Hukseflux
Thermal Sensors

FTN02

Field thermal needle system for thermal conductivity / resistivity measurement

FTN02 Field thermal needle system performs accurate on-site (field) measurements of the thermal resistivity and thermal conductivity of soils. Measurements with FTN02 comply with ASTM D5334 and IEEE 442 standards. The system is specifically designed for surveys that require measurements from the surface down to a depth of 1.5 m. Due to the long and thin lance to which the sensor is mounted, the insertion of the thermal needle into the soil requires just a small-diameter access hole, typically made using a ground drill. Using a lance rather than digging trenches saves time. FTN02 is operated and powered from the hand-held control and readout unit CRU02.

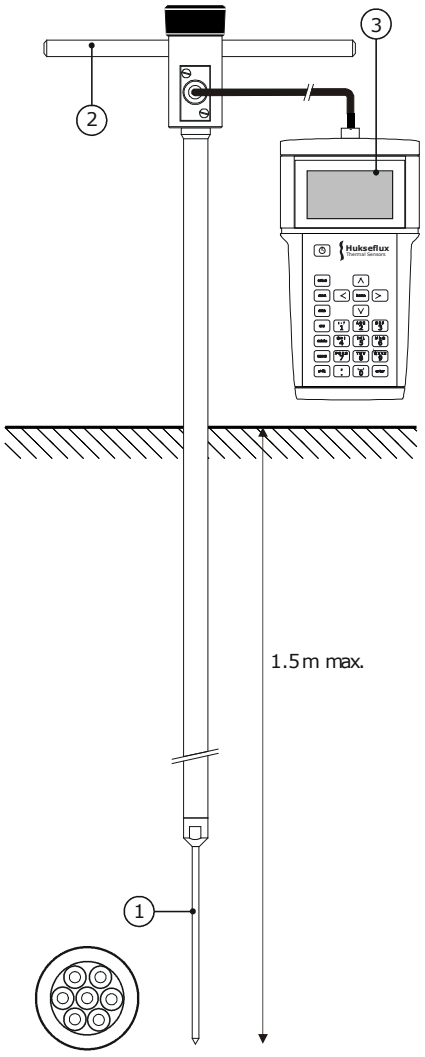

Figure 1 *FTN02 system: Mounted at the tip of the lance, LN02 (2), the thermal needle TP09 (1) is inserted into the soil. Users control the measurement using the keyboard and LCD display of CRU02 (3). On the display, the user can monitor the measurement and see the measurement result. After confirmation by the user, results are stored in CRU02's memory. CRU02 contains a rechargeable battery pack for powering the system.*

Introduction

FTN02 is a thermal needle measuring system for on-site measurements of thermal conductivity (or the inverse value, resistivity) at depths from the surface down to a depth of 1.5 metre. Due to its robustness and length, FTN02 is the best solution for route-surveying of high-voltage electric power cables and heated pipelines (typical depth of burial of 1.5 m). The measurement method is based on the use of a "thermal needle". This method employs a heating wire and a temperature sensor in a needle. The FTN02 system consists of the thermal needle, model TP09, mounted on a long lance, LN02, and a control and readout unit CRU02. FTN02 is easy to use. After making a small-diameter access hole, the thermal needle TP09 is brought down to just above the point that must be investigated and then pushed into the local undisturbed soil below. The user performs control and readout of the measurement from the handheld CRU02.

Figure 2 *FTN02 being used in an on-site (field) survey*

The measurement result is generated immediately by the CRU02 from the analysis of the time series of the temperature and the heating power during the heating interval.

Suggested use

- route surveys, on-site (field) measurements
- with extension for laboratory analysis of soil specimens (see TNS02)

FTN02 design and benefits

Suitable for on-site (field) surveys: FTN02 is sufficiently robust to survive rough handling during a typical survey. It performs measurements as a stand-alone unit. The batteries in the CRU02 can be recharged through the cigarette-lighter receptacle in an automobile, using the CA02 car adapter, or from 220/110 VAC using the WSA02 wall socket adapter.

Saving time: With FTN02 there is no need for digging a large-diameter access hole to perform measurements. Because of the lance LN02, drilling a small access hole made with a ground drill, typically 30 mm in diameter, is sufficient. With measurement systems without a lance, such as MTN02, the user has to make a large-diameter access hole or even to dig a trench.
A typical measurement requires around 60 s to get to thermal equilibrium plus 300 s for the actual heating interval.

Easy data processing: CRU02 gives an immediate indication of the end result and an indication of the quality of the measurement. It can store 50 measurements. ASTM and IEEE require that the end result is visually checked and recalculated. This is typically done during later analysis of the measured data in a spreadsheet. CRU02 is connected to a PC by using USB.

Local calibration / conformity assessment: The accuracy of the measuring system can be verified (before a survey) by measurement in glycerol. For high accuracy verification against a reference material with formal traceability, CRC05 calibration reference cylinders can be separately purchased.

System extension for laboratory use

For laboratory use, FTN02 may be combined with a shorter and thinner sensor mounted on a short insertion tool (MTN02). See system TNS02.

FTN02 specifications

Measurands	-thermal conductivity -thermal resistivity -temperature
Measurement range	0.1 to 6 W/(m·K) (all common soils)
Rated operating temperature range	from 0 to + 50 °C
Measurement method	absolute measurement per ASTM D 5334-08 and IEEE 442-1981 (03)
Data analysis	initial analysis by CRU, final review of measurement on PC (required by ASTM)
Uncertainty (at 20 °C)	± (6 % of reading + 0.04) W/(m·K)
Heating interval	300 s (typical)
Data storage capacity	50 measurements
Length LN02	1.4 m
Length TP09	0.17 m
Diameter TP09	6.3 x10^{-3} m
Data communication	USB

Ordering

Please consult the product manual. Send us an e-mail to get the latest version. The standard configuration of FTN02 includes one spare needle. Product training is available upon request.

Standards

Applicable standards are IEEE 442-1981(03) Guide for Soil Thermal Resistivity Measurements and ASTM D5334-08 Standard Test Method for Determination of Thermal Conductivity of Soil and Soft Rock.

Figure 3 *FTN02: robust TP09 needle mounted on LN02*

Figure 4 *FTN02: CRU02 control and read out unit*

Figure 5 *The complete FTN02 system: FTN02 includes one spare sensor TP09, adapters for charging the system in the office, WSA02, and in an automobile, CA02. Also included are communication software and a jar for glycerol. Glycerol must be purchased locally.*

See also

Hukseflux is specialised in thermal needle design. Alternative models, for instance for laboratory use, are available at Hukseflux. Consult the brochures of complementary systems MTN02 and TNS02. Please also look at TPSYS02, which is more accurate but has less robust needles.
We also provide separate solutions for measurements of sediment core samples and off-shore measurement at large depths (down to 3000 m).

About Hukseflux

Hukseflux Thermal Sensors offers measurement solutions for the most challenging applications. We design and supply sensors as well as test & measuring systems, and offer related services such as engineering and consultancy. With our laboratory facilities, we provide testing services including material characterisation and calibration. Our main area of expertise is measurement of heat transfer and thermal quantities such as solar radiation, heat flux and thermal conductivity. Hukseflux is ISO 9001:2008 certified. Hukseflux sensors, systems and services are offered worldwide via our office in Delft, the Netherlands and local distributors.

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