

## Thermobalance L81

The current L81 thermal balance design complements our complete selection of thermal analyzers. The L81 has seen many improved designs in its 40 years history. The L81 uses the latest advances in hardware and software to measure independent or one sample simultaneous TGA, DTA and DSC data. The balance hardware is based on a taut bond balance mechanism. The balance arm displacement is detected by highly sensitive inductive transducers. The transducers regulate the current to magnetic coils which compensate for the weight change and keep the balance arm at a constant zero position. The compensation current is proportional to the weight change, This current is amplified and produces a TGA signal. The magnetic coils are also used to electronically tare the system.

The L81 thermal balance can measure data horizontally from  $-150^{\circ}\text{C}$  up to  $1000^{\circ}\text{C}$  and vertically from  $20^{\circ}\text{C}$  up to  $2400^{\circ}\text{C}$ . Various sample holders are available depending on sample size, vertical or horizontal measurements, and data output: ex. TGA, DTA, DSC or simultaneous TGA/DTA or TGA/DSC. The balance design supports vacuum, inert or flowing atmosphere. Analysis in a corrosive atmosphere is available with the proper precautions. Precautions include flowing inert gas through the balance mechanism, proper venting, or combustible gas safety system. The system also adapts to residual gas analysis systems using an optional heated capillary. The complete balance is very versatile. New components can be added to change temperature range, measuring design, or data output.

Six different furnaces are available for independent or simultaneous TGA, DTA, or DSC measurements. The balance is usually built in a bench top design. The 1750°C and 2400°C designs are built on floor mount racks for added support.

The advanced MS® Windows™ software is designed for simple operation with comprehensive data analysis. System control and data collection is performed with the Linseis L70/2001 controller card inserted in a Personal Computer expansion slot. The multi-tasking software can collect data and analyze data simultaneously.

## L81 basic balance for horizontal and vertical operation

The basic balance that is used for horizontal and vertical measurements can be seen in picture 1. The horizontal method is used for measurements from -150°C up to 1000°C.

By design the horizontal balance beam is longer than the vertical, this increases the balance resolution. The advantage of this method is the one direction gas flow. The large sample holder increases the surface area of the sample which is exposed to the flowing gas.

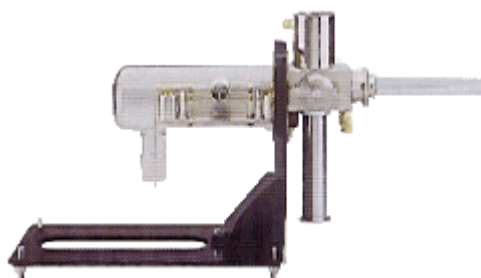
### Vertical operation design

The advantage of measuring in the vertical design is higher final temperature. Also as the measuring system expands with increasing temperature vertically, it does not have any impact on the resulting mass signal. Also the DTA and DSC signal is easily adjusted for higher sensitivity and better signal/noise ratio.

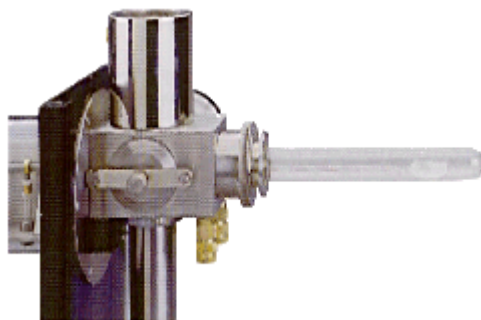
Technical Data for balance L81

Sample weight max.:  
horizontal 10g  
vertical 25g

measuring ranges:



Picture 1. basic balance for horizontal and vertical measurements



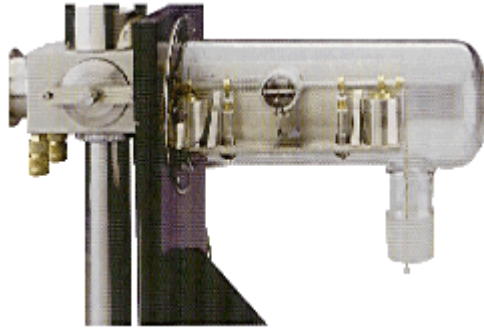
Picture 2. horizontal measuring mode

horizontal      1            10 100 1000 mg  
vertical        2,5          25 250 2500 mg

tare:      electronically

temperature drift:      0,01 mg/°C

vacuum: 10<sup>-5</sup> mbar max.



**Picture 3. detailed view of the balance mechanism**



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## Horizontal measuring system for TG

L81/4011 measuring system with quartz spoon 1000°C used for solids, powders and liquids with large surface area, without thermocouple volume: 3,5 ccm. fitting TE L81/22

## Horizontal measuring system for simultaneous TGA/DTA

### L81/411

quartz TGA/DTA measuring system, temp. range 1000°C Type S thermocouples. The tubular shape of the measuring system insures a large surface area for reactions. This measuring system is best suited to measure powders and liquids. Solid granulates that show bad heat transfer should be mixed with  $Al_2O_3$  powder. Volume 2 x 0,6 ccm.

### L81/412

quartz TGA/DTA measuring system temp. range 1000°C with ring shaped type S thermocouples which support platinum crucibles. Volume: 2 x 0,08 ccm.

## Vertical measuring system for TGA

### L81/421

vertical  $Al_2O_3$  measuring system 1550°C with built in thermocouple type S

## Vertical measuring system for TGA

### L81/432

vertical  $Al_2O_3$  measuring system 1550°C with built in differential thermocouples type S

### L81/442

vertical  $Al_2O_3$  measuring system 1750°C with built in differential thermocouples EL18, long version

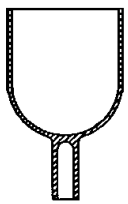






### L81/452

vertical Tungsten measuring system 2400°C with built in differential thermocouples type C for crucible L81/5011

## vertical measuring system for TG/HDSC

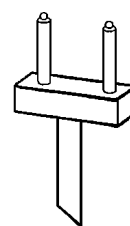
### L81/472

vertical  $Al_2O_3$  measuring system /PtRh(0) with built in differential thermocouples type S

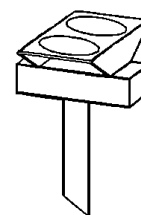
Crucible	Size	Material	Order #
	3,0 ml	$Al_2O_3$	L81/439
	0,3 ml	$Al_2O_3$ Pt	L81/438 L81/434
	0,085 ml	$Al_2O_3$	L81/4496
	0,12 ml	Pt	L81/4494
	0,075 ml	Pt $Al_2O_3$	Pt044 20007013
	0,08 ml	Pt Al	L81/4021 L81/4022
	0,08 ml	W	L81/5011



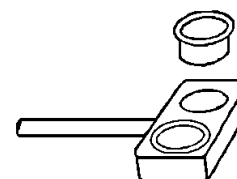
L81/421



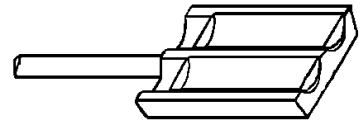
L81/432  
L81/442



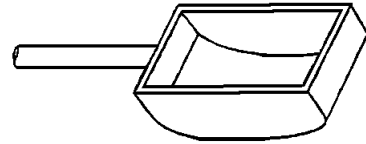
L81/472



L81/412



L81/411



L81/4011



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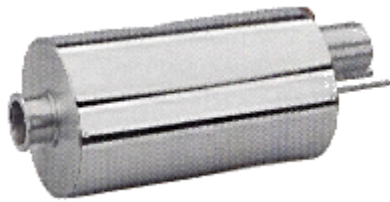
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# Furnace Programs

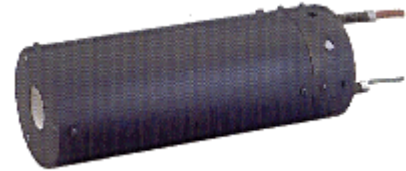
All thermal balances can be equipped with different furnaces



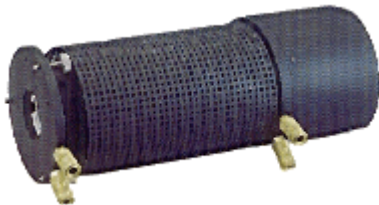
temperature range - 150°C - 500°C



temperature range - 20°C - 1000°C



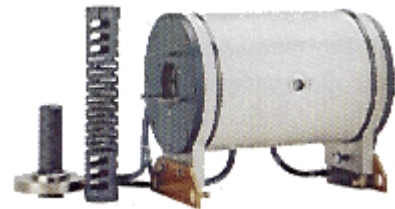
temperature range - 20°C - 1250°C



temperature range - 20°C - 1550°C



temperature range - 20°C - 1750°C



temperature range - 20°C - 2400°C

## List of Thermal balance furnaces

### Horizontal

Temperature range	Type	Heating element	Const. zone	Atmosphere	Coolant	TC type
20°C-1000°C	L81/220	Kanthal wire	+/-1,5°C	air	air	K
-150°C-500°C	L81/264	LN2/heating wire	+/-2°C	air	LN/2	K

### Vertical

20°C-1000°C	L81/220	Kanthal wire	+/-1,5°C	air	air	K
20°C-1250°C	L81/230	Kanthal wire	+/-1,5°C	air	water	S
20°C-1550°C	L81/240	SIC tube	+/-2°C	air	water	S
20°C-1750°C	L81/250	pyrox	+/-3°C	air	air	B
20°C-2400°C	L81/270	tungsten	+/-3°C	air	water	B

## List of available thermal balances

Type	Mode	Temperature
L81/1000	horizontal	TG/T
L81/1000+DTA	horizontal	TG/DTG/DTA/T
L81/150	vertical	TG/DTG/T
L81/1550+DTA	vertical	TG/DTG/DTA/T

L81/1750	vertical	TG/DTG/T	20°C-1750°C
L81/1750+DTA	vertical	TG/DTG/DTA/T	20°C-1750°C
L81/11750+HDSC	vertical	TG/DTG/HDSC/T	20°C-1750°C
L81/2400+DTA	vertical	TG/DTG/DTA/T	20°C-2400°C
L81/0811	low temperature furnace		-150°C-+500°C

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# Linseis Software for Thermobalances

All Linseis Thermal Analysis instruments are controlled through Advanced MS® Windows™ software. The complete program consists of 3 sections: temperature control, data acquisition and data evaluation. Essential sample information is entered in the data acquisition section.

## Data acquisition section

The screenshot shows a Windows-style dialog box titled "Data Acquisition Setup - Sample TG+DTA". It is divided into several sections for data entry:

- Operator:** Dr. Höffgen
- Laboratory:** Linseis
- Atmosphere:** Air
- Flow Rate:** 0.0 [l/min]
- Sample:**
  - Name: Sample 1
  - Weight: 50.0 [mg]
- Reference:**
  - Name: Al2O3
  - Weight: 50.0 [mg]
- Measurement TG:**
  - Sample File: SAMPLE-1.GPR
  - Zero File: ZERO-1.GNL
  - Comment: TG measurement
  - Range: 25 [mg]
  - Sampling Interval: 1.0 [sec]
  - Duration: 100 [min]
  - End Temp.: 1000 [°C]
- Measurement DTA:**
  - Sample File: SAMPLE-1.TPR
  - Zero File: ZERO-1.TNL
  - Comment: DTA measurement
  - Range: 100 [µV]
  - Sampling Interval: 1.0 [sec]
  - Duration: 100 [min]
  - End Temp.: 1000 [°C]

Buttons for "OK" and "Cancel" are located in the top right corner.

Picture 1: menu for the documentation set

Essential data for each sample test includes: operator, laboratory, atmosphere, gas flow, material, sample file name, zero file name, commands, sample weight, measuring range, max. temperature, duration of run, sampling frequency, heating and cooling rate and number of cycles.

All menus are easily handled and intuitive. The software is quickly mastered with a minimum of training.

## Programming of the furnace heating profile

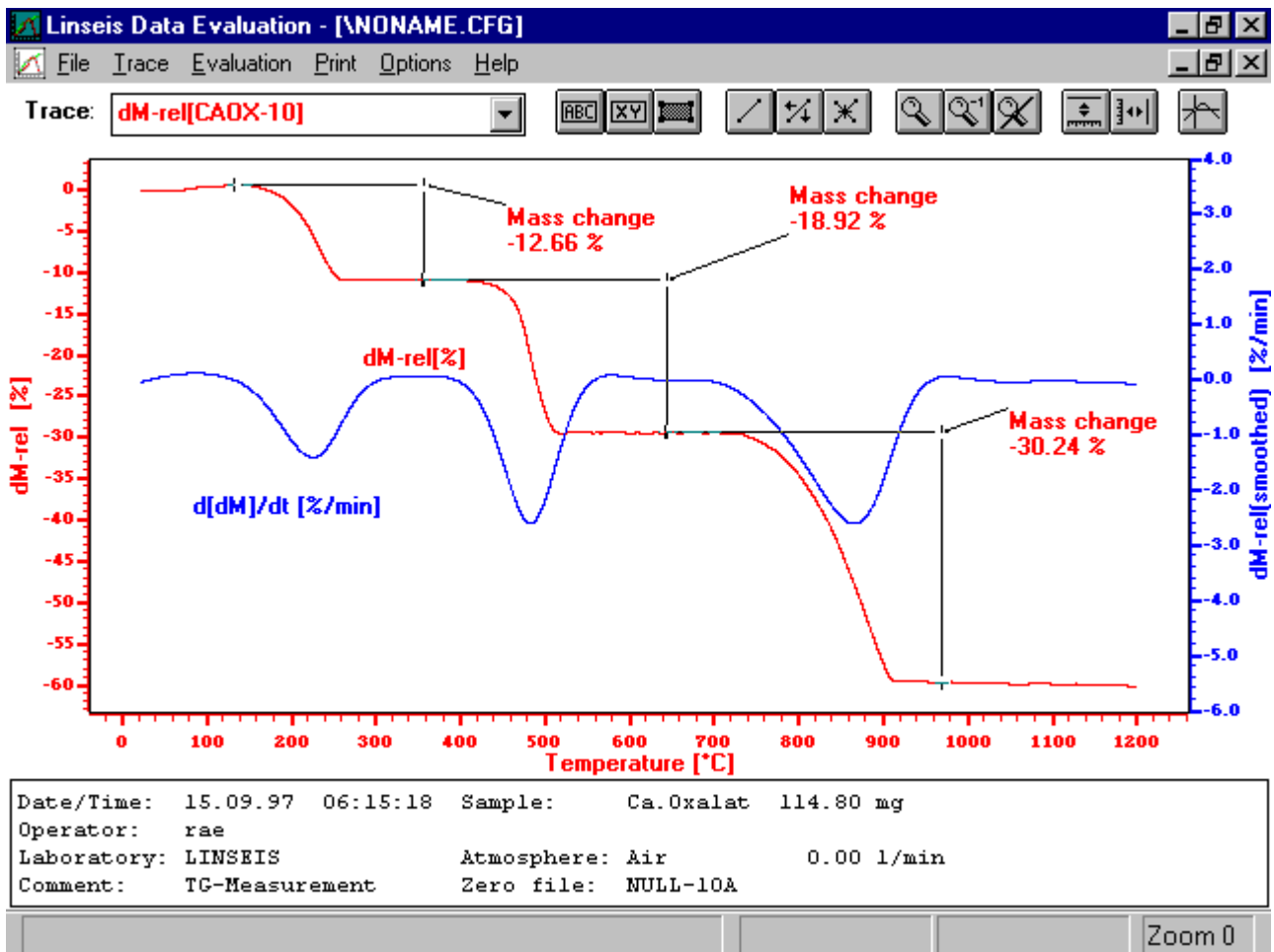
Temperature Target Profile									
Segment	Rate [K/min]	Target Temp. [°C]	Dwell Time		Pmax [%]	Relays			
			[h]	[min]		1	2	3	4
1	10.00	1000	0	5	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	30.00	700	0	0	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	10.00	400	0	0	100	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	0.00	0	0	0	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	0.00	0	0	0	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	0.00	0	0	0	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	0.00	0	0	0	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	0.00	0	0	0	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9	0.00	0	0	0	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10	0.00	0	0	0	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11	0.00	0	0	0	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12	0.00	0	0	0	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13	0.00	0	0	0	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14	0.00	0	0	0	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15	0.00	0	0	0	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16	0.00	0	0	0	100	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Number of Cycles

Picture 2: furnace heating profile

With this menu, the heating rate, the target temperature and a dwell time can be programmed. The program is able to run 16 temperature stages in up to 99 cycles. Also 4 relays outputs can be programmed that can be used for gas control or other purposes.

## Evaluation section



Picture 3: evaluation menu

The evaluation is part of the complete windows software. It features a number of functions enabling a full evaluation of all types of data. All evaluation and data collection can be performed simultaneously. Data can be corrected using zero and calibration correction. Data evaluation includes: signal corrections and smoothing, derivation, relative mass change, mass calculation, curve arithmetic, data peak evaluation, glass point evaluation, slope correction. A mean curve with statistical analysis can be performed on multiple curves. Graphical displays can be printed on all windows, compatible printers or plotters. Data can be displayed and printed in a table format. The software also includes an ASCII export feature.

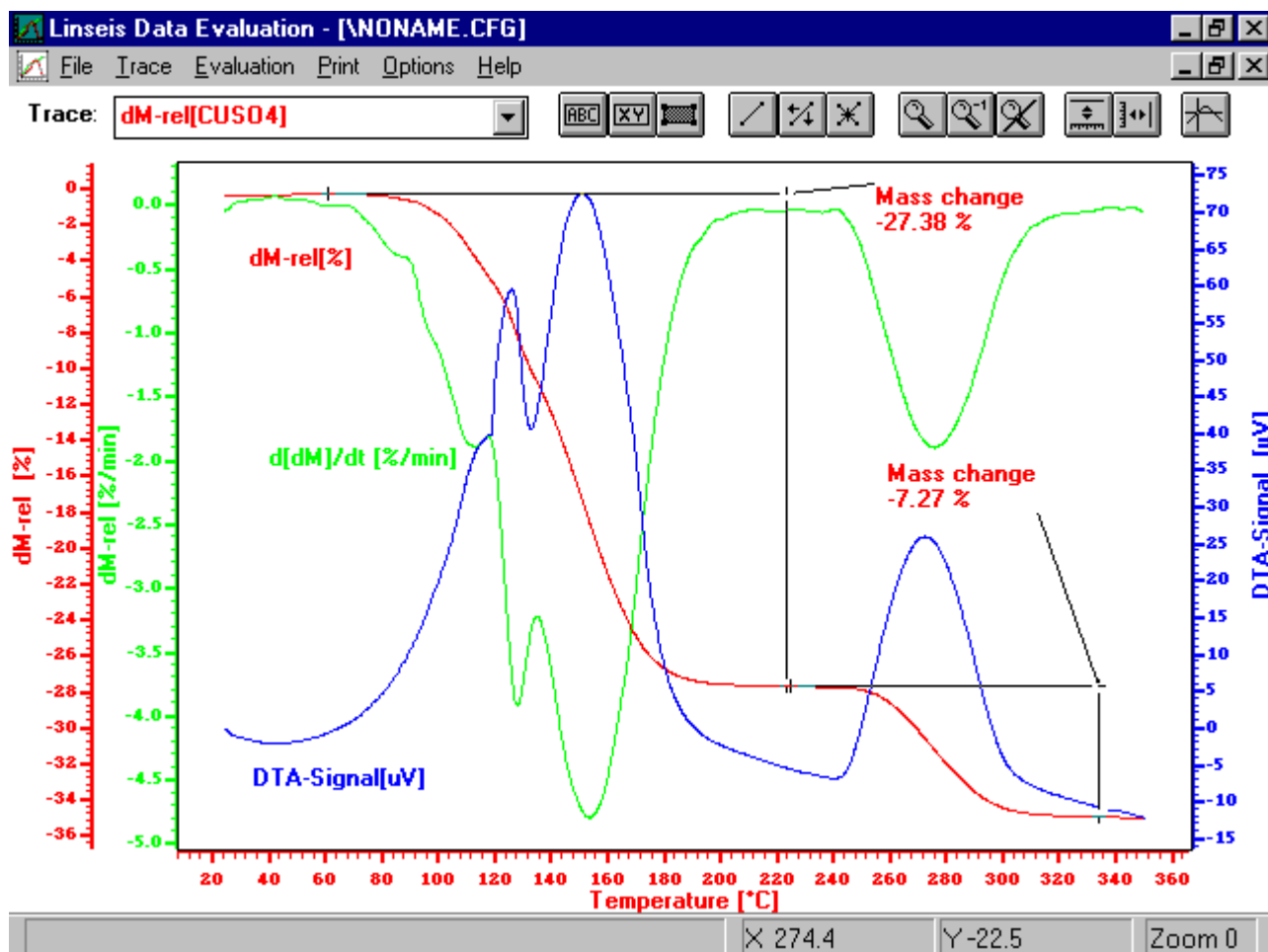


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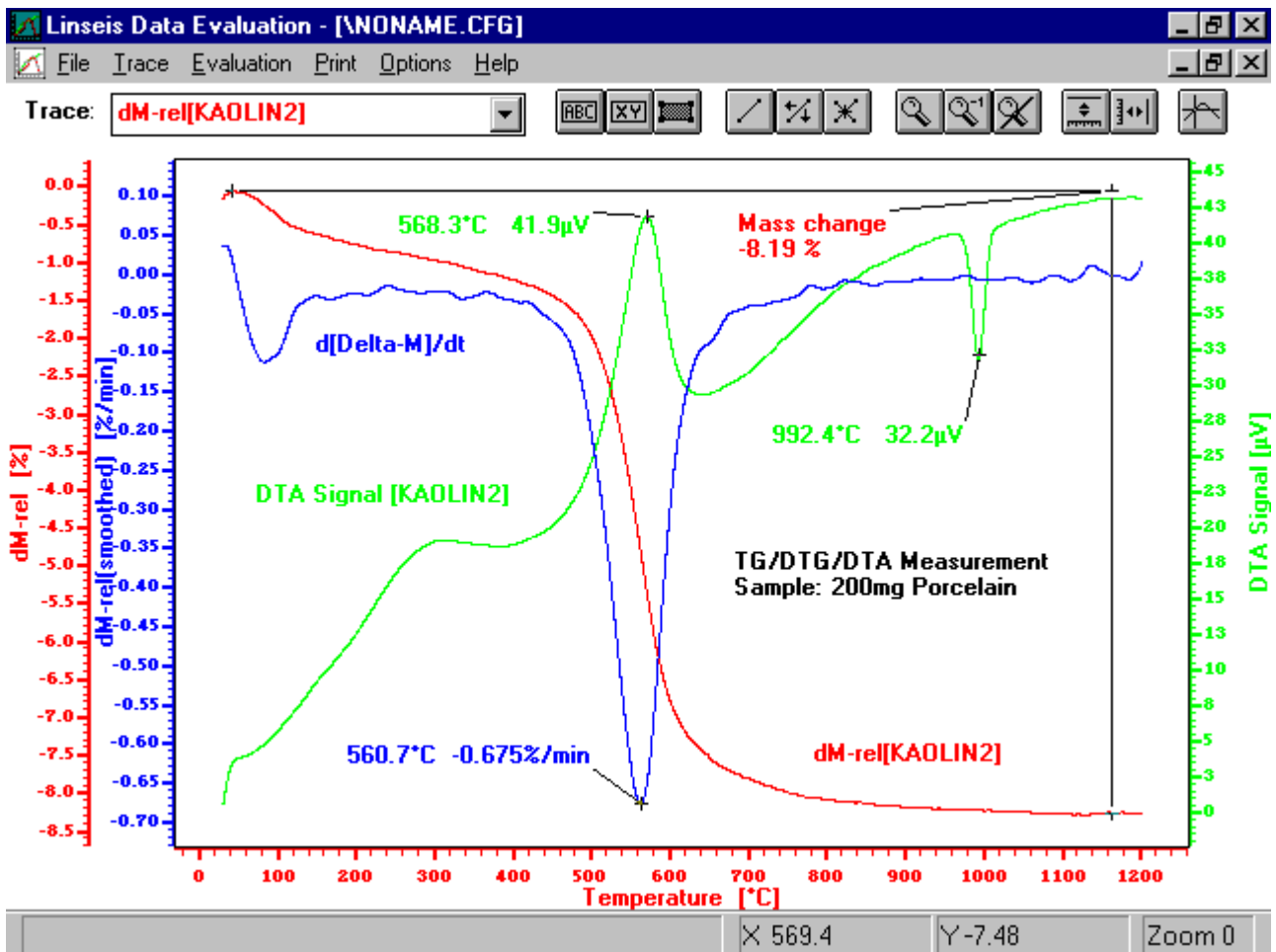
## Copper sulfide/Pentahydrate



Picture 4: TGA/DTA/DTG curves of Copper-sulfide/Pentahydrate

Picture 4 shows the dehydration of Copper-sulfide/Pentahydrate. This measurement is one of the classical tests for the performance of a TG/DTA/DTG instrument. It is especially suited for the calibration of the balance. The measured values in picture 4 reflects the chemistry Of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ .

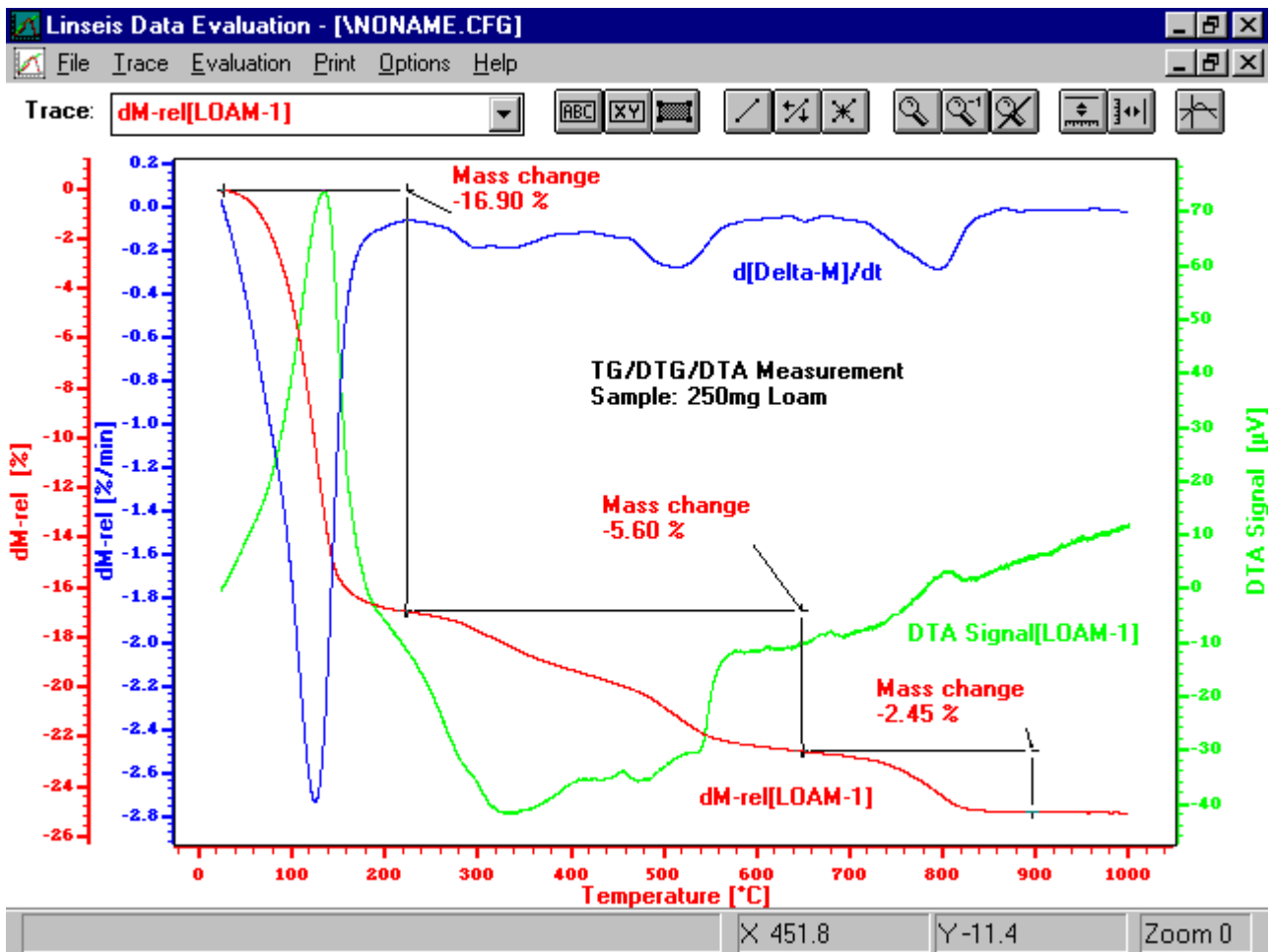
## Porcelain industry



**Picture 5: measurement of Kaolinit**

The knowledge about the content of Kaolinit is an important parameter for the quality control in the porcelain manufacturing industry. This is especially so as the complex mixture of raw materials differ depending on origin. The TG/DTA/DTG method was introduced for these measurements for the porcelain industry during the early stages of thermogravimetric analysis Here TGA measurements were used as semiquantitative analysis and as a comparison to local standards (foot print). The TG/DTA/DTG measurement of a sample of Kaolinit is shown in picture 5.

**Building ceramics, tiles, bricks etc.**



Picture 6: measurement with rawmaterial for bricks

Picture 6 shows the TG/DTG measurements that were done on a mixture of raw materials for the brick and tile industry. These measurements provide quick information about the contents of the raw material as well as the quantitative part of single raw material components. The DTG curve shows on top that the sample contains 2 to 3 more active components in the temperature range between 350°C and 700°C, after the crystal water has been evaporated.



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