



**METER**

## TEMPOS THERMAL PROPERTIES ANALYZER



### Takes compliance to a whole new level

The ASTM 5334- and IEEE 442 -compliant TEMPOS is engineered using ISO 2008 standards. It takes accurate readings of thermal conductivity, thermal resistivity, thermal diffusivity, and specific heat in many material types across multiple disciplines, from soil and concrete to food, plastics, lubricating oil, and even human tissue.

Each needle produces only a discrete amount of heat, virtually eliminating the moisture movement (or free convection in liquids) that could alter a reading. Short heating times mean you can use the TEMPOS to measure frozen materials and even fluids.

### One minute changes everything

Ambient temperature changes of a thousandth of a degree per second, the sun warming the soil for example, destroy the accuracy of thermal properties calculations. Unique from all other thermal needle systems, the TEMPOS corrects for the linear temperature drift that causes erroneous readings. New proprietary algorithms allow the TEMPOS to make these measurements in as little as one minute (ten minutes for ASTM-compliance). And, these algorithms will eventually allow the TEMPOS to measure previously impossible-to-test highly porous materials such as insulation.

### Features

- Improved algorithms increase accuracy
- One-minute read times
- Measure thermal diffusivity and specific heat
- ASTM 5334- and IEEE 442-compliant
- Controlled, consistent heating
- Updated interface
- Straightforward menu navigation
- Interactive color screen
- Automatic identification of the sensors
- Illustration of heating
- Extended battery life
- Rugged, ergonomic case
- Portable: use in the field or in the lab
- Measure solid or liquid samples
- Short heating times
- No moisture movement/drying
- Robust sensor needles limit breakage
- Automatic correction for linear temperature drift
- Resolves temperature to  $\pm 0.001$  °C



**BİLMAR BİLİMSEL ARAŞTIRMA VE MÜHENDİSLİK ANONİM ŞİRKETİ**

Web page : [www.bilmar.com.tr](http://www.bilmar.com.tr)

E-mail : [bilkim@bilmar.com.tr](mailto:bilkim@bilmar.com.tr)



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#### Technical Specifications

<b>OPERATING ENVIRONMENT (CONTROLLER)</b>	<b>Range</b> : 0-50°C <b>Power</b> : 5 AA batteries <b>Battery life</b> : More than 250 high-power measurements <b>Data storage</b> : 2,048 measurements in flash memory (both raw and processed data are stored for download) <b>Read modes</b> : Manual and unattended measurement mode
<b>OPERATING ENVIRONMENT (SENSORS)</b>	<b>Range</b> : -50 to 150°C
<b>PHYSICAL CHARACTERISTICS</b>	<b>CONTROLLER</b> <b>Length</b> : 18.5 cm <b>Width</b> : 10 cm <b>Height</b> : 3.5 cm <b>CARRYING CASE</b> <b>Length</b> : 37 cm <b>Width</b> : 30 cm <b>Height</b> : 10.5 cm
<b>DISPLAY SIZE</b>	<b>Width</b> : 5.5 cm <b>Height</b> : 4.0 cm
<b>SENSOR INTERFACE</b>	DB-15 connector
<b>PACKAGE CONTENTS</b>	TEMPOS controller Carrying case Mini-USB data download cable 5 AA alkaline batteries (installed in TEMPOS controller) Glycerin verification standard Sensor positioning jigs Thermal grease Sensors (ordered with device) Pilot pins (if TR-3 sensor ordered) Drill bits (if TR-3 sensor ordered) Extra septum SH-3 needle guides (if SH-3 sensor ordered) SH-3 Delrin® verification block (if SH-3 sensor ordered)
<b>RK-3 SENSOR KIT CONTENTS</b>	4-mm drill bit RK-3 sensor Arctic alumina 1-m cable



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### RK-3 ROCK SENSOR PACKAGE

RK-3 Rock Sensor Package for the TEMPOS adds increased functionality for measuring hard materials like rock and concrete. Until now good measurements in very hard materials have not been possible.

Using the same technology as other TEMPOS sensors, RK-3's larger diameter allows the use of a 5/32 inch rotary hammer drill bit to easily create a properly sized pilot hole. Simply coat RK-3 with thermal grease, insert, and measure.

### Sensor Use Guide

SAMPLE MATERIAL	KS-3	TR-3	SH-3	RK-3
LOW VISCOSITY LIQUIDS (E.G. WATER)	Best <sup>1</sup>	No	No	No
HIGH VISCOSITY LIQUIDS (E.G. GLYCEROL, OIL)	Best <sup>2</sup>	Ok <sup>2</sup>	No	No
INSULATION AND INSULATING MATERIALS	Best <sup>3</sup>	No	No	No
MOIST SOIL	Ok	Best	Ok	Ok
DRY SOIL, POWDERS, GRANULAR MATERIALS	Ok	Best	Ok	Ok
CONCRETE	No	Best <sup>4,6</sup>	Ok <sup>5</sup>	Best <sup>4,6</sup>
ROCK	No	Best <sup>4,6</sup>	Ok <sup>5</sup>	Best <sup>4,6</sup>
OTHER SOLIDS	No	Best <sup>4</sup>	Ok <sup>5</sup>	Ok <sup>4</sup>
VOLUMETRIC SPECIFIC HEAT	No	No	Best	No
THERMAL DIFFUSIVITY	No	No	Best	No

<sup>1</sup> In low-viscosity liquids operate in low-power mode to avoid free convection and avoid any vibration of the sample. Some users have found good results by placing the TEMPOS in unattended mode, reading every 15–30 min, and leaving it to read overnight. The lowest readings obtained are those without convection.

<sup>2</sup> In high-viscosity liquids, only use the KS-3 or TR-3 in low-power mode.

<sup>3</sup> The KS-3 in default mode (low-power, 1-min read).

<sup>4</sup> In solid materials where a pilot hole has been drilled and contact resistance can be significant, use thermal grease.

<sup>5</sup> The SH-3 sensor takes accurate measurements in rock and cured concrete, but it is very difficult to drill small diameter, parallel holes in these materials to accommodate the SH-3 needles.

<sup>6</sup> The TR-3 is generally more accurate than the RK-3 sensor and should be used if possible. However, it is extremely difficult (or impossible) to drill a long, thin hole into cured concrete and rock samples to accommodate the TR-3. The TR-3 also comes with pilot pins for use in wet concrete or fluidized backfill.



## TEMPOS THERMAL PROPERTIES ANALYZER

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#### Sensor Specifications

##### KS-3 (6 cm [small] single needle)

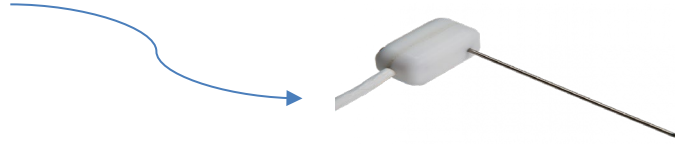
###### Range:

- Conductivity: 0.02-2.00 W/(m • K)
- Resistivity: 50-5,000 °C • cm/W

###### Accuracy:

- Conductivity:  $\pm 10\%$  from 0.2-2.0 W/(m • K)

Size: 1.3 mm diameter \* 60 mm length



##### TR-3 (10 cm [large] single needle)

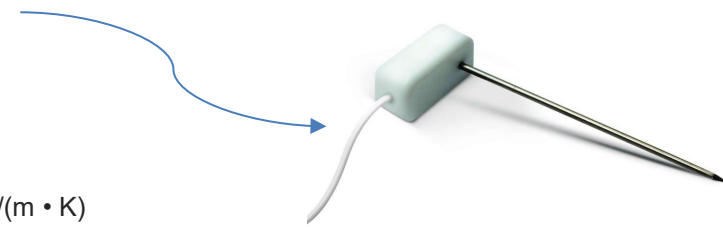
###### Range:

- Conductivity: 0.1-4.0 W/(m • K)
- Resistivity: 25-1,000 °C • cm/W

###### Accuracy:

- Conductivity:  $\pm 10\%$  from 0.1-4.0 W/(m • K)

Size: 2.4 mm diameter \* 100 mm length



##### SH-3 (3 cm dual-needle)

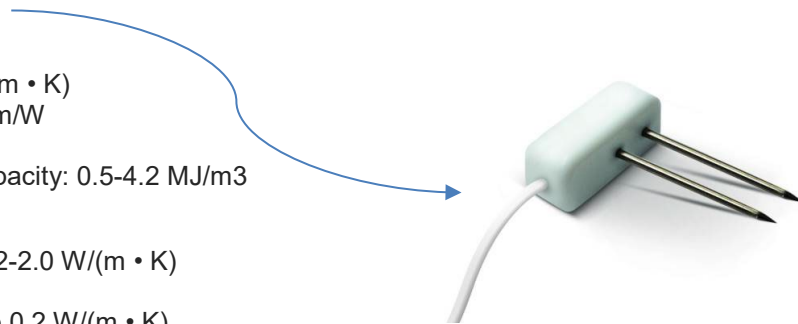
###### Range:

- Conductivity: 0.02-2.00 W/(m • K)
- Resistivity: 50-5,000 °C • cm/W
- Diffusivity: 0.1-1.0 mm<sup>2</sup>/s
- Volumetric specific heat capacity: 0.5-4.2 MJ/m<sup>3</sup>

###### Accuracy:

- Conductivity:  $\pm 10\%$  from 0.2-2.0 W/(m • K)
- Diffusivity:
  - $\pm 10\%$  at conductivity above 0.2 W/(m • K)
  - $\pm 0.02$  W/(m • K) from 0.10-0.20 W/(m • K)
- Volumetric specific heat capacity:
  - $\pm 10\%$  at conductivities above 0.1 W/(m • K)

Size: 1.3 mm diameter × 30 mm length, 6 mm spacing



##### RK-3 (6 cm [thick] single needle)

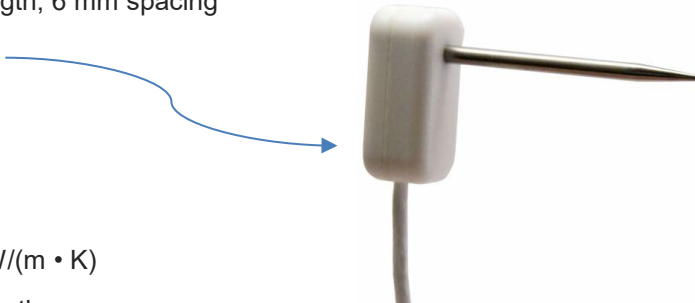
###### Range:

- Conductivity: 0.1-6.0 W/(m • K)
- Resistivity: 17-1,000 °C • cm/W

###### Accuracy:

- Conductivity:  $\pm 10\%$  from 0.1-6.0 W/(m • K)

Size: 3.9 mm diameter × 60 mm length



#### COMPLIANCE

Manufactured under ISO 9001:2015 EN 61326-1:2013 EN 55022/CISPR 22