



The leader in transient techniques

## Thermal Conductivity measurements on an *NPL* certified **Inconel 600** sample and **brass** sample at high temperatures with the Hot Disk Thermal Constants Analyser

### High Temperature Measurements

The Hot Disk Thermal Constants Analyser comes with a wide range of high temperature accessories such as the circulating bath, furnace and furnace with insert for controlled atmospheres.

The furnaces and the circulating baths are fully automatically controlled via the PC making high temperature measurements very easy and time efficient. Power, measurement time, number of measurements at each temperature step, sample relaxation time and temperature precision are pre-programmed for each temperature step with the easy-to-follow software. After setting up the measurements and starting the sequence, the PC takes over full control and carries out all the measurements automatically.

Measurements at temperatures up to 700 °C are possible with specially designed MICA insulated Nickel sensors. In this application note an **Inconel 600** sample, certified by National Physics Laboratory (NPL) in the UK and a brass sample from an industrial maker were measured with the Hot Disk Thermal Constants Analyser. A thick-muffle furnace was used for heating the samples.

The measurements on the Inconel 600 sample were carried out with the following measurement parameters and a MICA insulated sensor S/N 4921 (9.7 mm radius).

Temperature [°C]	Repetitions	Power [W]	Measurement time [s]	Temperature precision [°C]
22	3	1	20	0.5
150	5	1	20	0.7
300	5	1	20	0.7
450	5	1	20	0.6
600	5	1	20	0.5

The measurements on the brass sample was carried out with these parameters (same sensor).

Temperature [°C]	Repetitions	Power [W]	Measurement time [s]	Temperature precision [°C]
150	5	3	5	0.7
300	5	3	5	0.7
450	5	3	5	0.6
600	5	3	5	0.5



The Inconel 600 sample, with the sensor and sample holder

The main reason for the shorter measurement time and the higher power is that the diffusivity of the brass sample is substantially higher than for the Inconel 600 sample.

### About the Hot Disk instrument

The Hot Disk Thermal Constants Analyser is a system designed to conveniently measure the thermal transport properties of a sample, i.e. thermal conductivity and thermal diffusivity. From these results specific heat can be derived. The system is based on a patented Transient Plane Source (TPS) technique, which can be used to study materials with thermal conductivities from 0.005 to 500 W/mK and covering a temperature range from 30 to 1000K.

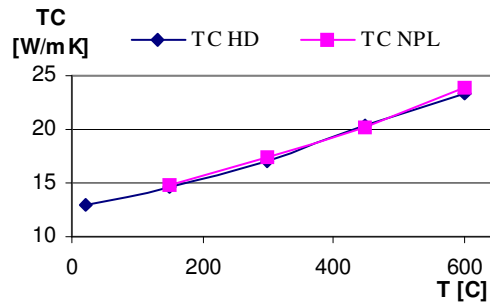
The following modes of operation are available with the Hot Disk instrument

- 1) **Basic method:** The sensor is sandwiched between 2 sample pieces. This method also features a single sided option.
- 2) **Thin Film method:** A special extremely sensitive sensor is sandwiched between 2 pieces of the film (10-500µm).
- 3) **Slab method:** For highly conducting materials (> 10W/mK like SiC, Cu etc.).
- 4) **Anisotropic method:** This method measures the anisotropic thermal conductivity and diffusivity in 2 directions of a uni-axial sample.
- 5) **Cp:** Determines Cp of solid samples.

For more information, please visit [www.hotdisk.se](http://www.hotdisk.se) or contact Hot Disk AB in Sweden.

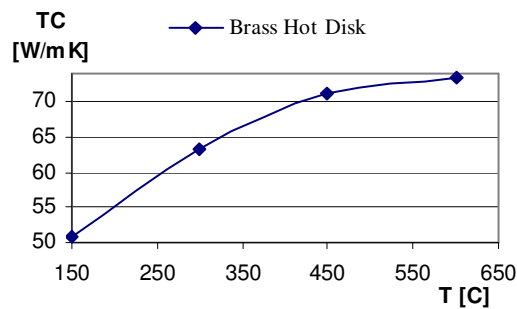
### Results for the Inconel 600 sample

The Hot Disk measured values are compared with the values provided by NPL below. Standard deviations are given in %.



Temp [°C]	TC [W/mK] Hot Disk	TC [W/mK] NPL
22	12,97 (2.5%)	
150	14,71 (0.4%)	14,8
300	17,04 (0.7%)	17,5
450	20,39 (0.4%)	20,2
600	23,35 (2%)	23,9

### Results for the brass samples



Temp [°C]	TC [W/mK] Hot Disk
22	-
150	50,934 (0.6%)
300	63,14 (0.8%)
450	71,17 (0.6%)
600	73,3 (1.3%)

### Comments

The thermal conductivity values measured with the Hot Disk Thermal Constants Analyser agrees well with the values given by NPL over the entire temperature interval. Overall the standard deviations are low, showing a high repeatability typical for the Hot Disk instrument.

The measurements on the brass sample illustrates the capacity of the Hot Disk Thermal Constants Analyser. A highly conducting sample is measured over a wide temperature interval with the same sensor commonly used for insulating materials. The only difference is that the measurement time is shorter and the output power is higher.

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