

HFM Series

Heat Flow Meter

Thermal Conductivity Meter for **insulation and construction materials**.

Conforms to ASTM C518, C1784,
ISO 8301, JIS A1412, EN 12667,
and EN 12664

HFM-100



HFM-100 HT

HFM-50

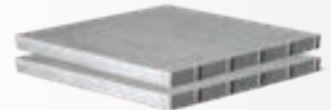
Insulation

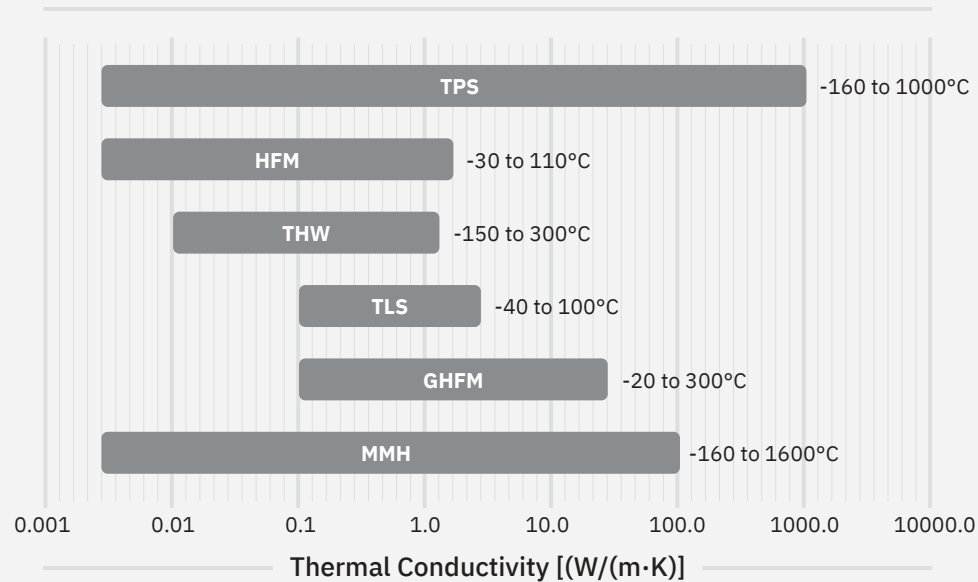


Wood



Concrete





MP-1 (Measurement Platform)

- MP-1: TPS (Transient Plane Source)
- MP-1: THW (Transient Hot Wire)
- MP-1: TLS (Transient Line Source)

MP-V (Measurement Platform)

- TPS (Transient Plane Source)
- THW (Transient Hot Wire)
- TLS (Transient Line Source)
- MTPS (Modified Transient Line Source)

HFM-100 | 50 | HT (Heat Flow Meter)

THW-L1 (Transient Hot Wire)

GHFM-01 (Guarded Heat Flow Meter)



MP-2 (Measurement Platform)

- MP-2: TPS (Transient Plane Source)
- MP-2: THW (Transient Hot Wire)
- MP-2: TLS (Transient Line Source)

TLS-100 (Transient Line Source)

THW-L2 (Transient Hot Wire)

HFM-25 (Heat Flow Meter)

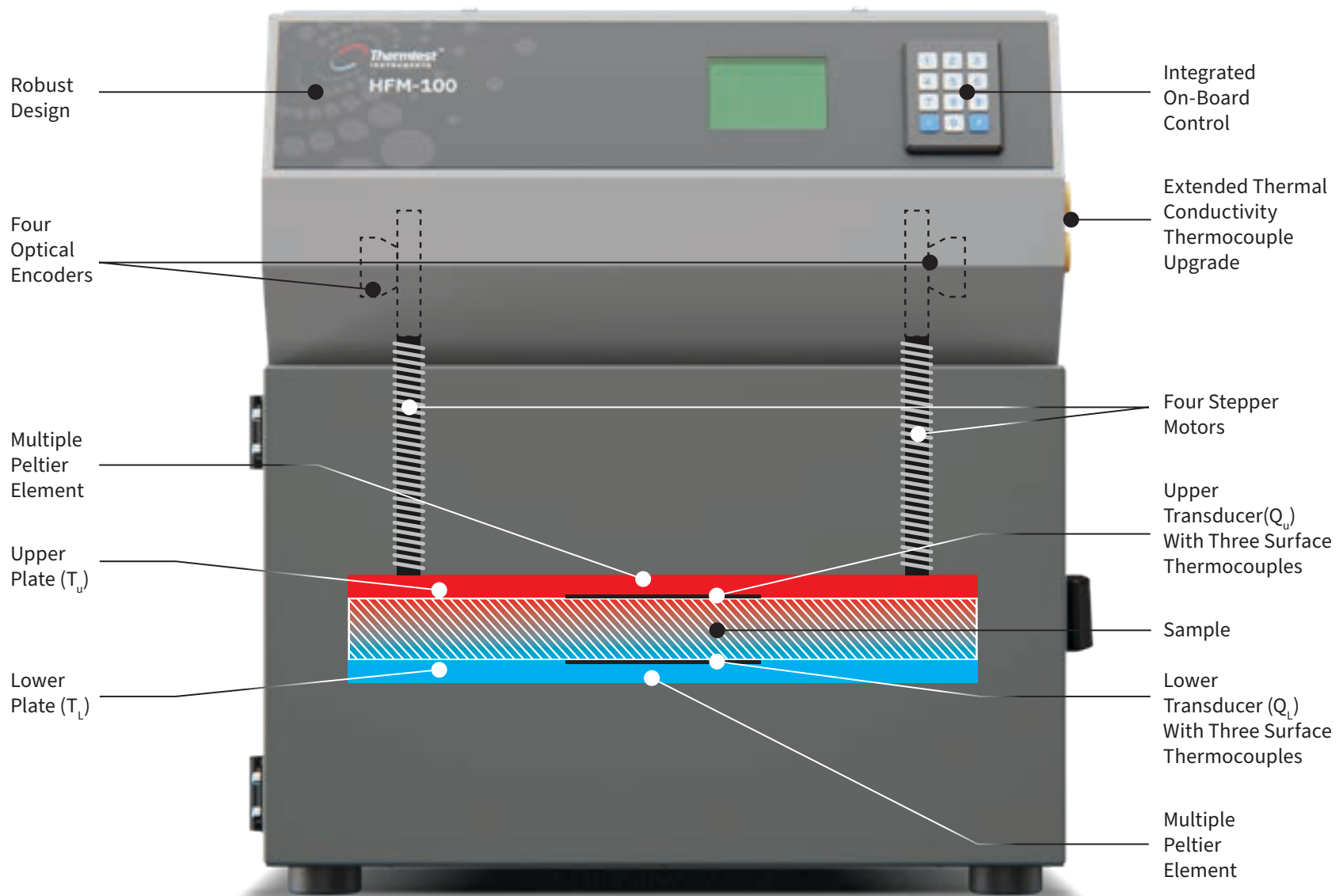
Thermtest has been advancing the measurement of thermal conductivity, thermal diffusivity and specific heat since 2005. With more than 3,000 satisfied customers worldwide, our unique combination of advanced thermal conductivity instrumentation for the laboratory, portable meters for the field and accessories enables us to provide ideal solutions to fit any material testing application and budget.



HFM Series

The Heat Flow Meter is an easy-to-use technique for measuring the thermal resistance and thermal conductivity of insulation products, construction materials, packaging and assemblies. Thermal conductivity is the measurement of the ability of a material to conduct heat and can be critical for defining energy efficiency and thermal performance in materials. Our HFM series was designed and engineered to combine the highest accuracy, repeatability, widest temperature range and industry leading performance all at an exceptional value.

HFM Series Features



Featured HFM Series Capabilities

The second generation HFM-100 / HFM-100 HT / HFM-50 instruments are an excellent choice when making steady-state thermal conductivity measurements of specimens like insulation products and construction materials. We've rigorously engineered the Heat Flow Meter (HFM) to meet the requirements of international standards including ASTM C518, C1784, ISO 8301, JIS A1412, EN 12667 and EN 12664. Operating the HFM is straightforward—a sample is positioned between two heating and cooling plates. The upper plate, powered by stepper motors positioned in each corner, lowers to contact the top of the sample. Plate contact with the test specimen is controlled by a standard applied pressure, or by a user defined specimen thickness.

Stepper motors are controlled by individual optical encoders for the measurement of sample thickness (L), to the nearest 0.05 mm (0.0019 in). Integrated logic between stepper motors allows the upper plate to sense and adjust for specimens with surface variations, optimizing plate - specimen contact for measurements. One heat flux sensor is integrated into each plate, and is used to monitor heat flux (Q/A), generated due to the difference in temperature (ΔT) between the top and bottom plate at regular intervals, until steady-state heat flux is observed. The composite heat flux is then used to measure thermal resistance (R) and calculate thermal conductivity (λ) according to Fourier's Law.

$$\lambda = \frac{Q}{A} \frac{L}{\Delta T}$$

UNITS
W/m•K or BTU/(hr•ft²•°F)

$$R = \frac{1}{\lambda} L$$

UNITS
m²•K/W or hr•ft²•°F/BTU

- Factory calibrated
- Two flux sensors with surface thermocouples for accurate measurement of thermal resistance and thermal conductivity
- Multiple Peltier heating / cooling plates for rapid control of temperature
- Thickness is measured to an accuracy of 0.05 mm (0.0019 in) with the use of four digital optical encoders
- Front panel operation allows full control of all HFM functions, or use the new feature packed HFM-100 / HFM-100 HT / HFM-50 Software for basic and additional functions, such as printing and exporting
- Plate clamping can be automated or set to a user defined thickness—ideal for compressible materials
- Follows international standards: ASTM C518, C1784, ISO 8301, JIS A1412, EN 12667 and EN 12664

HFM Series Specifications

Following international standards, the HFM-100 is designed for testing both homogeneous and heterogeneous materials. The HFM-100 / HFM-100 HT / HFM-50 sample size allows for representative testing of materials typically found in insulation and construction industries.

Materials	Insulation, Solids, and Textiles
Type of Sensors	Flux Sensors (x2)
Surface Thermocouples	Three for each flux sensor
Applications	General Testing
Direction	Through-Thickness
Factory Calibrated	Yes
Thermal Conductivity Range	0.002 to 0.5 W/m•K
Specific Heat Capacity	Optional
High Thermal Conductivity Kit	Up to 2.5 W/m•K
Measurement Time	30 to 40 minutes
Reproducibility	± 0.5 to 1%
Accuracy*	± 1 to 2%
HFM-100 / HFM-50 Plate Temperature Range**	-20 to 75 °C (-4 to 167 °F)
HFM-100 HT Plate Temperature Range**	-30 to 110 °C (-22 to 226 °F)
HFM-100 / HFM-100 HT Sample Size	Up to 300 x 300 x 100 mm (12 x 12 x 4 in)
HFM-50 Sample Size	Up to 200 x 200 x 50 mm (8 x 8 x 2 in)
Standard	ASTM C518, C1784, ISO 8301, JIS A1412, EN 12667, and EN 12664

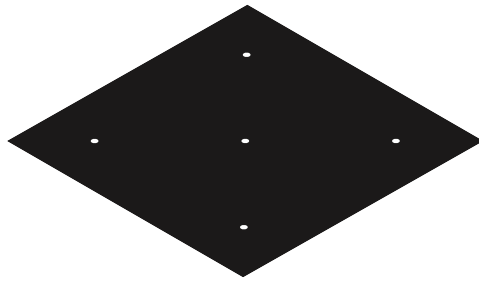
*Performance verified with NIST 1435d / 1450e

**Chilled circulator required

Method is continually improved; specifications are subject to change without prior notice.

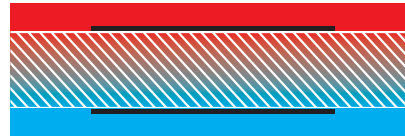
HFM Series Highlights

Accurate Measurements



Heat Flux Sensors

Temperature Control



Resolution < 0.01°C (0.018°F)

Thickness Measurement



Accuracy < 0.05 mm (0.0019 in)

Versatile Operation



OR



Stand-Alone or Software

Clamping Control



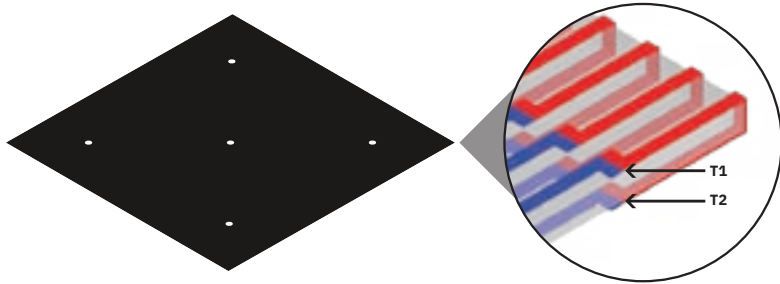
Automated or Manual

Reference Materials



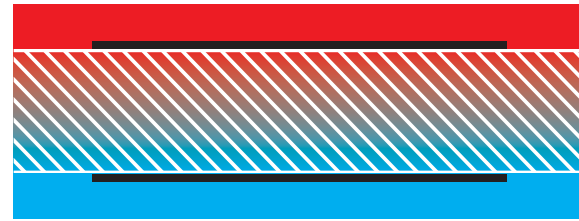
Certified or Custom

HFM Series Characteristics



Measurement of Heat Flux

Accurate sample thickness is optimal for determining the thermal resistance of a material with the measurement of thermal conductivity. The HFM Series systems feature the advantage of either an automatic determination of sample thickness for rigid materials, or a user defined sample thickness for compressible materials. Sample thickness is measured using digital optical encoder technology. Four encoders are positioned at each corner of the top sample plate. Multi-position encoder placement ensures the most accurate ($< 0.05 \text{ mm} / 0.0019 \text{ in}$) measurement of sample thickness and in the end, thermal resistance for materials being measured. The design of the encoder assembly allows for constant and reliable coupling of the plate and optical encoder via a securely attached gear rack. By keeping the gear rack perfectly coupled to the encoder at all times, the HFM systems are able to intelligently and precisely resolve any misalignment of the plates.



Temperature Control

Thermoelectric Peltier elements are used to heat and cool the HFM testing plates. A thermoelectric element is a solid-state active heat pump which transfers heat from one side of the device to the other, with consumption of electrical energy, depending on the direction of the current. This flexibility allows the user to easily change heating and cooling direction to best match their testing application, at a temperature resolution of $< 0.01^\circ\text{C}$ (0.018°F). Each plate contains multiple high power thermoelectric modules, matched with a surface thermocouple and smart temperature control to optimize the speed and accuracy of the plate temperatures.



The screenshot shows the NI-DAQmx software interface. At the top, there is a blue header bar with the text "NI-DAQmx" and a "Download PDF" button. Below the header, there is a table with 10 columns: "Signal", "Status", "Signal", "Status", "Signal", "Status", "Signal", "Status", "Signal", "Status". The table contains 10 rows of data, each representing a digital input channel. The first row is highlighted in blue. Below the table, there are two graphs. The left graph is labeled "Signal" and shows a square wave. The right graph is labeled "Status" and shows a square wave. The status graph has a y-axis labeled "Status" with values 0 and 1. The status graph shows a square wave that is high (1) for most of the time and low (0) for a short duration. The status graph is labeled "Status" and shows a square wave. The status graph has a y-axis labeled "Status" with values 0 and 1. The status graph shows a square wave that is high (1) for most of the time and low (0) for a short duration.

The HFM offers users two versatile and convenient methods of operation—run your measurements independently using the integrated front control panel, or by using the feature packed Windows based HFM software included with each system. The simple to use software offers additional features over the front panel operation, including unlimited steps of temperature automation when testing, and additional functions like saving, exporting, and printing measurement results. With front panel control, users can automate up to five steps of temperature when making measurements, or unlimited steps with the HFM software. HFM results are conveniently available in both SI, and Imperial Units of measure.



Clamping Control

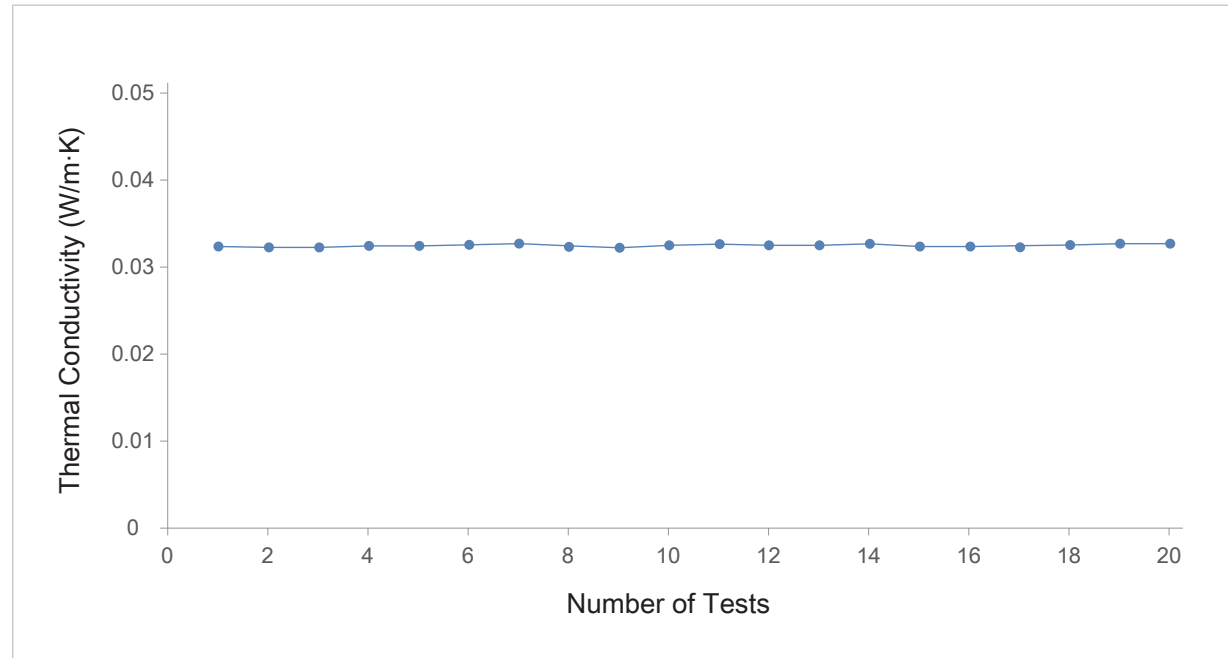
For rigid materials, plates automatically clamp together for optimum contact between sample and heat flux sensors. For compressible materials, the desired height of the sample may be entered manually and the plate will automatically stop at the entered sample height.



Reference Materials

Every HFM system comes complete with one Standard Reference Material (SRM) from the National Institute of Standards and Technology (NIST). SRM 1450e- Fibrous Glass-Board is certified for thermal conductivity from 6.85 to 66.85°C (44.33 to 152.33°F) and is available in a thickness of 25 mm (1 in). Additionally available is SRM 1453 - Expanded Polystyrene Board is certified for thermal conductivity from 7.85 to 39.85°C (46.13 to 103.73°F) and is available in a thickness of 12.5 mm (0.5 in). In addition to NIST Standard Reference Materials, we can develop Thermal Transfer Standards (TS) for specialized testing applications.

Accuracy & Repeatability



A sample of NIST SRM 1450d was repeatedly tested to confirm the accuracy and repeatability of the HFM-100. Prior to each of the 20 measurements, the NIST 1450d sample was removed, and then placed back within the HFM-100 chamber. The certified thermal conductivity for the NIST piece at **20°C** (68°F) is 0.03239 W/m·K. The average thermal conductivity value received from all 20 tests was **0.0325 W/m·K**. All tests had a repeatability within **± 0.5%**, and an accuracy within **± 1%** of the certified value.

Sample Measurement

The Sample

1



The sample should have parallel surfaces. Sample height is automatically measured by the HFM; however, for compressible materials, desired sample thickness can be manually entered for predetermined testing thickness.



1 min.

Insert Sample

2



Place the sample between the HFM's parallel testing plates. For smaller samples or samples of differing shapes from the testing chamber, place the sample within the center of the lower plate, positioned directly over the heat flux sensor.



1 min.



3 Close Plates

The top plate automatically lowers for rigid samples or to a predetermined thickness for compressible samples. For added accuracy when testing rigid samples, the top plate makes a short confirming movement for optimum contact, and measurement of thickness. Additionally, this short movement will also compensate for any issue with sample flatness.



1 min.



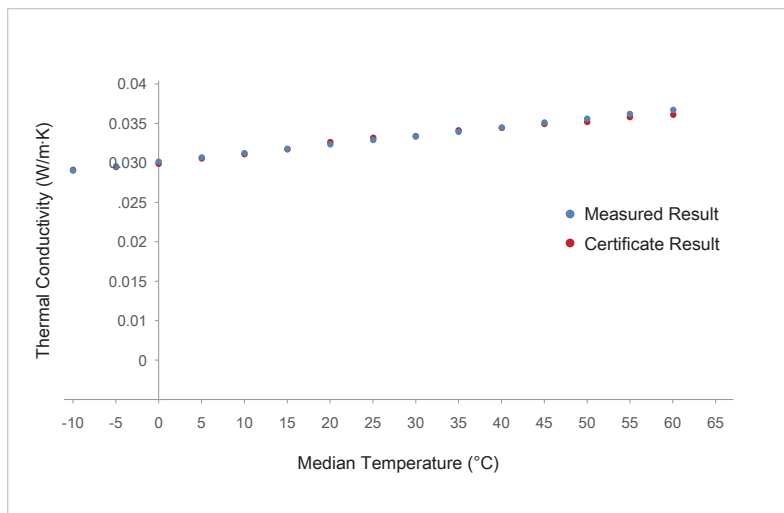
4 Run Experiment

A single mean temperature or steps of temperature may be selected for an automated testing routine. Testing can be performed in either quality control or high accuracy (30 to 40 min.) modes for test times which best fit your application. Once testing is complete, results can be saved, printed, or exported to Microsoft Excel for further processing.



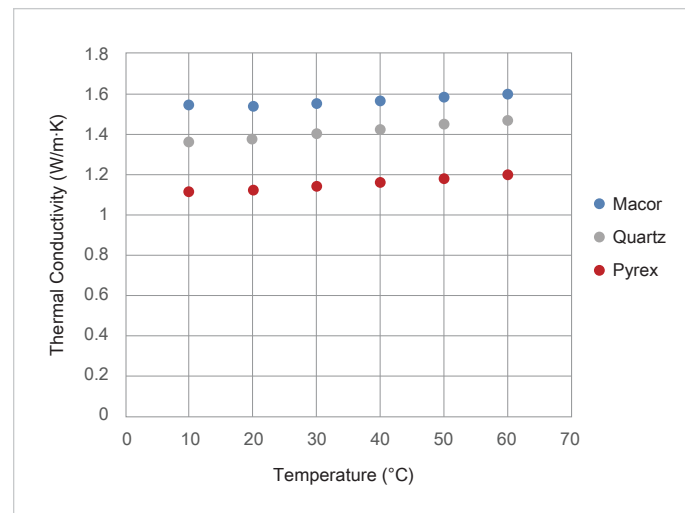
30-40 min.

HFM Series Applications



Insulation vs. Temperature

The HFM-100 / HFM-50 are capable of testing materials over a temperature range of **-20 to 75°C** (-4 to 167°F). NIST 1450d, Fibrous Glass Board, is a certified Standard Reference Material from the National Institute of Standards and Technology. Measured results are within 2% of the certified values.



High Thermal Conductivity Kit

With the added High Thermal Conductivity Kit, the HFM-100 / HFM-50 are able to accurately and efficiently measure higher thermal conductivity materials, such as glass and ceramics. For such applications, an external thermocouple kit is used in combination with the sample being tested. Macor, Quartz, and Pyrex were tested in the HFM from 10°C to 60°C (50°F to 140°F). All measured values are within the stated accuracy of the system, **± 5%**.

HFM Series Applications



Batting Insulation

When testing compressible materials, such as batting insulation, slight changes to the density of a material, due to compressive forces, may alter thermal conductivity. Both a fiberglass and a stone wool batting insulation were tested with the HFM. A thermal conductivity of **0.0430 W/m·K** was the result of the fiberglass testing, where **0.0364 W/m·K** was the result of the stone wool insulation test. These values were within **3%** of the stated manufacturers thermal conductivity.



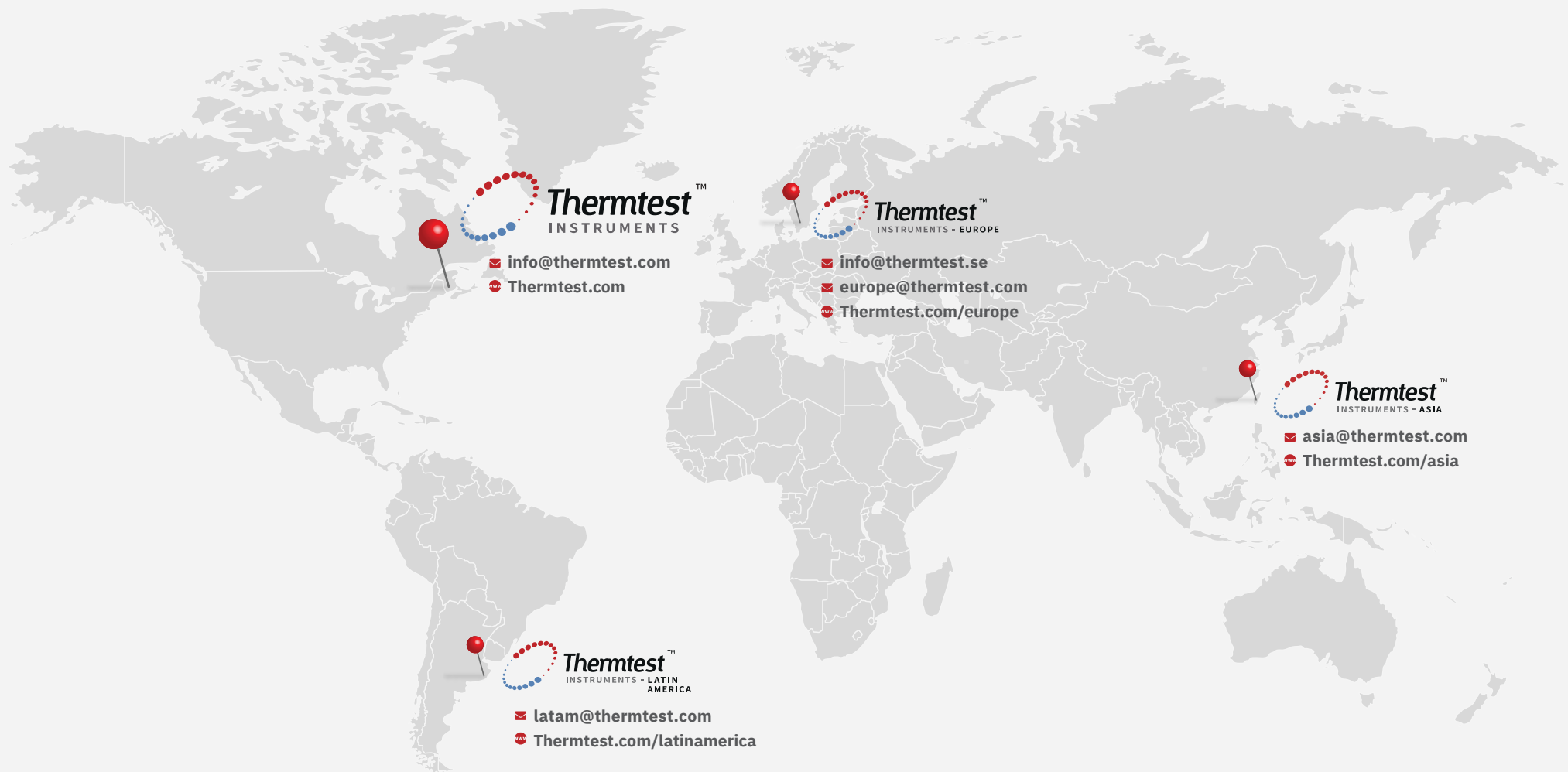
Aerogel Blankets

Aerogel has one of the lowest thermal conductivities known to solids. An aerogel blanket of choice was selected to test by the Heat Flow Meter. Results concluded a thermal conductivity of **0.014 W/m·K**, which is within **3%** to the manufacturers specification.



Wood

As wood is rigid, the HFM can be set to automatically adjust to the height of the sample. Testing of this softwood produced a thermal conductivity reading of **0.12 W/m·K**, an exact match to the literature values for softwoods.



HEADQUARTERS

Thermtest Inc.

Fredericton, New Brunswick
Canada

Phone: +1 506 458 5350

Email: info@thermtest.com
Thermtest.com

RIFERIMENTO PER L'ITALIA



Qi srl

t +39 06 9105461

www.qitech.it | SalesQi@qitech.it