

# Geothermal Response Test

The in-situ thermal test will provide data on the thermal properties of the ground. The results of the test are provided as a lambda ( $\lambda$ ) value of thermal conductivity (W/m/K-1), and borehole resistance (Rb [K/W/m]). The data relates to the specific thermal conductivity from the tested installation and may be used for the final design of a closed loop ground energy system, which includes the optimum practical depth of the boreholes, spacing and heat yield estimations.

## The test includes:

- TRT of borehole heat exchanger; as per specification from client.
- Acquisition of digital data from the test.
- Production of TRT report including interpretation of results to give thermal conductivity of the ground and thermal resistivity of the borehole heat exchanger.

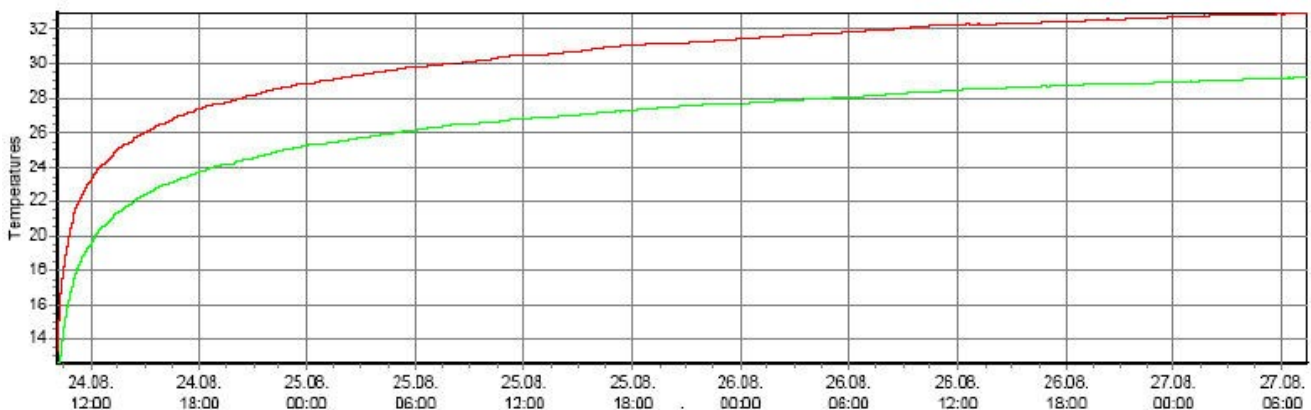
## Test methodology

The test will be run for between 36 – 50 hours minimum as per the European standard VDI 4640, IGSHPA 2008 guidelines and ASHRAE standards.

Power for the equipment is derived via a 3 phase silent running diesel generator which runs constantly for the duration of the test.

Water is circulated through the closed loops by an electric pump within the test equipment. The water is heated at a constant rate by electrical heaters, also within the test equipment.

Plot of temperature against time *red - temperature in green - temperature out*



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The temperature of the circulating fluid is monitored by several pairs of thermocouples at the entry and exit of the loop (flow and return of the borehole, and back into the test itself) although the test will only consider the input from input and output to the borehole.

Sensor	Lower Time Criterion [hours]	Lambda [W / (m x K)]	Thermal Borehole Resistance [K / (W x m)]
T1	19,08	1,67	0,234
T2	18,37	1,74	0,168
T3	19,08	1,67	0,234
T4	18,37	1,74	0,168
Average	18,72	1,71	0,201

The temperature is recorded every 10 minutes electronically throughout the test, with the flow through the closed loop system measured by a flow meter and converted to an electronic signal and logged at 10 minute intervals as well.

### Information required prior to TRT

- Copy of borehole drilling log
- Borehole depth
- Borehole diameter
- Specifications of ground loop collector pipe, inc. OD and ID
- Collector fluid
- Specification of grouting in borehole
- Reported geological sequence
- Groundwater level if known

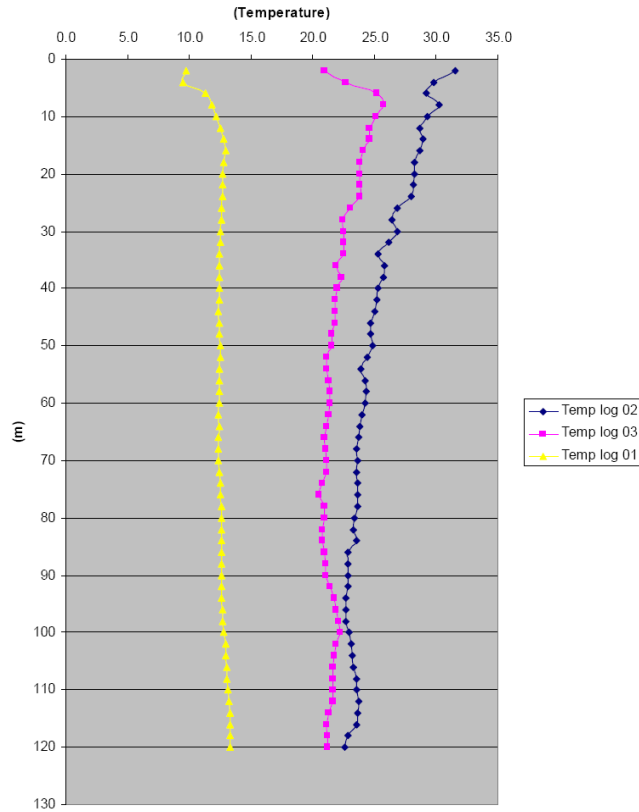
### International standards

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) make recommendations for the execution and analysis of thermal conductivity testing to which Lankelma Green Energy adheres. These are also reflected in the IGSHPA 2007 standards.

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## Temperature profile

A temperature profile is performed on the geothermal loop, once before and twice following the test in order to accurately measure the undisturbed temperature pre test, and identify any ground water movements which may have an influence on the results of the test.



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