

Hot Disk[®] Thermal Constants Analyser



TPS 500

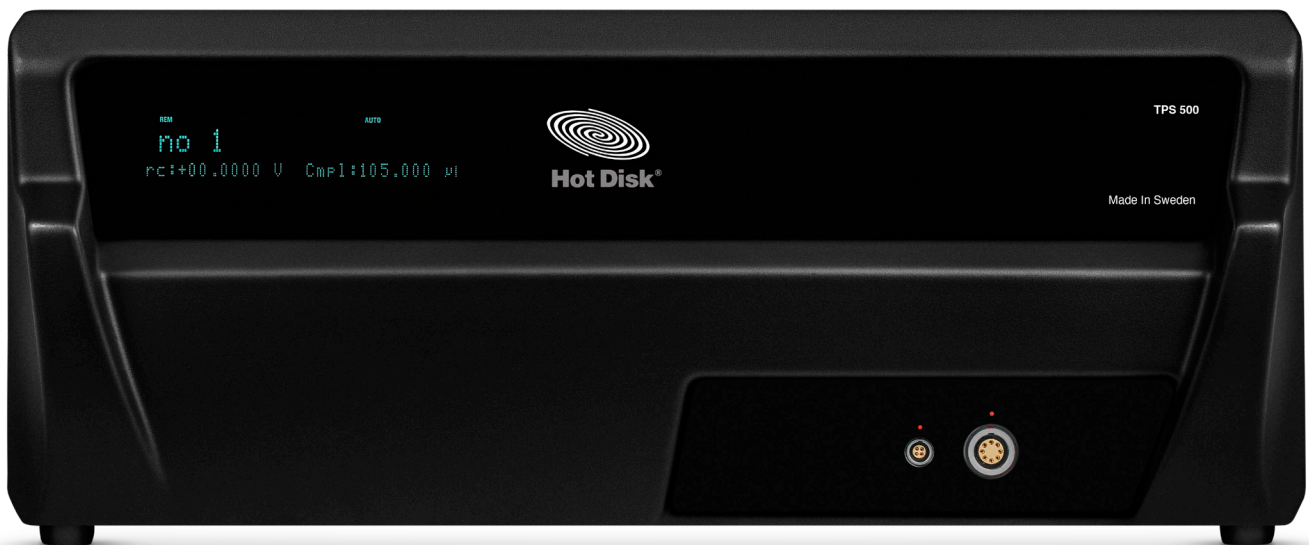


hotdiskinstruments.com

Hot Disk[®] Instrument

TPS 500

The Hot Disk[®] TPS 500 swiftly and accurately measures the Thermal Conductivity, Thermal Diffusivity, Thermal Effusivity and Specific Heat Capacity of a wide range of materials. It is therefore a favorable step-in thermal conductivity meter, and highly suitable for QC testing. The TPS 500 can handle bulk sample sizes down to a thickness of a few millimeters. The TPS 500 Thermal Conductivity range is from 0.03 to 100 W/m/K, and its temperature range from -100°C to 200°C. It is partly based on ISO 22007-2 and is CE marked.



For the economical lab

The accessible Hot Disk® TPS 500 Thermal Constants Analyser quickly and accurately measures Thermal Conductivity, Thermal Diffusivity, Thermal Effusivity, and Specific Heat Capacity of a wide range of materials and is therefore an excellent step-in thermal conductivity meter for the economical laboratory or QC testing set-up.

The TPS 500 instrument condenses our patented and now ISO standardised TPS technology with our user-friendly test and analysis software, resulting in a smart, simple-to-use thermal conductivity meter.

The TPS 500 measures the Thermal Transport Properties of solids, powders, pastes, gels and liquids over a temperature range of -100 °C to 200 °C. The instrument encompasses similar accuracy and sample size flexibility as the benchmark TPS 2500 S and workhorse TPS 1500 (the latter two instruments are designed according to ISO 22007-2).

Advantages of the TPS technology as realized in the TPS 500:

- Pours, transparent samples are easy to measure.
- Surface roughness or surface color does not influence measurement results.
- Contact pressure of sensor to sample surface does not influence measurement results.
- The method is non-destructive.
- Minimum- or no sample preparation (single-sided testing).
- Instant and fully consistent thermal conductivity results.
- Four thermal properties extracted from a single transient reading.
- No calibration or reference sample verification required (as it is an absolute technique).

Hot Disk® instrument users now number in the thousands world-wide. They appreciate our TPS technique for its unmatched measurement capability, together with its ease-of-use and effortless sample preparation. The operative simplicity of the TPS 500 instrument and the performance achieved when using optimally designed Hot Disk® sensors, makes the instrument uniquely suitable for QC applications, in particular automated production line QC via the capability of single-sided testing.

The test and analysis software (Hot Disk Desktop App) for the TPS 500 instrument incorporates tools for scheduled measurements as well as automatic ambient temperature control, using our temperature control unit accessories (e.g. Bath Circulator and Convection Oven). For precise ambient temperature readings an optional PT100 Temperature Sensor is available.

The TPS 500 test and analysis software also includes automated sensor switching functionality applying our Sensor Switch Unit accessories. It also incorporates tools for exporting measurement data and results to xlsx- or txt-files, for further processing or more advanced statistical analysis. With the optional Automation Module it is possible to remotely control the TPS 500 instrument. This facilitates isolation of the testing set-up from the operator, which is particularly useful for QC-testing at robotic controlled production line applications.

Key Features

Simplicity: Our latest user friendly, yet sophisticated, test and analysis software simplifies testing, making the learning curve very short. Also, normally no sample preparation is necessary. This makes the TPS 500 a smart, simple-to-use tool, easy to integrate.

Rapidity: The TPS 500 will test most materials in less than 20 seconds. For multiple measurements on the same sample, a cooling time between tests is recommended.

Sensors: The TPS 500 includes two specially selected Hot Disk[®] sensors suitable for the specified range of materials and applications, with a respective radius of 3.2 mm and 6.4 mm.

Single-Sided Testing: When two pieces of a sample for optimized double-sided testing is not available, the included single-sided background insulation material can be used to measure on a single sample piece. This ability lends itself for QC operations at near-line or in-line production workflow.

Temperature Control: Using our test and analysis software, automatic series of measurements at different ambient temperatures (isothermal steps) are easy to perform using our optional Bath Circulator and Convection Oven accessories.

Everything to get you started: The basic TPS 500 configuration includes everything to get you started making measurements. The instrumentation includes the Isotropic and Single-Sided Testing Modules, two Hot Disk[®] sensors, a Stainless Steel verification sample for data verification, a single-sided background insulation for single-sided testing, and a room temperature sample holder (without protective hood).

Optional Measurement Modules: In addition to the included Isotropic and Single-Sided Testing Modules, the optional Automation Module is available for remote control of the TPS 500 instrument.



TPS 500

Made In Sweden



TPS 500 Specifications¹

Measurement

Sample Types	Bulks, fine granules, powders, pastes, creams, gels, liquids, and foams.
Evaluation	
Anisotropy	No.
One-Dimensional	No.
Sample Dimensions	
Smallest	3 mm thick x 13 mm wide (circle or square).
Largest	Unlimited.
Sample Temperature Range	-100°C to 200°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 200°C.
	Muffle Furnace: RT to 200°C.
	Tubular Furnace: RT to 200°C.
Measurement Time ²	2.5 to 2560 seconds (depending on sample material and sensor dimensions).
Measurement Range	
Thermal Conductivity	0.03 to 100 W/m/K.
Thermal Diffusivity	0.02 to 50 mm ² /s.
Thermal Effusivity	40 to 20000 W√s/m ² /K.
Specific Heat Capacity	0.1 to 4.5 MJ/m ³ /K.
Measurement Accuracy	
Thermal Conductivity	Better than 5%.
Thermal Diffusivity	Better than 10%.
Measurement Reproducibility ³	
Thermal Conductivity	Typically better than 2%.
Thermal Diffusivity	Typically better than 10% (Kapton-insulated Hot Disk [®] sensor model 5501).
Measurement Repeatability ⁴	

Thermal Conductivity	Typically 0.32% (Stainless Steel bulk sample, Kapton-insulated Hot Disk® sensor model 5501, and 22°C sample temperature).
Thermal Diffusivity	Typically 1.3% (Stainless Steel bulk sample, Kapton-insulated Hot Disk® sensor model 5501, and 22°C sample temperature).
Measurement Sensitivity⁵	
Temperature	Typically 610 μK (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.

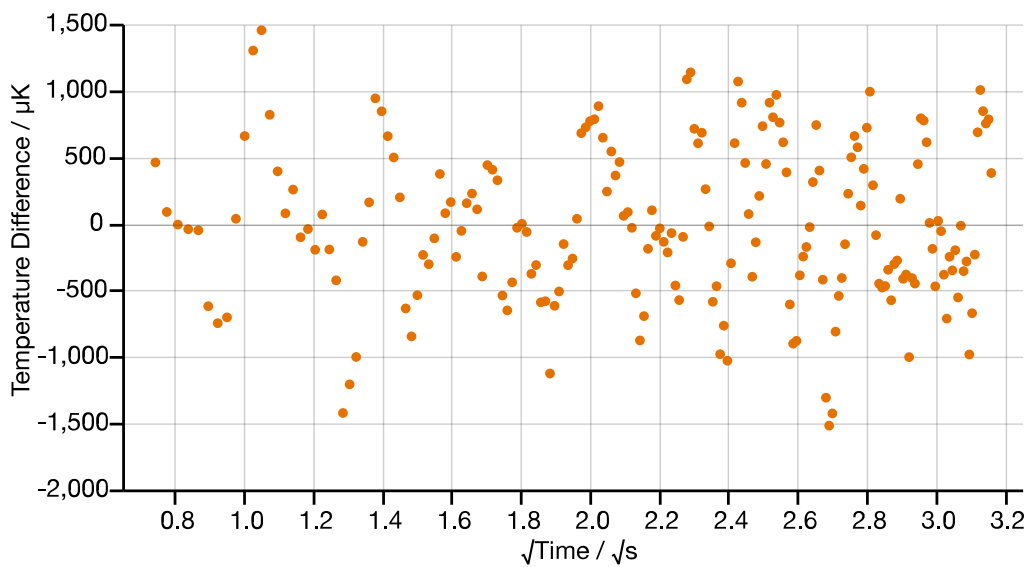
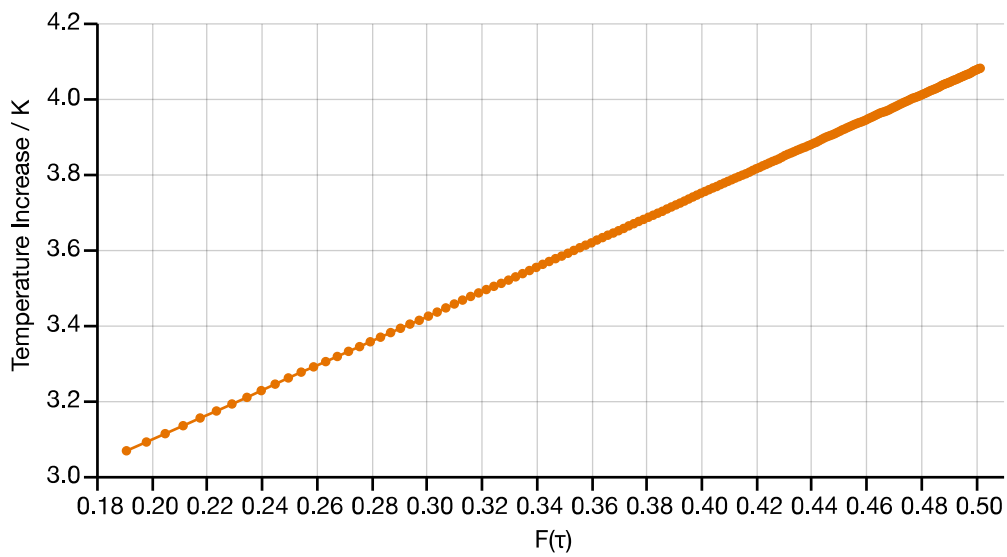
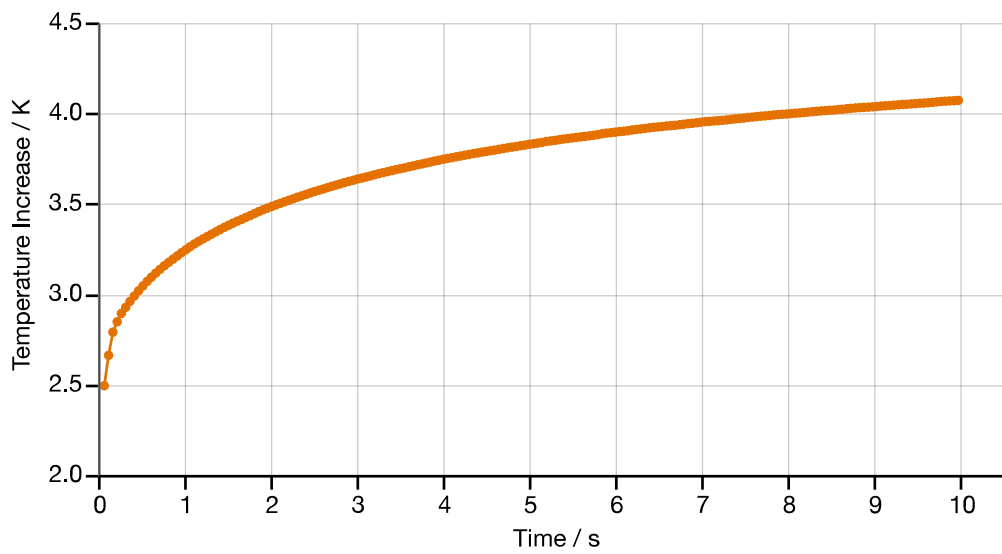
General

Meets ISO Standard 22007-2	Yes, with revised electronics.
Measurement Modules	
Included	Isotropic and Single-Sided Testing.
Optional	Automation.
Sensor Models	
Hot Disk® sensor – Kapton-insulated	Models 5465 and 5501..
Hot Disk® sensor – Teflon-insulated	Models 5465 and 5501..
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	18 W typical, 190 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® or Hot Strip® sensor. LEMO 4 pin connector (female) for optional PT100 temperature sensor.
Instrument Dimensions	190 mm high x 455 mm wide x 485 mm deep.
Instrument Weight	11 kg.
Instrument CE Marking	Yes.

TPS 500 Measurement Demonstration

Stainless Steel

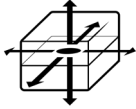
Sample	
Material	Stainless Steel, AISI 316/316L.
Type	Bulk.
Temperature	22°C
Measurement Parameters	
Measurement Module	Isotropic.
Sensor Model	Kapton-insulated Hot Disk® sensor 5501 (radius 6.4 mm).
Measurement Time	10 s.
Heating Power	1.6 mW.
Measurement Results	
Data Points	11-200.
Thermal Conductivity	13.63 W/m/K.
Thermal Diffusivity	3.762 mm ² /s.
Specific Heat Capacity	3.623 MJ/m ³ /K.
Probing Depth	12.2 mm.
Temperature Increase	1.0378 K.
Standard Deviation in Fitting $\Delta T(\tau)$	587 μ K.



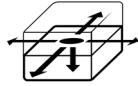
Included with the TPS 500 Instrument

- 2 x Measurement Modules: Isotropic and Single-Sided Testing.
- 2 x Kapton-insulated Hot Disk® sensors: Models 5465 and 5501, with cable
- 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 optional).
- Instructions manual.
- Instrument test protocol.
- Power supply cord and USB cable.

Available measurement modules for the TPS 500



Isotropic
(Standard)



Single-Sided
Testing

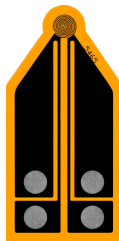


Automation

Available sensors for the TPS 500



Kapton-insulated
Hot Disk® sensor
Models 5465 and 5501.



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

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 2500S
The benchmark instrument.



TPS 2200
For day-to-day testing.

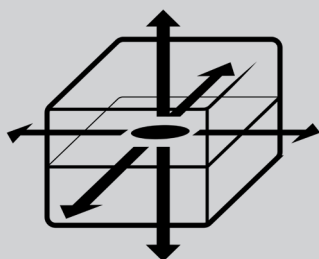


TPS 1500
For heavy-duty testing.

Hot Disk®

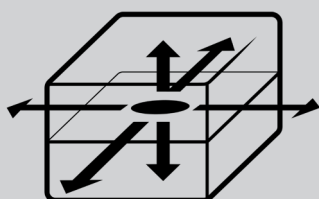
Measurement Modules

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.



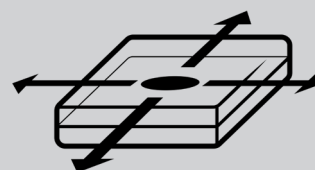
Isotropic (Standard)

All-round testing of bulk samples.



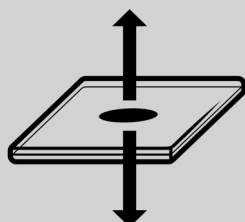
Anisotropic

Testing samples with direction dependent properties.



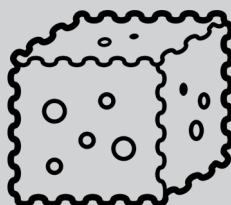
Slab

Testing highly thermal conductive slab or sheet samples.



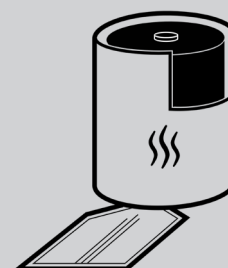
Thin Film

Testing thermal insulating thin film samples.



Low-Density / Highly-Insulating

Testing the lightest and most insulating samples.

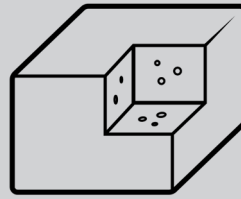


Specific Heat Capacity

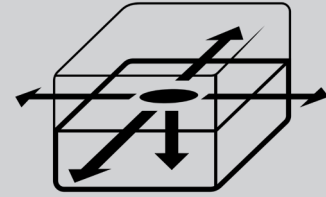
Testing Cp of complex samples and batteries.



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

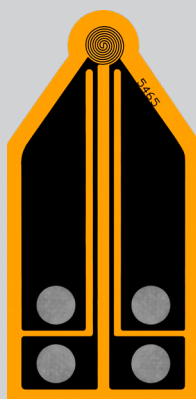
Hot Disk[®] Sensors

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.



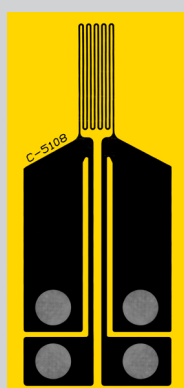
Kapton-insulated
Hot Disk[®] sensor



Teflon-insulated
Hot Disk[®] sensors



Mica-insulated
Hot Disk[®] sensors



Kapton-insulated
Hot Strip[®] sensor



Aluminium & Gold
Hot Cell[®] sensors



Notes

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