stable position of the sample in the furnace

### Disadvantage:

- Complicated construction

## Horizontal system

### Advantages:

- Small buoyancy effects

### Disadvantages:

- Very difficult sensor exchange
- Difficult sample handling
- Very high purge gas rate required
- Problems due to sensor expansion during heating/cooling

## Vertical system (sample on bottom)

### Advantage:

- Stable position within furnace

### Disadvantages:

- Difficult sensor exchange
- “Dangerous” gas flow within balance housing (sample gets blown out)
- Sensor position depends on sample weight

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# New features

## Electronic Upgrade

The new measuring electronics offer significant performance improvements, inspired by the architecture of the „Linseis Digital Balance“. The benefits of this new digital balance architecture include:

- **Minimization of drift:** Ensures consistently high precision over long periods of time.
- **Improved resolution:** Unique sub-microgram resolution.
- **Highest accuracy:** Improves the reliability of your measurement results.
- **Reproducibility:** Ensures consistent results with repeated measurements.

## Linseis Lab Link

With Linseis Lab Link, we offer an integrated solution to address uncertainties in measurement results. With direct access to our application experts via the software, you can get advice on the correct measurement procedure and evaluation of results. This direct communication ensures optimal results and maximizes the efficiency of your measurements for precise analysis and research as well as a smooth process flow.

## Software Improvements

- **Lex Bus Plug & Play:** Our latest hardware interface Lex Bus revolutionizes the way data communicates within our systems. Lex Bus enables seamless and efficient integration of new hardware and software tools.
- **Improved furnace control:** Our new and further improved furnace control offers a faster heating and cooling as well as more precise temperature control, which leads to better measurement results through better temperature sequencing according to your wishes and requirements.
- **New software with user interface:** Our communication is now even more focused on the needs of our customers to ensure that you are always informed of the latest status and receive support whenever it is needed.
- **Process security:** We have optimized our software for process security to ensure that your data is protected at all times and processed in a fail-safe manner.
- **Error messages and bug fixes:** Our system automatically detects errors and bugs, which are immediately documented and fixed to minimize downtime.
- **Automatic updates and new features:** Our software receives regular automatic updates that not only improve security, but also continuously provide new features.
- **Permanent system monitoring:** Our software constantly monitors the system parameters to ensure optimum performance.
- **Preventive maintenance and problem detection:** Our preventive maintenance approach detects problems and wear and tear before they can cause damage and keeps your device in top shape.



## Design Improvements

The new device design is characterized by an elegant aluminum casing that is both robust and aesthetically pleasing. The LED status bar provides a user-friendly visualization of important information. A touch panel enables intuitive operation and contributes to a modern user experience that combines comfort and functionality. The new device design focuses on ergonomic operation.

# Unique features

## Automatic Evacuation

The devices feature a built-in automatic evacuation capability, ensuring efficient processes and smooth operation.

## Vacuum and controlled atmosphere

- Supports high vacuum, inert, reducing, oxidizing, or humidified atmospheres
- Optional pressurization up to 5 bar overpressure
- Analysis of certain corrosive conditions with precautions
- Adaptability for residual gas analysis with optional heated capillary

## Evolved gas analysis

Optional gas analysis with MS, FTIR, or GCMS is possible, providing valuable additional information. The system can be configured with standalone and integrated MFC for gas dosing. Additionally, customer-specific options such as a heated inlet can also be integrated into the device.

## Gas safety system

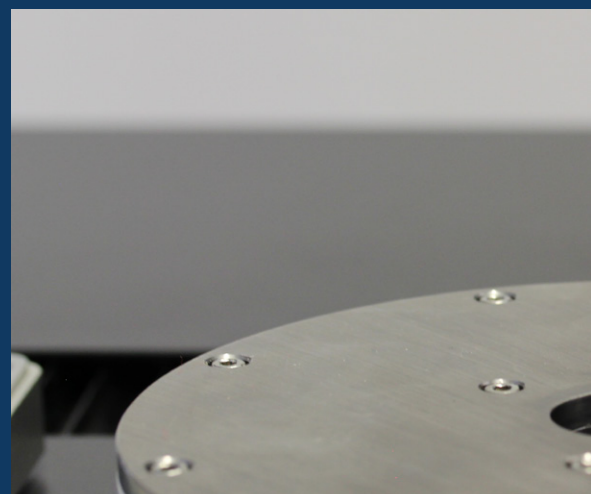
The gas safety system is designed to accommodate various gases such as hydrogen or carbon dioxide, ensuring secure operation and user safety.

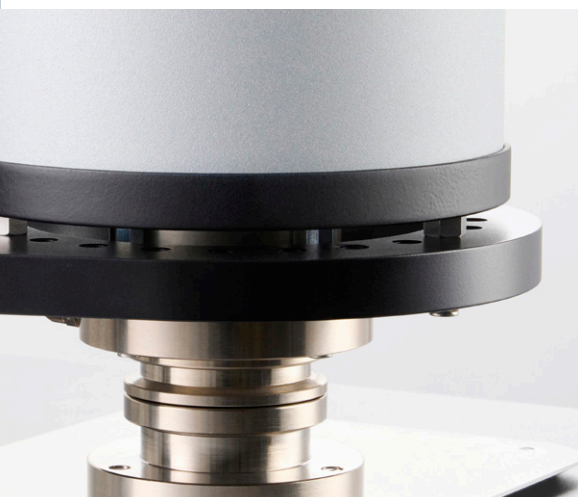
## Controlled humidity and water vapour

The device can regulate the humidity and water vapour during the measurement.

## Sample robot

Our TGA L81 can be equipped with a proven sample robot for unattended sample measurements for highest throughput.





### Wide temperature range -150 °C to 2400 °C

The LINSEIS TGA instruments can be equipped with up to two furnaces at the same time. A broad variety of different furnaces are available to enable measurements in the widest temperature range on the market.

### Automatic calibration

We offer an automatic calibration function in the software and hardware. With this function, our TGA automatically calculates a calibration factor, which is also displayed.

### Integrated LINSEIS platform

The integrated LINSEIS software offers a comprehensive solution, combining both hardware and software for maximum process security and precision. By providing a unified platform, it ensures seamless integration of components and devices from external partners, resulting in a highly robust system.



### Customization

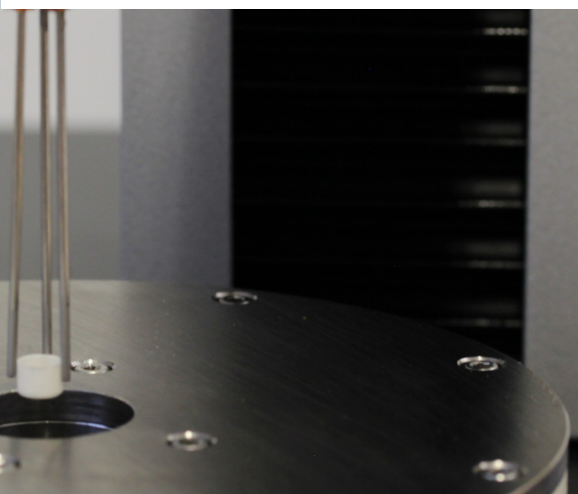
Close collaboration with the customers to tailor unique solutions, leveraging LINSEIS expertise to meet their specific needs.

### Service

Our international presence across every continent enables us to deliver the best and fastest service possible.

### Accessories starter kit

The accessory starter kit guarantees fast and uncomplicated usage, serving as a complete system for instant application.





## Equipment for gas control and safety (H<sub>2</sub>, CO, CO<sub>2</sub>, 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<sub>2</sub>, CO, CO<sub>2</sub>, etc...)
- optional burn off unit
- Continuous monitoring to ensure safe operating conditions



Fig. 1

# 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 confusion and must be considered carefully: The difference between water vapor and relative humidity.

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.

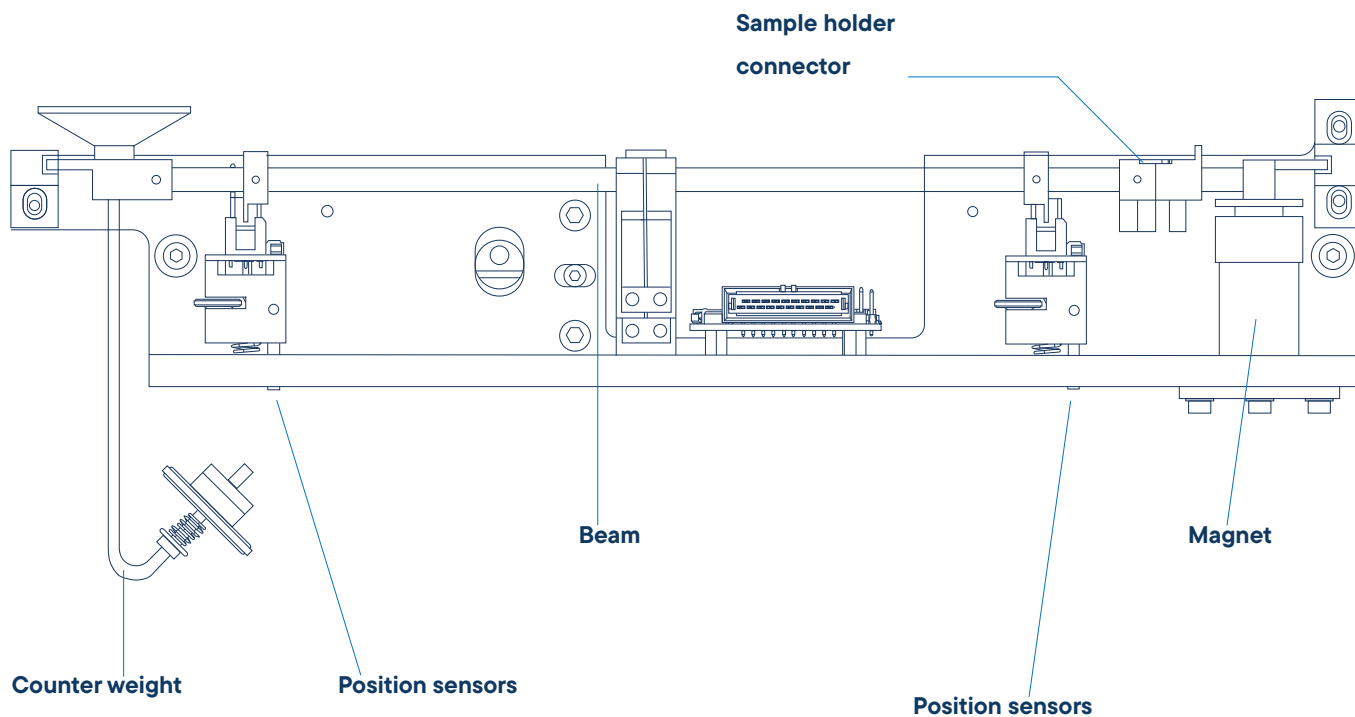


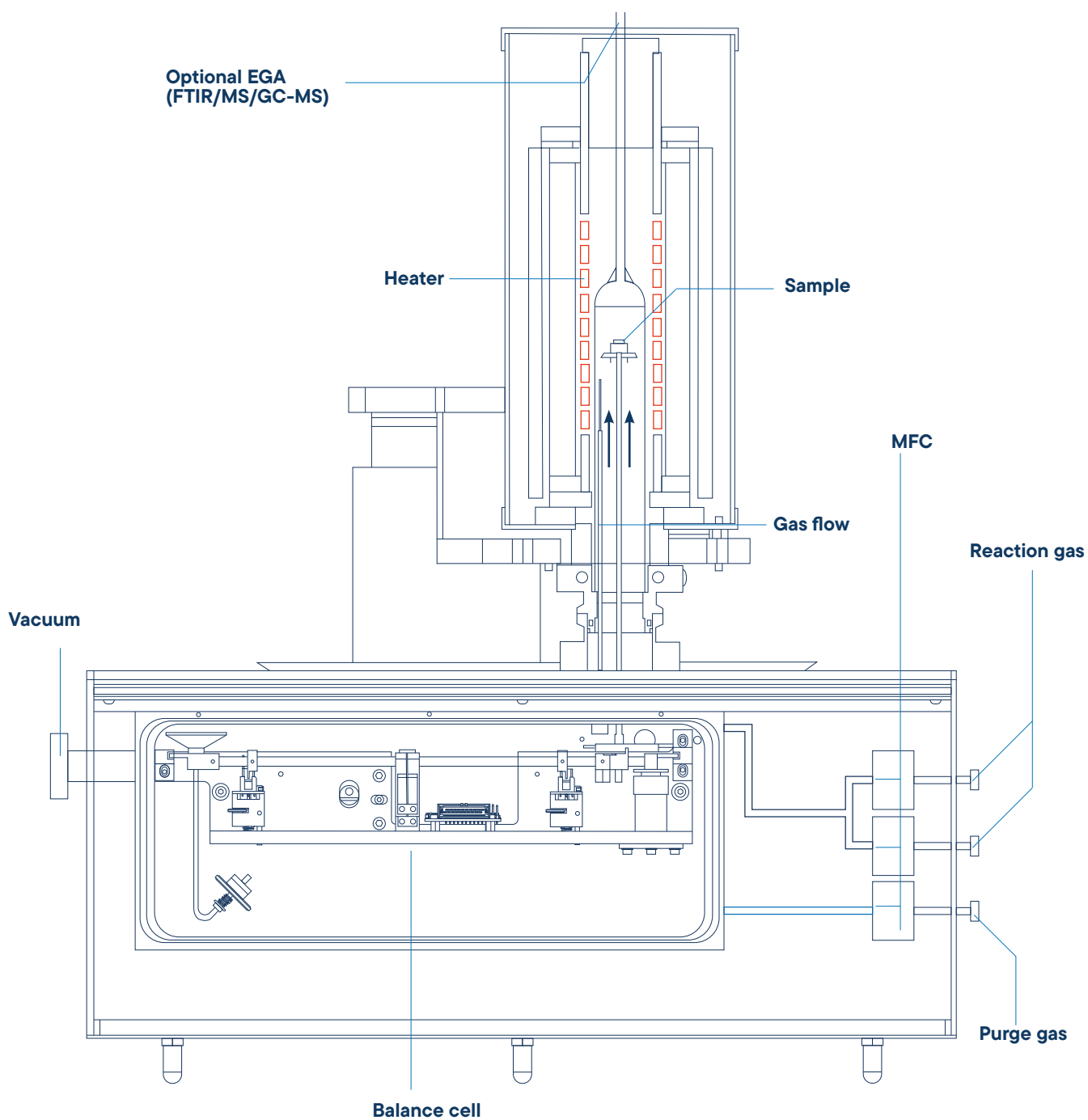
## Highest precision beam balance

Our different microbalances are specifically designed to accomplish thermal analysis tasks in the best possible way.

Providing ultra light weight design to follow fast weight changes and symmetric construction for ultra low drift long term measurements.

Linseis micro balance  
especially designed for  
thermal  
analysis instruments





### Advantages of LINSEIS balance design

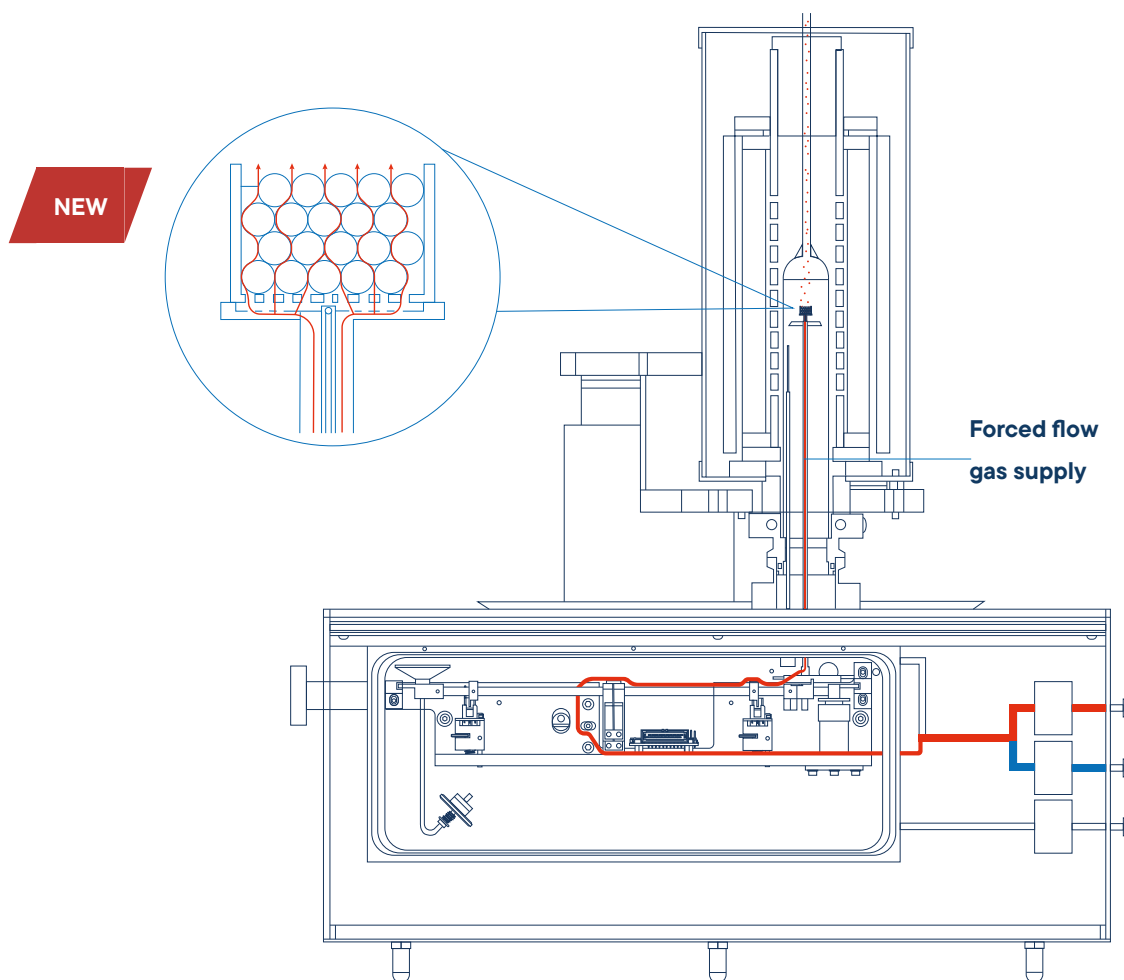
- Sample mass compensation by a counterweight enables improved sensitivity
- Improve symmetrical design for high interference levels
- Not affected by local gravity
- Not affected by thermal fluctuations
- Highest possible PRECISION
- Concept enables easy maintenance
- Depending on model, balance can handle from mg up to 50 g sample mass



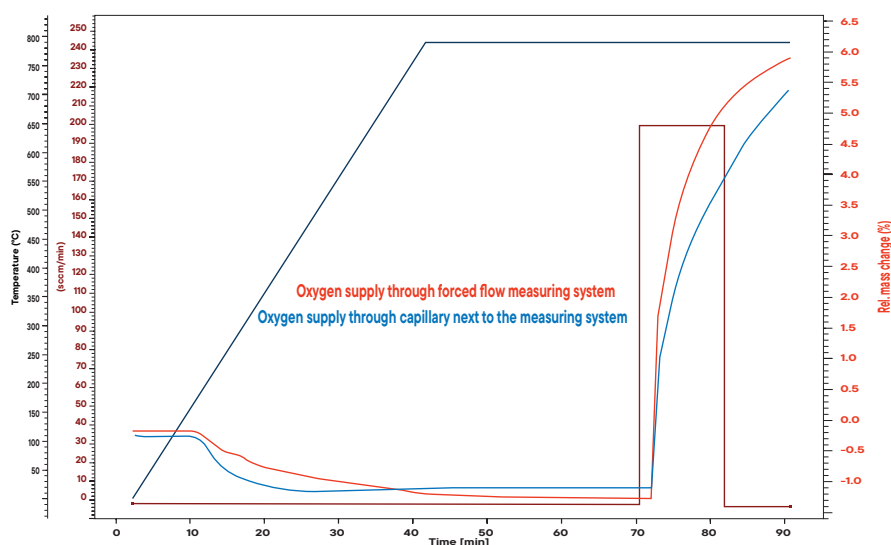
## Forced-flow offers several advantages in the investigation of gas/solid phase reactions

Patented (EP 4 632 226 A1)

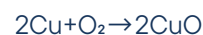
1. Controlled Conditions: Precise control of reaction conditions for a reproducible environment.
2. Faster Reaction Times: Acceleration of slow reactions through continuous flow.
3. Better Mixing: Uniform distribution of reactants for improved reaction kinetics.
4. Continuous Analysis: Enables real-time monitoring and control of the reaction.
5. Scalability: Easier adaptation to different volumes and flow rates for optimized production.



## Oxidation rates of copper with different gas supplies



During the oxidation of copper, copper oxide is formed, with reaction speeds depending on the gas supply. The Forced-Flow principle ensures that the gas is quickly and evenly distributed across the entire sample material from the outset. This allows faster reaction rates compared to conventional methods where the gas slowly comes into contact with the sample. The reaction for the formation of copper oxide can be represented as:



The Forced-Flow principle ensures that the oxidizing agent ( $\text{O}_2$ ) reacts rapidly and efficiently with the copper ( $\text{Cu}$ ), leading to accelerated reaction rates.

The image shows a simulated fluidized bed. It is possible to observe the fluidized bed during the reaction using a camera. A fluidized bed is a system where solid particles are kept in motion by a gas stream, enabling intense mixing and efficient reactions. The vigorous movement of the solid material in the fluidized bed reactor ensures uniform distribution and mixing of solid and gas, crucial for efficient chemical reactions.





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# 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 incorporates 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 arithmetics
- Statistical evaluation package
- Free scaling
- Automatic calibration
- Optional Kinetic and Lifetime Prediction
- Software packages
- Interface to MS and FTIR

## TG – Features:

- Mass change as % and mg
- Rate Controlled Mass Loss (RCML)
- Evaluation of mass loss
- Residue mass evaluation





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 identification 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.

## Report Generator

Convenient template selection to generate customized measurement reports.

## 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.

## Multi-User

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

## Database

State of the art database design enables easy data handling.



# Technical Specifications

	<b>TGA L81</b>	
<b>Temperature range</b>	-150 up to 2400 °C	
<b>Vacuum</b>	10 <sup>-5</sup> mbar (depends on vacuum pump)	
<b>Pressure</b>	up to 5 bar (optional)	
<b>Heating rate</b>	0.01 up to 100 °C/min (depends on furnace)	
<b>Temperature precision</b>	0.01 °C	
<b>Sample robot</b>	optional 42	
<b>TG</b>	<b>1</b>	<b>2</b>
<b>Resolution</b>	0.01 µg	0.02 µg
<b>Sample weight</b>	Balance can read weight automatically automatically	
<b>Measuring range</b>	5 g / ± 2500 mg (mass change)	25 g / ± 2500 (mass change)

Contract testing

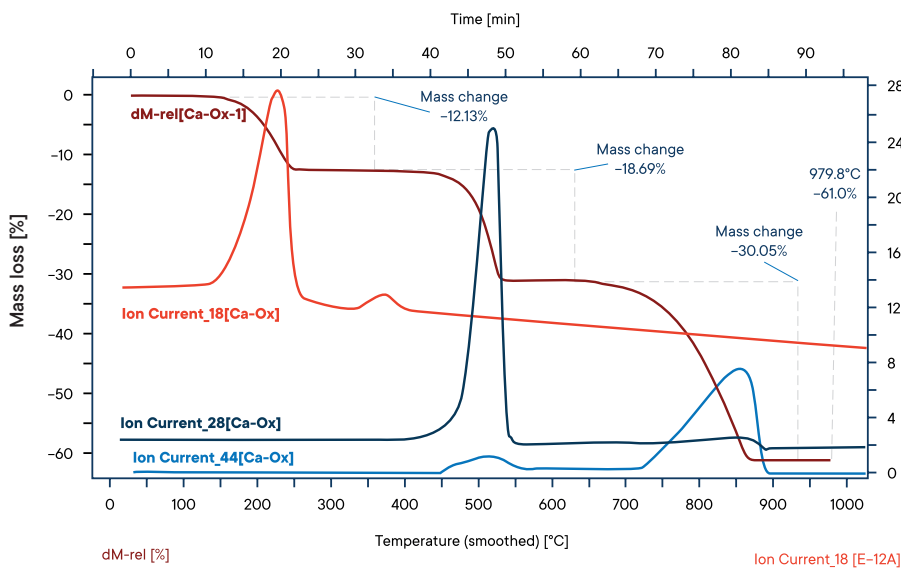


# Applications

TGA Overview

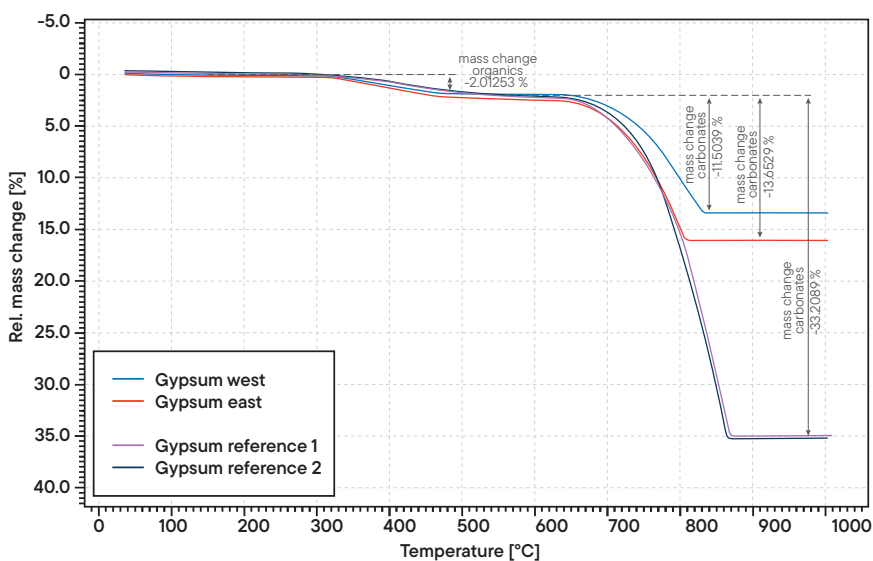


## Decomposition of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$



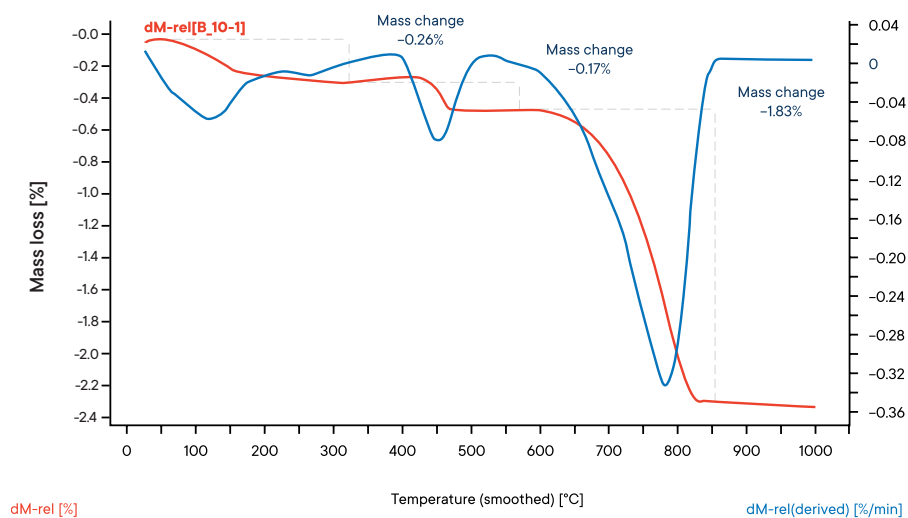
The evolved gases from the decomposition of calcium oxalate has been fed into the mass spectrometer with a heated capillary. The ion currents for mass numbers 18 (water), 28 (carbon monoxide) and 44 (carbon dioxide) have been imported into the graph.

## Mass change of gypsum



TGA measurements of various gypsum samples show several characteristic mass losses: at around 200 °C, bound crystal water is released, while between 600 °C and 900 °C, the decomposition of the carbonate components begins. Minor differences between the samples indicate varying contents of organic components and carbonates.

## Thermal decomposition of cement



The TGA measurement of a cement sample shows three characteristic mass losses: below 400 °C, adsorbed water is released; between 400 °C and 700 °C, hydroxides decompose; and at around 800 °C, calcium carbonate decarbonates. These steps reflect the typical thermal decomposition and phase transformation of cement.

# ***LINSEIS***

*pushing boundaries*

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