

Hot Disk[®] Thermal Constants Analyser



TPS 2200



hotdiskinstruments.com

Hot Disk[®] Instrument TPS 2200

The Hot Disk[®] TPS 2200 is a general-purpose, affordable R&D instrument for accurate measuring of Thermal Conductivity, Thermal Diffusivity, Thermal Effusivity and Specific Heat Capacity, when performance and price are both in consideration. The TPS 2200 tackles a satisfying range of sample geometries, including down to millimeter-thick bulk samples. It can measure Thermal Conductivity from 0.01 to 500 W/m/K, and handles a temperature range from -100°C to 750°C. It can also analyse the anisotropic thermal transport properties of uniaxial materials. The TPS 2200 naturally meets ISO 22007-2 and is CE marked.



For day-to-day testing

This general-purpose R&D instrument is designed for precision analysis of thermal transport properties – including thermal conductivity, thermal diffusivity and specific heat capacity. The TPS 2200 covers a significant span of materials of various geometries and dimensions, including solids, pastes and liquids. While not as versatile as the flagship TPS 2500 S, it meets ISO Standard 22007-2 just like its more powerful sibling. The restrictions compared to the TPS 2500 S chiefly regard sample size, measurement time and maximum thermal conductivity tackled. Being slower than the TPS 2500 S, the TPS 2200 is not suitable for measurements of tiny samples, and/or ones of very high thermal conductivity.

The TPS 2200 is however an excellent option for measurements of larger bodies of extruded polymers, building- and insulation materials, sheet metals, laminated samples etc. It should also be noted that the TPS 2200 betters the performance of the more modest TPS 1500, in being able to tackle many high-conductivity samples and medium- to high-viscosity liquids. Equally, the TPS 2200 features an expanded measurement range as well as improved accuracy in comparison to the lesser TPS 500 S.



A selection of optional measurement modules allows the TPS 2200 to be used in several specialized applications, from precise testing of isotropic materials (Isotropic module) to measurements of slab samples (Slab module); anisotropic samples or layered structures (Anisotropic module); thin films or coatings (Thin Film module); and extremely light and low-conducting materials (Low-density/Highly-insulating module); also featured is direct testing of specific heat capacity of bulk samples (Cp module) – all important applications in e.g. the electronics, automotive, aerospace, nuclear and chemical industries.



TPS 2200 Specifications¹

Measurement

Sample Types	Bulks, slabs, wafers, sheets, foils, films, laminates, composites, minerals, batteries, textiles, 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	No.
Sample Dimensions	
Smallest	Bulk sample: 2 mm thick x 8 mm wide (circle or square). Slab sample: 100 µm thick x 15 mm wide (circle or square). Thin film sample: 10 µm thick x 22 mm wide (circle or square).
Largest	Bulk sample: unlimited. Slab sample: 20 mm thick x unlimited wide (circle or square). Thin Film sample: 500 µm thick x unlimited wide (circle or square).
Sample Temperature Range	-100°C 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	2.5 to 2560 seconds (depending on sample material and sensor dimensions).
Measurement Range	
Thermal Conductivity	Bulk sample: 0.01 to 500 W/m/K. Slab sample: 5 to 500 W/m/K.

Thermal Diffusivity	Thin Film sample: 0.01 to 5 W/m/K.
	Bulk sample: 0.01 to 300 mm ² /s.
	Slab sample: 5 to 300 mm ² /s.
	Thin film sample: 0.02 to 2 mm ² /s.
Thermal Effusivity	20 to 40000 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 0.052% (Stainless Steel bulk sample, Kapton-insulated Hot Disk [®] sensor model 5501, and 22°C sample temperature).
Thermal Diffusivity	Typically 0.23% (Stainless Steel bulk sample, Kapton-insulated Hot Disk [®] sensor model 5501, and 22°C sample temperature).
Measurement Sensitivity⁵	
Temperature	Typically 16 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.

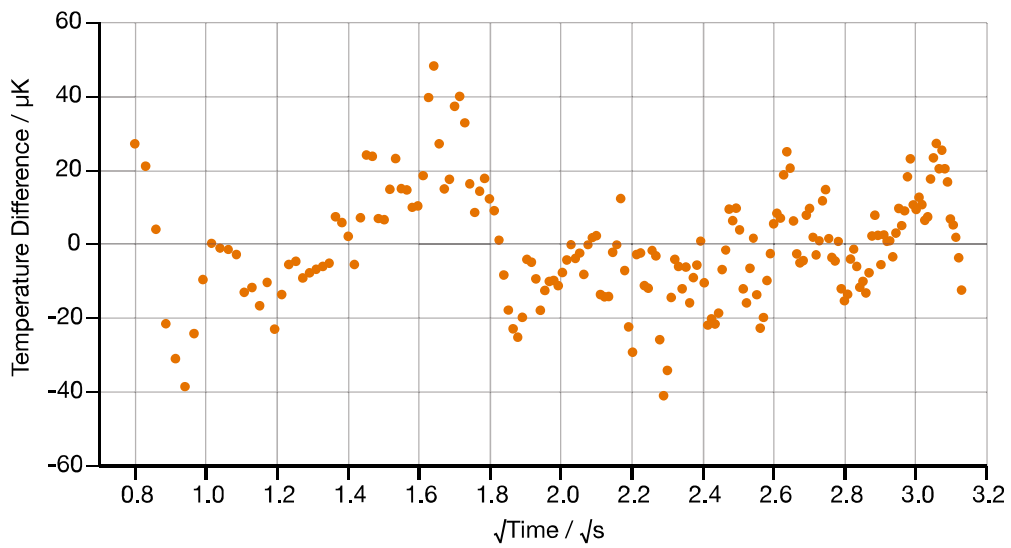
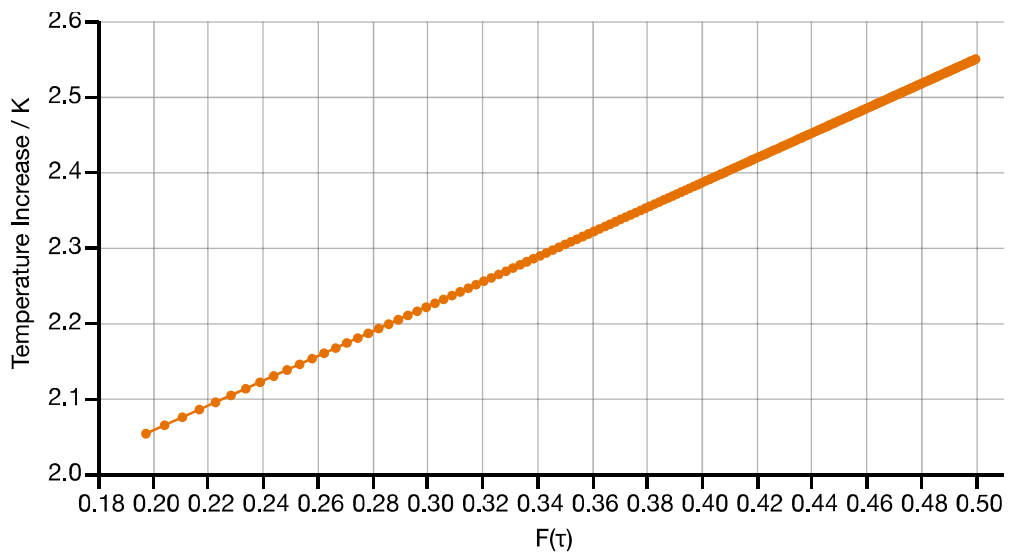
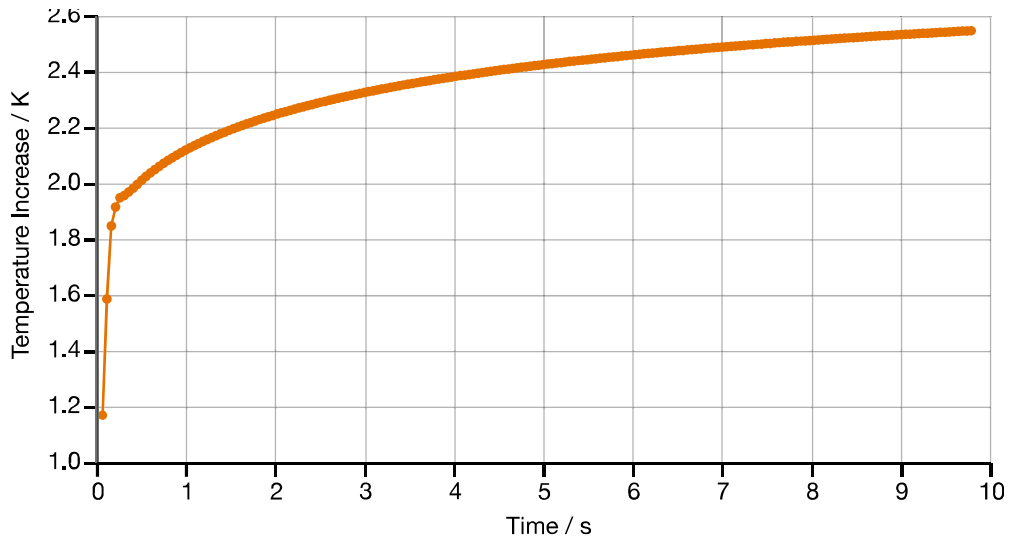
General

Meets ISO Standard 22007-2	Yes.
Measurement Modules	
Included	Isotropic and Single-Sided Testing
Optional	Anisotropic, Slab, Thin Film, Low-Density/Highly Insulating, Specific Heat Capacity, and Automation.
Sensor Models	
Hot Disk® sensor – Kapton-insulated	Models 7577, 5465, 5501, 8563, 4922, and 5599.
Hot Disk® sensor – Teflon-insulated	Models 7577, 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	46 W typical, 240 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 Cell® sensor. LEMO 4 pin connector (female) for optional PT100 temperature sensor.
Instrument Dimensions	325 mm high x 455 mm wide x 490 mm deep.
Instrument Weight	24 kg.
Instrument CE Marking	Yes.

TPS 2200 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	10 s.
Heating Power	800 mW.
Measurement Results	
Data Points	13-200.
Thermal Conductivity	13.71 W/m/K.
Thermal Diffusivity	3.796 mm ² /s.
Specific Heat Capacity	3.611 MJ/m ³ /K.
Probing Depth	12.2 mm.
Temperature Increase	0.5083 K.
Standard Deviation in Fitting $\Delta T(\tau)$	15 μ K.



Included with the TPS 2200 Instrument

Basic Option:

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

Regular Complete Option:

- 6 x Measurement Modules: Isotropic, Anisotropic, Single-Sided Testing, Slab, Thin Film, and Specific Heat Capacity.
- 5 x Kapton-insulated Hot Disk® sensors: Models free of choice, with cable. Always included

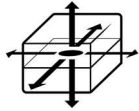
Extended Complete Option:

- 7 x Measurement Modules: Isotropic, Anisotropic, Single-Sided Testing, Slab, Thin Film, Low-Density/Highly Insulating, and Specific Heat Capacity.
- 5 x Kapton-insulated Hot Disk® sensors: Models free of choice, with cable.

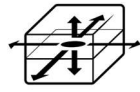
Always included:

- 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 2200



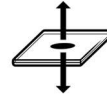
Isotropic
(Standard)



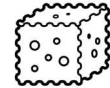
Anisotropic



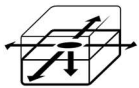
Slab



Thin Film



Low-Density /
Highly-Insulating



Single-Sided
Testing



Specific Heat
Capacity



Automation

Available sensors for the TPS 2200



Kapton-insulated
Hot Disk® sensor
Models 7577,
5465, 5501, 8563,
4922, and 5599.



Teflon-insulated
Hot Disk® sensors
Models 7577,
5465 and 5501.



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



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.



TPS 500S
For the small-scale lab.



TPS 500
For the economical lab.



M1
Portable and educational.



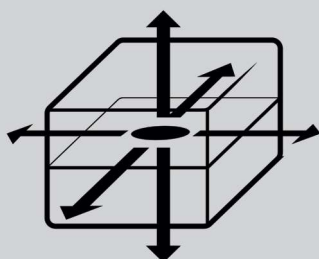
TPS 1000
For cost-effective quality assurance.

Notes

Hot Disk®

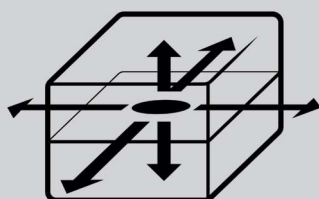
Measurement Modules

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.



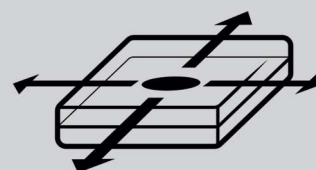
Isotropic (Standard)

All-round testing of bulk samples.



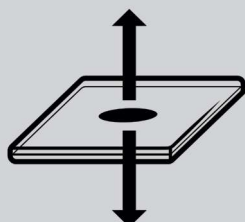
Anisotropic

Testing samples with direction dependent properties.



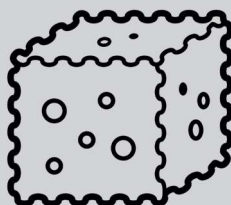
Slab

Testing highly thermal conductive slab or sheet samples.



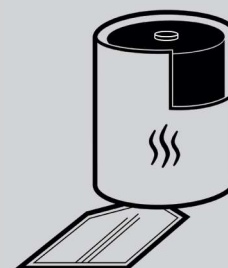
Thin Film

Testing thermal insulating thin film samples.



Low-Density / Highly-Insulating

Testing the lightest and most insulating samples.

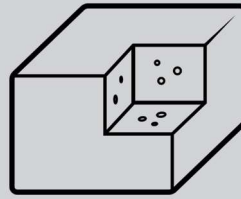


Specific Heat Capacity

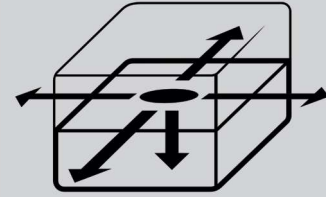
Testing Cp of complex samples and batteries.



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.



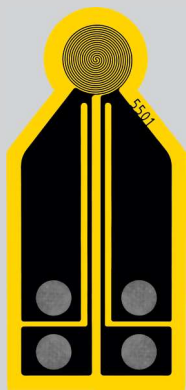
Automation
Remote-controlled testing.

Notes

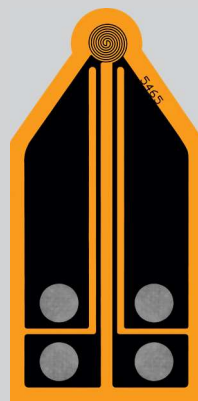
Hot Disk[®] Sensors

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.

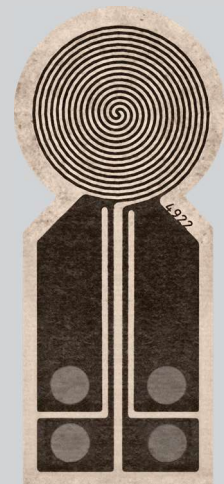
Our patented Hot Disk[®] sensor is our baseline sensor for measuring Thermal Conductivity and Thermal Diffusivity of isotropic samples. It is also used for testing 2D anisotropic samples, e.g. uniaxial crystals and layered composites with different properties in the in- and through-plane directions. 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

Hot Disk[®]

Johanneberg Science Park
Sven Hultins Gata 9 A
412 58 Gothenburg
Sweden

+4631 411 410
www.hotdiskinstruments.com
info@hotdiskinstruments.com

