

Hot Disk[®] Thermal Constants Analyser



TPS 1500



hotdiskinstruments.com

Hot Disk[®] Instrument

TPS 1500

The affordable Hot Disk[®] TPS 1500 is the ideal thermal conductivity meter for testing building materials, insulation materials or any other type of large bulk samples. The TPS 1500 Thermal Conductivity range comprises 0.01 to 400 W/m/K, and the instrument handles temperatures from -100°C to 750°C. Sample sizes down to a thickness of a few millimeters can be accommodated. It can also analyse the anisotropic thermal transport properties of uniaxial materials. The TPS 1500 meets ISO 22007-2 and is CE marked.



For heavy-duty testing

The well-established TPS technique – today used in more than 1000 laboratories – is highly appreciated for its ability to simultaneously and quickly determine thermal conductivity, thermal diffusivity and specific heat capacity from a single measurement, with minimum sample preparation. Utilizing the unique Hot Disk® sensors, the TPS 1500 system serves as a robust tool for testing the thermal properties of solids, powders, pastes and foams. If larger samples are available, also highly conducting samples, such as metals, semi-conductors and high-conductivity oxides, can be tested.

The TPS 1500 is designed as a reliable workhorse instrument for materials R&D within heavy-duty industries. The construction industry, for example, will see concrete and cement mixtures, woods, fibrous structures, and insulating materials readily and efficiently analysed. The Hot Disk Analysis software for the TPS 1500 system incorporates tools for automated measurements as well as automatic temperature control of external devices. In addition to the standard Isotropic and One-dimensional software modules the system can be extended with software to allow testing of anisotropic samples (Anisotropic module) and extremely light and low-conducting materials (Low-density/Highly-insulating module). Also available is a dedicated module for analysing specific heat capacity of solid samples, such as complex composites (Cp module).

The Hot Disk Thermal Analyser software for the TPS 1500 system incorporates tools for automated measurements as well as automatic temperature control of external devices. It also incorporates tools for exporting results to 3rd-party software (MS Excel), for additional processing or statistical analysis. For precise and automatic temperature readings an optional PT100 temperature sensor is available.



Key Features

Sensors: The TPS 1500 operates a selection of Hot Disk® sensors suitable for different materials and applications.

Temperature Control: Automatic Temperature series measurements (Isothermal Steps) are easy to perform using either an optional external Furnace or a temperature-controlled Bath Circulator. The Hot Disk Analysis software and TPS 1500 instrument controls the external device using RS-232 protocol.

Everything to get you started: The basic TPS 1500 setup includes everything you need to begin making measurements. The instrumentation includes: Software with standard isotropic module, one Sensor, Stainless Steel verification samples and a Room-Temperature Sample Holder.

Optional Software Modules: In addition to the standard Isotropic and One-Dimensional modules, optional ones for Anisotropic, Specific Heat Capacity, and Low-Density, Highly-Insulating Samples are available.



TPS 1500 Specifications¹

Measurement

Sample Types	Bulks, rods, laminates, composites, minerals, pellets, granules, beads, grains, powders, pastes, creams, gels, liquids, foams and insulators.
Evaluation	
Anisotropy	Yes, 2D anisotropic (uniaxial) materials can be characterised, using optional Anisotropic Measurement Module.
One-Dimensional	Yes, axial estimations possible for a complex sample configuration.
Sample Dimensions	
Smallest	Bulk sample: 3 mm thick x 13 mm wide (circle or square). Rod sample: 20 mm long x 7 mm wide (circle or square).
Largest	Bulk sample: unlimited. Rod sample: unlimited length x 60 mm wide (circle or square).
Sample Temperature Range	-100°C (20 K) to 750°C.
Core Instrument	RT.
With Optional TCU	Cryostat: -100°C to RT. Low-to-High Temperature Chamber: -60°C to 300°C. Bath Circulator: -40°C to 200°C. Convection Oven: RT to 600°C. Muffle Furnace: RT to 750°C. Tubular Furnace: RT to 750°C (gas purging for >400°C is recommended).
Measurement Time²	20 to 5120 seconds (depending on sample material and sensor dimensions).
Measurement Range	
Thermal Conductivity	Bulk sample: 0.01 to 50 W/m/K. Rod sample: 1 to 400 W/m/K.
Thermal Diffusivity	Bulk sample: 0.01 to 30 mm ² /s. Rod sample: 1 to 100 mm ² /s.
Thermal Effusivity	20 to 35000 W√s/m ² /K.
Specific Heat Capacity	Up to 5 MJ/m ³ /K.

Measurement Accuracy	
Thermal Conductivity	Better than 5%.
Thermal Diffusivity	Better than 10%.
Measurement Reproducibility³	
Thermal Conductivity	Typically better than 2%.
Thermal Diffusivity	Typically better than 5%.
Measurement Repeatability⁴	
Thermal Conductivity	Typically 0.59% (Stainless Steel bulk sample, Kapton-insulated Hot Disk [®] sensor model 5501, and 22°C sample temperature).
Thermal Diffusivity	Typically 0.80% (Stainless Steel bulk sample, Kapton-insulated Hot Disk [®] sensor model 5501, and 22°C sample temperature).
Measurement Sensitivity⁵	
Temperature	Typically 44 μ K (Stainless Steel sample, Kapton-insulated Hot Disk [®] sensor model 5501, and 22°C sample temperature).

Notes:

1. Hot Disk AB reserves the right to make changes without prior notice, whether due to misprints, improved hardware, or extended software capabilities.
2. Time of transient temperature reading. An additional temperature settling time that depends on the sample material and TCU (if applied) is required to ensure isothermal condition before the reading.
3. Comparing measurements performed by different instrument set-ups.
4. Variation in consecutive measurements performed by a single instrument set-up. Note that this value depends on sample material, sensor model, and sample temperature.
5. Standard deviation in fitting $\Delta T(\tau)$ -function to the transient temperature reading. Note that this value depends on sample material, sensor model, sample temperature, and can vary considerably.

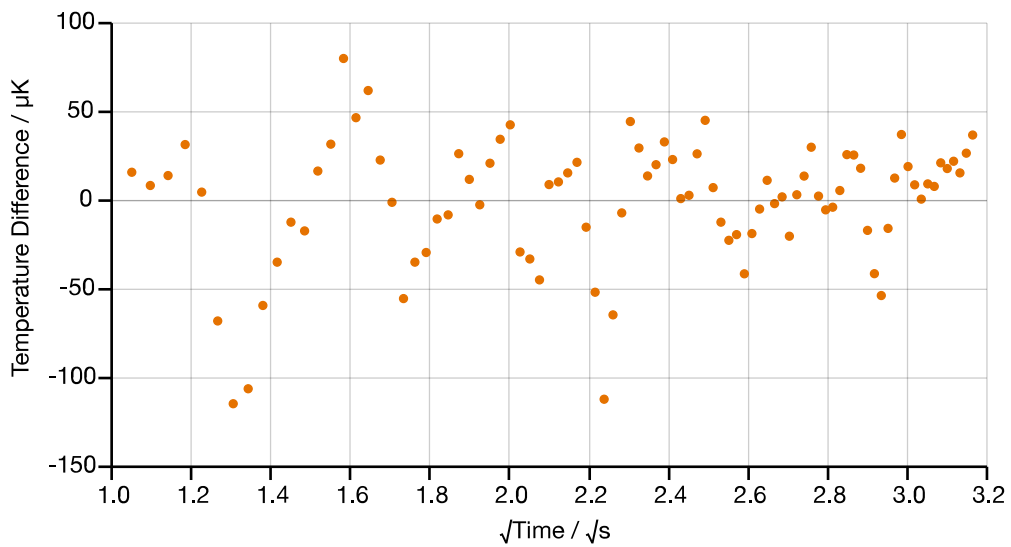
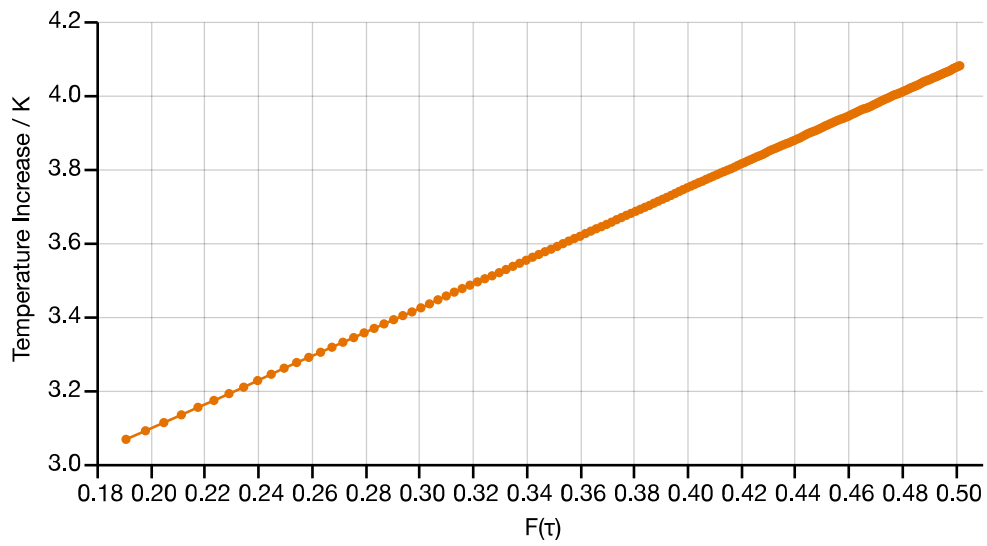
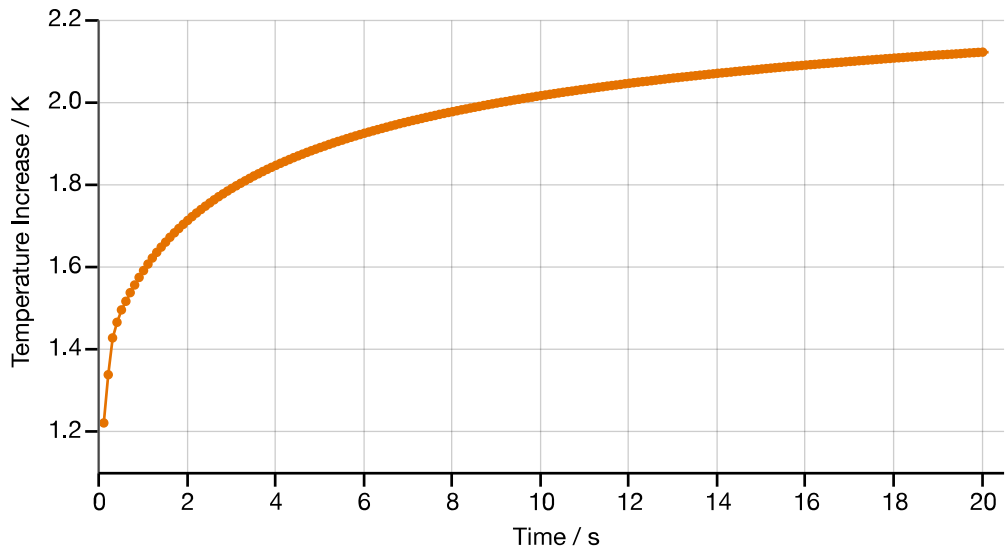
General

Meets ISO Standard 22007-2	Yes.
Measurement Modules	
Included	Isotropic, Single-Sided Testing, and One-Dimensional.
Optional	Anisotropic, Low-Density/Highly Insulating, Specific Heat Capacity, and Automation.
Sensor Models	
Hot Disk® sensor – Kapton-insulated	Models 5465, 5501, 8563, 4922, and 5599.
Hot Disk® sensor – Teflon-insulated	Models 5465 and 5501.
Hot Disk® sensor – Mica-insulated	Models 5465, 5082, 4921, 4922, and 5599.
Hot Strip® sensor – Kapton-insulated	All models.
Hot Cell® sensor – Cell size <250 mm	All models.
Hot Cell® sensor – Cell size >250 mm	Please inquire.
Instrument Environment	
Operating	15°C to 30°C.
Storage	-20°C to 45°C.
Instrument Line Power	
Supply Voltage	100 – 240 VAC, 50 – 60 Hz.
Power Consumption	45 W typical, 155 W maximum.
Instrument Warm-Up	2 hours to rated measurement performance.
Instrument Input and Output	
Rear Panel	USB type B connector (female) for connectivity. RS232 connector (male) for optional TCU.
Front Panel	LEMO 8 pin connector (female) for Hot Disk®, Hot Strip® or Hot Cell® sensor. LEMO 4 pin connector (female) for obsolete sensor.
Instrument Dimensions	280 mm high x 455 mm wide x 490 mm deep.
Instrument Weight	26 kg.
Instrument CE Marking	Yes.

TPS 1500 Measurement Demonstration

Stainless Steel

Sample	
Material	Stainless Steel, AISI 316/316L.
Type	Bulk.
Temperature	23°C
Measurement Parameters	
Measurement Module	Isotropic.
Sensor Model	Kapton-insulated Hot Disk® sensor 5501 (radius 6.4 mm).
Measurement Time	20 s.
Heating Power	800 mW.
Measurement Results	
Data Points	11-100.
Thermal Conductivity	13.63 W/m/K.
Thermal Diffusivity	3.608 mm ² /s.
Specific Heat Capacity	3.777 MJ/m ³ /K.
Probing Depth	12.0 mm.
Temperature Increase	0.4248 K.
Standard Deviation in Fitting $\Delta T(\tau)$	35 μ K.



Included with the TPS 1500 Instrument

Basic Option:

- 3 x Measurement Modules: Isotropic, Single-Sided Testing, and One-Dimensional.
- 1 x Kapton-insulated Hot Disk® or Hot Strip® sensor: Model free of choice, with cable.

Regular Complete Option:

- 5 x Measurement Modules: Isotropic, Anisotropic, Single-Sided Testing, One-Dimensional, and Specific Heat Capacity.
- 5 x Kapton-insulated Hot Disk® or Hot Strip® sensors: Models free of choice, with cable.

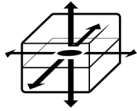
Extended Complete Option:

- 6 x Measurement Modules: Isotropic, Anisotropic, Single-Sided Testing, Low-Density/Highly Insulating, One-Dimensional, and Specific Heat Capacity.
- 5 x Kapton-insulated Hot Disk® or Hot Strip® sensors: Models free of choice, with cable. Always included

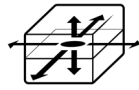
Always Included:

- Hot Disk® Desktop App software (latest version)
- 1 x Stainless Steel verification bulk sample.
- 1 x Single-sided background insulation (single-sided testing).
- 1 x Room temperature sample holder (protective hood included).
- Instructions manual.
- Instrument test protocol.
- Power supply cord and USB cable.

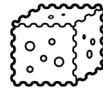
Available measurement modules for the TPS 1500



Isotropic (Standard)



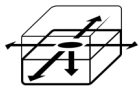
Anisotropic



Low-Density / Highly-Insulating



One-Dimensional



Single-Sided Testing



Specific Heat Capacity



Automation

Available sensors for the TPS 1500



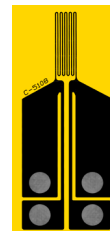
Kapton-insulated Hot Disk® sensor
Models 5465, 5501, 8563, 4922, and 5599.



Teflon-insulated Hot Disk® sensors
Models 5465 and 5501.



Mica-insulated Hot Disk® sensors
5465, 5082, 4921, 4922, and 5599.



Kapton-insulated Hot Strip® sensor
All models.
(Works only with the One-Dimensional Measurement Module.)



Aluminium & Gold Hot Cell® sensors
All models.

Hot Disk®

Instrument Portfolio

A wide range of Hot Disk® instrument models is available for testing and measuring Thermal Conductivity, Thermal Diffusivity, Thermal Effusivity and Specific Heat Capacity following ISO 22007-2. While typically generous of measurement spectrum, our top-of-the-line instruments are unique in monitoring ultra-short transient temperature readings, thereby tackling sub-millimeter-thick samples and highly-thermal conducting materials, beyond 1800 W/m/K. A further unique feature of our instrumentation is that it requires no external calibration. Our clients can confidently continue its employ, without worrying over the inconvenience of being obliged to return their instruments for re-calibration at regular intervals. Each Hot Disk® instrument includes two LEMO connector ports: one for the relevant Hot Disk® sensor, and one for the optional PT100 ambient temperature sensor.1 Please consult our interactive links below, to help determine which Hot Disk® instrument is best suited to your intended applications and needs.



TPS 3500
For testing the extreme.



TPS 2500 S
The benchmark instrument.



TPS 2200
For day-to-day testing.

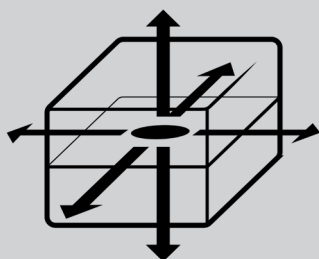


TPS 1500
For heavy-duty testing.

Hot Disk®

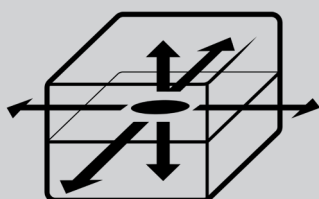
Measurement Modules

Hot Disk® instruments can be tailored to specific testing needs not only by the selection of sensors, but also by the wide range of measurement modules available. These modules allow for the testing of samples of special geometries, thermal conductivity ranges and material types. The Isotropic Module is the standard module for measuring bulk samples, and is included in all instruments. The add-on modules in turn extend the capabilities of your instrument, for example to tackle anisotropic-, slab-, or thin film samples. Based on long client experience, Hot Disk conveniently offers its clients clustered configurations along with many instrument models, via grouping several modules of related interest together, or by providing for the full available range. In effect, this means Hot Disk customers have the option of ordering several add-on modules at a quantity discount. Please contact your local Hot Disk sales representative for available cluster options.



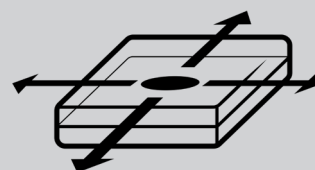
Isotropic (Standard)

All-round testing of bulk samples.



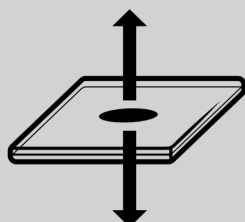
Anisotropic

Testing samples with direction dependent properties.



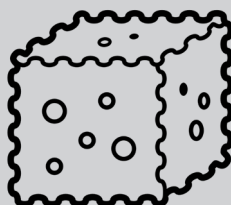
Slab

Testing highly thermal conductive slab or sheet samples.



Thin Film

Testing thermal insulating thin film samples.



Low-Density / Highly-Insulating

Testing the lightest and most insulating samples.

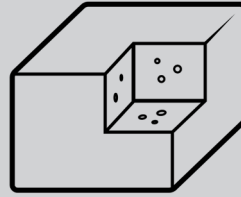


Specific Heat Capacity

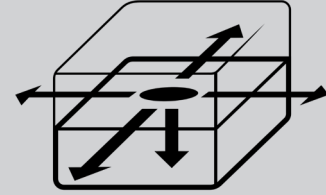
Testing Cp of complex samples and batteries.



One-Dimensional
Testing rod-like samples.



Structural Probe
Identify defects and structural changes inside samples and components.



Single-Sided Testing
Rapid production line QC testing.



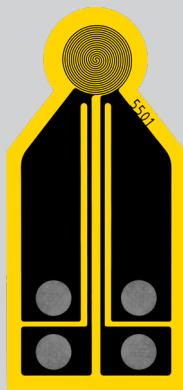
Automation
Remote-controlled testing.

Notes

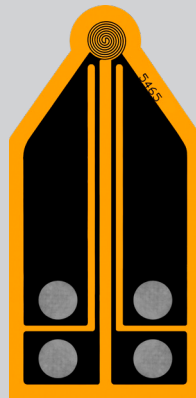
Hot Disk[®] Sensors

We currently supply three different types of sensors to be used with our Hot Disk[®] instruments – configured in tandem with our range of Measurement Modules. All three sensor types make use of a TPS element – a patterned Nickel foil with electrically insulating cladding – that is used for simultaneous transient heating and precise temperature reading.

Our patented Hot Disk[®] sensor is our baseline sensor for measuring Thermal Conductivity and Thermal Diffusivity of isotropic samples. It is also used for testing 2D anisotropic samples, e.g. uniaxial crystals and layered composites with different properties in the in- and through-plane directions. Our patented Hot Strip[®] sensor is used as complement to our Hot Disk[®] sensor, primarily for testing 3D anisotropic samples, e.g. biaxial crystals and fiber composites with different properties along, across, and through the fiber orientation direction. Our Hot Cell[®] sensor is our newest type addition, developed in-house to measure the Specific Heat Capacity of materials or components (with focus on batteries) of arbitrary type, shape, and size.



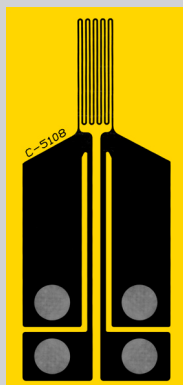
Kapton-insulated
Hot Disk[®] sensor



Teflon-insulated
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Mica-insulated
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Kapton-insulated
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Aluminium & Gold
Hot Cell[®] sensors



Notes

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