LINSEIS

pushing boundaries

HFM L57

Heat Flow Meter

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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.

Engineering & Innovation

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.

Testing of **insulation materials**

The Heat Flow Meter determines the steady-state heat transfer properties of insulation and other materials with high accuracy

In a variety of applications, including construction, equipment manufacturing, and refrigerators, freezers, and other appliances, a material with low thermal conductivity is used for thermal insulation.

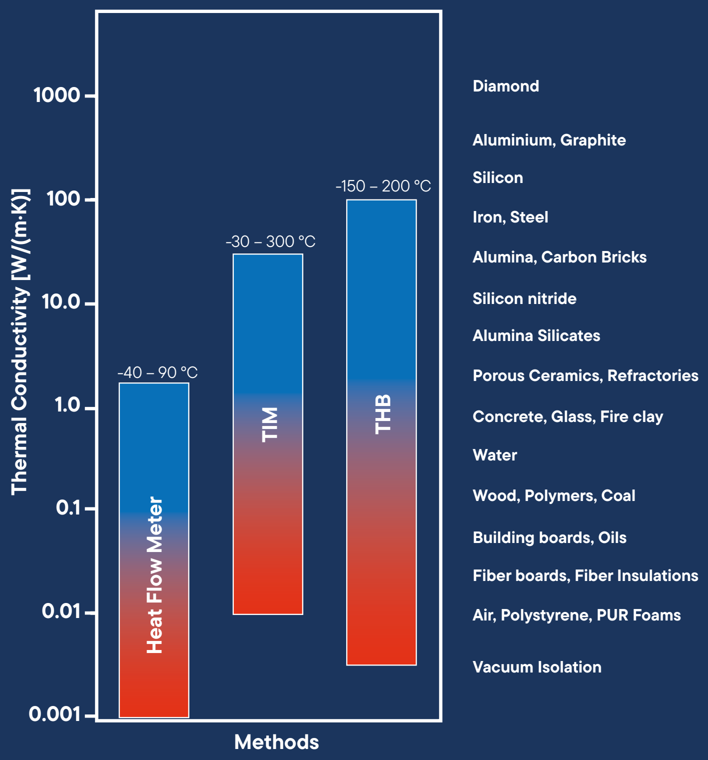
Thermal conductivity and the heat transfer coefficient, also known as the U-value, which measures the transfer of heat from one area to another, are two physical properties that can determine the effectiveness of an insulation material.

Thermal Conductivity range:

- With extension: 0.001 up to 2.5 W/m·K
- Without extension: 0.001 up to 0.5 W/m·K

Temperature range:

- 0 °C to 90 °C
- -20 °C up to 90 °C
- -40 °C up to 90 °C



The Heat
Flow Meter

The LINSEIS Heat Flow Meter is a robust and easy to use instrument for determining the thermal conductivity of low conductive insulation materials. Measurements can be made in minutes due to its unique design.

Peltier heating and cooling technology provides highly accurate temperature control while reducing maintenance and downtime.
Excellent long-term stability allows accurate longterm aging studies. Fast measurement cycles of as little as 15 minutes can be achieved, resulting in a high sampling rate.

To enable these fast and accurate sampling intervals, the instrument uses a dual sensor arrangement. Built-in potentiometers for length measurements (µm resolution) provide immediate sample thickness data.

Short Test Cycles

The double heat flux sensor configuration ensures shortest possible measurement cycles.
A typical measurement for most samples can take as little as 15 minutes until the temperature stabilizes.

Zero Maintenance

The rugged system design and unique zeromaintenance
Peltier heating and cooling cycle ensure minimal maintenance costs.

Highest accuracy

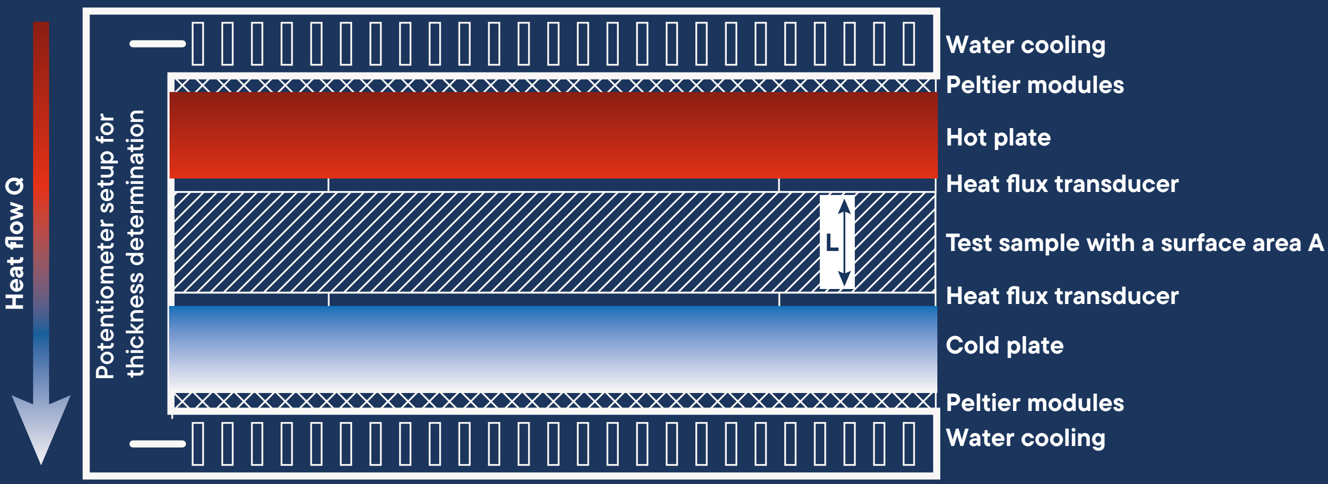
The instrument has two built-in linear potentiometers, offering automated highest precision sample thickness determination. Two heat flux sensors then measure the heat flow, between the hot and cold plate.

- Clean system design with improved isolation and optimized electronics
- Unmatched precision and accuracy
- Low power consumption
- Instrument design based on ASTM C518, JIS A1412, ISO 8301, DIN EN 12664 and DIN 12667

Software benefits

- The instrument can be operated from the front panel
- Easy input of measurement parameters
- Measurement data storage and export
- Report printing, layout can be customized
- Multilingual software versions
- Instrument monitoring (plate temperature, thermal conductivity results, and output signal monitoring)
- Optional user log-in and data monitoring

Unit operation



Fourier's law of heat conduction is the basis for the calculation of thermal conductivity and thermal resistance.

$$U = \frac{\dot{Q}}{A \cdot \Delta T}$$

The heat transfer coefficient can be calculated from the measured heat flow through the sample divided by the cross-sectional area and the applied temperature difference.

$$\lambda = U \cdot L$$

For a homogeneous material, the thermal conductivity Lambda is the product of the heat transfer coefficient (U-value) and the sample thickness.

$$R = \frac{1}{U}$$

λ: Thermal Conductivity [W/m·k]

$\dot{Q}$: Heat Flux [W]

A: Sample surface area[m^2]

L: Sample thickness[m]

ΔT: Temperature gradient[K]

R: Thermal resistance[m^2K/W]

U: Heat transfer coefficient[W/m^2K]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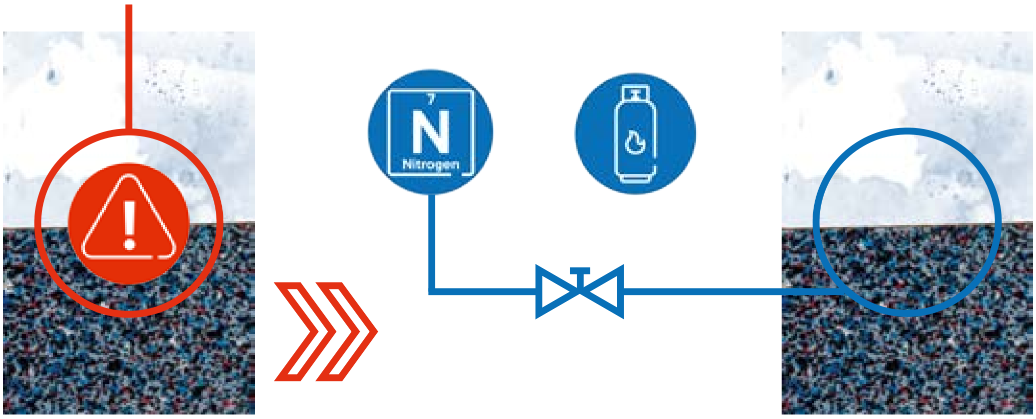
Integrated dew protection system

to prevent moisture from affecting thermal conductivity

condensed humidity on sample

Nitrogen or dry air

sample surrounded with nitrogen or dry air



The condensed humidity (dew) might be soaked into the sample and change the thermal conductivity of the sample.

During the measurement the humid air surrounding the sample can be replaced by a constant flow of dry gas.

If an object is being cooled below the dew point of the ambient air, the humidity contained will start to condensate on that object.
This would also be the case for samples that are inserted into the HFM L57 and are supposed to be measured with any temperature below the dew point. The condensed humidity (dew) might be soaked into the sample and change the thermal conductivity of the sample.

To prevent this problem, the surrounding air can be replaced by dry air or nitrogen with a constant gas flow throughout the complete measurement duration.

The required components, such as a throttle valve and a flow meter are integrated into the Linseis HFM. This allows precise, stable and reproducible measurements.

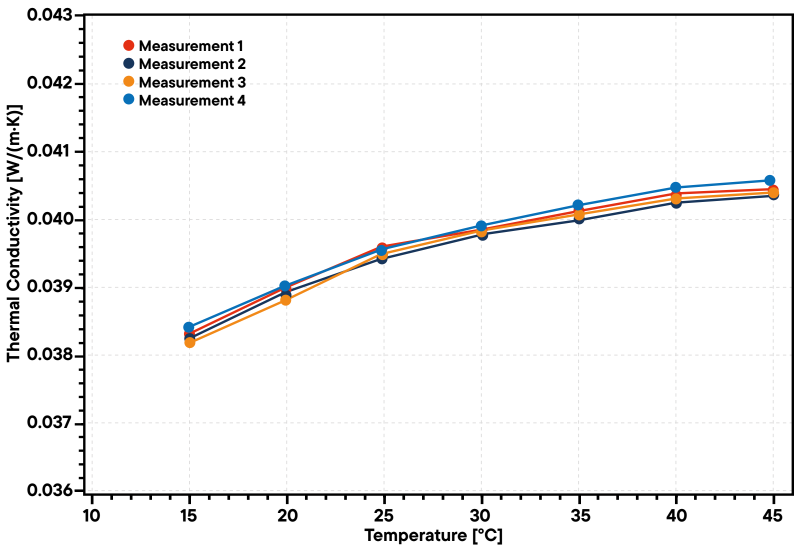
Specifications

	HFM L57 200	HFM L57 300	HFM L57 600
Temperature range (plates)	0 to 90 °C -20 up to 90 °C -35 up to 90 °C	0 to 90 °C -20 up to 90 °C -35 up to 90 °C	-20 up to 70 °C
Cooling system (depends on temp. range)	External chiller or thermostat	External chiller or thermostat	External chiller or thermostat
Temperature control (plate)	Peltier	Peltier	Peltier
Temperature reso-lution	0.0001 °C	0.0001 °C	0.0001 °C
Measurement Data points	up to 100	up to 100	up to 100
Sample size	200 x 200 up to 90 mm thickness	300 x 300 up to 100 mm thickness	600 x 600 up to 200 mm thickness
Th. resistance measuring	0.2 to 8.0 m^2K/W with extension: 0.036 to 8.0 m^2K/W	0.2 to 8.0 m^2K/W with extension: 0.036 to 8.0 m^2K/W	0.2 to 8.0 m^2K/W with extension: 0.036 to 8.0 m^2K/W
Reproducability	0.25 % / 0.5 %	0.25 % / 0.5 %	0.25 % / 0.5 %
Accuracy	± 1 up to 2 %	± 1 up to 2 %	± 1 up to 2 %
Variable contact pressure	up to 1.3 kPa, optional up to 25 kPa	up to 1.3 kPa, optional up to 25 kPa	up to 2.4 kPa
Thermal conductivity	0.001 up to 0.5 W/m·K with extension: 0.001 up to 2.2 W/m·K	0.001 up to 0.5 W/m·K with extension: 0.001 up to 2.5 W/m·K	0.001 up to 0.5 W/m·K with extension: 0.001 up to 2.5 W/m·K

HFM Overview

Applications
HFM L57 200/300/600

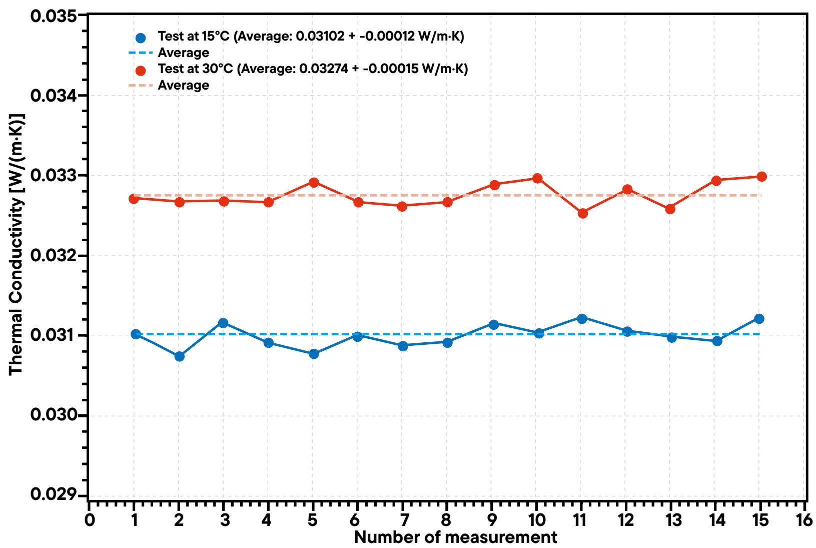
Elastomer Foam



Reproducibility:

The measurement clearly demonstrates the outstanding reproducibility of the LINSEIS HFM series. A reproducibility of 0.25 % was achieved. The graph shows four measurements of an elastomer foam in the temperature range from 15 to 40 °C. The sample was removed and placed into the instrument again after each measurement.

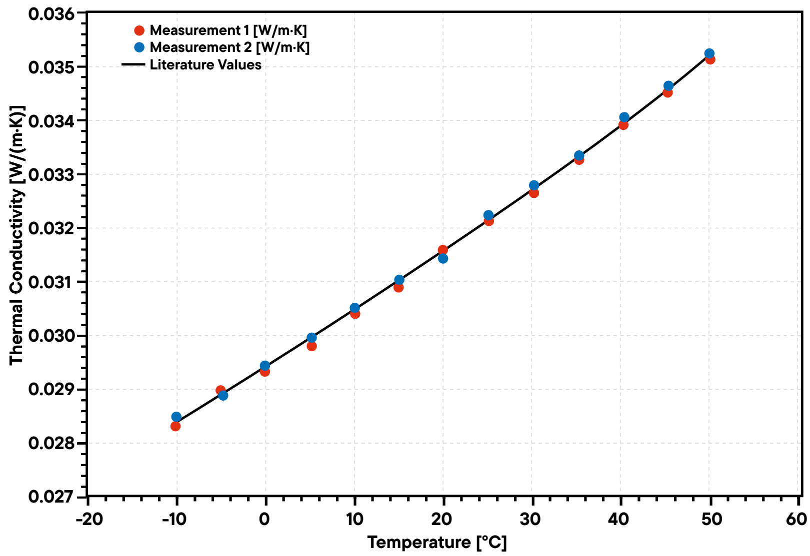
440-certified reference material - IRMM



Repeatability:

The graph shows the results of 15 measurement of the IRMM-440 certified reference material (resin bonded glass fibreboard) and highlights the very good repeatability of the HFM.

Glass wool specimen



Precision:

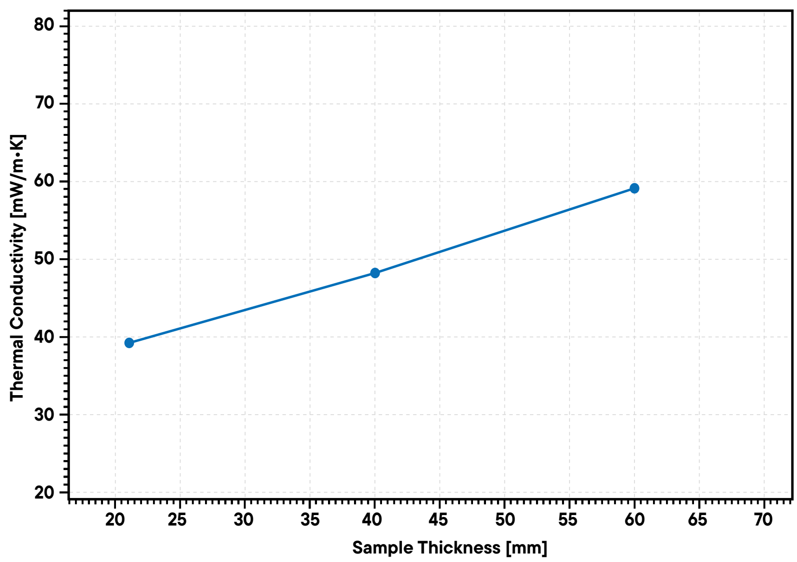
The graph shows two measurements of same glass wool specimen at several temperatures.

The sample was measured in an HFM 300, starting at -10 °C to 50 °C.

The black line shows the thermal conductivity according to the manufacturer information. The deviation is less than 1 %.

Linseis Service Lab

Polyester fibers



Compressible materials can change their properties depending on the compression. This was demonstrated on a mat of polyester fibers. A sample of size 300 mm x 300 mm and initial thickness of about 60 mm was placed into a Linseis HFM 300 and tested at room temperature.
Using the distance control, the sample thickness was step by step reduced to 60 mm, 40 mm and 20 mm. At each sample thickness a gradient of 20 K was applied until a stable state was reached. The compression results in a significant reducing thermal conductivity.

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