

# IMPACT IMPACT IMPACT Test Equipment

## ***KD2 Pro Thermal Properties Meter***

*with sensors for liquids and solids*



Code	SL368
Other Standards	ASTM D5334-08
Tariff	848079 00 0

The KD2-Pro is a fully portable field and lab thermal properties analyser. It uses the transient line heat source method to measure thermal diffusivity, specific heat (heat capacity), thermal conductivity and thermal resistivity.

Sophisticated data analysis is based on 30+ years of research experience on heat and mass transfer in soils and other porous materials.

Complies with ASTM, IEEE, SSSA Standards.

The KD2 Pro has three interchangeable sensors which measure thermal conductivity, thermal diffusivity and specific heat (heat capacity) along with data storage capabilities and an automatic data collection mode.

It allows unattended (user programmable) measurements and on-board data storage with space for over 4,000 measurements.

### Features

- ▶ Heated needle technology
- ▶ Requires no calibration
- ▶ Displays in engineering units
- ▶ Small needle minimises soil disturbance

Supplied with



- ▶ KS-1 Thermal Conductivity/Resistivity sensor (for liquids)
- ▶ TR-1 Thermal Conductivity/Resistivity sensor (for solids)
- ▶ SH-1 Dual-needle Thermal Properties sensor
- ▶ User's manual
- ▶ Pelican carrying case
- ▶ Readout stand
- ▶ Performance verification standards
- ▶ Thermal grease
- ▶ Drill bit for drilling pilot holes in materials
- ▶ Concrete pilot pin
- ▶ KD2-Pro download utility
- ▶ RS232 cable

## Corrects for Temperature Drift

Temperature changes of a thousandth of a degree per second (the sun warming the soil, for example, or someone walking into the lab) destroy the accuracy of thermal properties calculations. Unlike other thermal needle systems, the KD2 Pro corrects for linear temperature drift that can account for large errors.

## Excellent Accuracy

The compact KD2 Pro controller is much more than a simple readout for time and temperature. A proprietary algorithm fits time and temperature data with exponential integral functions using a nonlinear least squares method. This full mathematical solution delivers thermal resistivity to within  $\pm 10\%$ .



## Specifications

Accuracy	$\pm 5$ to $\pm 10\%$ Thermal Conductivity/Resistivity $\pm 10\%$ Specific Heat $\pm 10\%$ Thermal Diffusivity
Measurement Speed	1, 2, 5, & 10 min. read times (see user's manual for more information)
Data Storage	4,095 readings, flash memory
Compliance to Standards	IEEE Standard 442-1981 and ASTM Standard D5334-08
Operating Environment of Sensors	-50 to 150°C
Battery Source	4 x AA
Auto-Read Mode	Users can collect unattended data at user-defined intervals in the auto-read mode
Type	Ultra low-power 16-bit micro-controller w/ 24-bit A/D converter
Display	Liquid Crystal Display (LCD) 7.5 cm x 4 cm
Case Dimensions	15.5 x 9.5 x 3.5 cm
Included Accessories	KS-1 Thermal Conductivity/Resistivity sensor (for liquids) TR-1 Thermal Conductivity/Resistivity sensor (for solids) SH-1 Dual-needle Thermal Properties sensor User's manual Pelican carrying case Readout stand Performance verification standards Thermal grease Drill bit for drilling pilot holes in materials Concrete pilot pin KD2 Pro download utility RS232 cable
Calibration	Each KD2 Pro comes factory calibrated and includes performance verification standards
Range of Measurements	K: 0.02 to 4 Wm <sup>-1</sup> C <sup>-1</sup> D: 0.1 to 1.0 mm <sup>2</sup> s <sup>-1</sup> R: 0.25 to 50mC W <sup>-1</sup> C: 0.5 to 4 MJ m <sup>-3</sup> C <sup>-1</sup> * Accuracy and measurement range vary with sensor type. See Sensor(s) Information.

## Supplied Sensors

### KS-1 6cm Sensor

The KS-1 is ideal for measuring thermal resistivity. It is 60mm long, 1.27mm diameter.

### TR-1 10cm Sensor

 The TR-1 measures thermal conductivity and thermal resistivity and conforms to IEEE Standard 442-

## SH-1 30mm Dual Senso

The SH-1 is the only sensor that measures thermal diffusivity and specific heat. 30mm long, 1.28mm diameter, 6mm spacing

Sensors



Specifications

Sensor	KS-1	TR-1	SH-1
Measurement	Read time - 60 Seconds	Read time - 5 Minutes	Read time - 2 Minutes
Accuracy	(Conductivity): ±5% from 0.2-2 W/(m·K)  ±0.01 W/(m·K) from 0.02-0.2 W/(m·K)	(Conductivity): ±10% from 0.2-4 W/(m·K)  ±0.02 W/(m·K) from 0.1-0.2 W/(m·K)	(Conductivity) ±10% from 0.2-2 W/(m·K) ±0.01 W/(m·K) from 0.02-0.2 W/(m·K) (Diffusivity) ±10% at conductivities above 0.1 W/(m·K) (Volumetric Specific Heat) ±10% at conductivities above 0.1 W/(m·K)
Range	K: 0.02 to 2 W/(m·K) R: 50°C to 5000°C cm/W	K: 0.1 to 4 W/(m·K) R: 25°C to 1000°C cm/W	K: 0.02 to 2.00 W/(m·K) R: 50°C to 5000°C·cm/W 0.1 to 1 mm <sup>2</sup> /s (diffusivity) 0.5 to 4 mJ/(m <sup>3</sup> K) (volumetric specific heat)
Cable	0.8 m	0.8 m	0.8 m
Environment	-50°C to 150°C	-50°C to 150°C	-50°C to 150°C
Sensors	6 cm, 1.27 mm Dia. needle	10 cm, 2.4 mm Dia. needle	30 mm, 1.27 mm Dia. 2 needles



- <sup>1</sup> In low viscosity liquids, the read time should be set to the minimum allowed 1 minute to avoid free convection.
- <sup>2</sup> In dry granular materials where contact resistance can be significant, extending the read time to the maximum allowed 10 minutes will produce the most accurate results.
- <sup>3</sup> In solid materials where a pilot hole has been drilled and contact resistance can be significant, using thermal grease and extending the read time to the maximum allowed 10 minutes will produce the most accurate results.
- <sup>4</sup> The SH-1 sensor will take accurate measurements in rock and cured concrete, but it is very difficult to drill small small diameter, parallel holes in these materials to accommodate the SH 1 needles.
- <sup>5</sup> The KS-1 needle with 10 min read time gives good results with insulation. Heater temperatures with the other two probes are quite high for insulation measurements.

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