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# TK04 Application Note

## Choosing a suitable probe for laboratory tests

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### General

This document deals with TK04 the laboratory probes only: needle probe (Standard VLQ), probes for plane surfaces (Standard HLQ and Mini HLQ). For in-situ tests the Field VLQ probe is used.

Basically, all sample materials can be tested with all probe types. This document helps to decide which probe type to use for a particular application.

### Accuracy

Accuracy is the same ( $\pm 2\%$ ) for all probe types except for the Mini HLQ probe for plane surfaces, which has a reduced accuracy of  $\pm 5\%$ . We recommend to use the larger Standard VLQ or Standard HLQ probes where possible and to resort to the Mini HLQ only if the samples are not large enough.

### Measuring range

For the Standard VLQ needle probes the measuring range is 0.1 to 10  $\text{Wm}^{-1}\text{K}^{-1}$ , for the Standard HLQ probes for plane surfaces it is 0.3 to 10  $\text{Wm}^{-1}\text{K}^{-1}$  and 0.3 to 3  $\text{Wm}^{-1}\text{K}^{-1}$  for the Mini HLQ.

### Sample size

While there is no maximum sample size limitation, each probe type requires a certain minimum size which could limit probe choice for a particular application:

Probe type	Sample diameter	Sample height
Standard VLQ	40 mm	85 mm
Standard HLQ	90 mm	20 mm
Mini HLQ	50 mm	20 mm

The minimum size is required to avoid that the propagating heat wave reflected by the sample boundaries runs back to the temperature sensor within the test time and disturbs the measurement. As the speed of the heat wave depends on several different factors (among them the thermal conductivity of the sample), the values listed in the table just give you a rough guide. Larger samples may be required, especially for materials with high thermal conductivities.

## Sample preparation

If sample size is no problem, the crucial factor is sample preparation. The needle probes require a narrow, long hole with constant diameter. In soft materials the probe usually can be pushed directly into the sample without drilling, while in very hard or brittle materials it might be difficult to achieve a drill hole with constant diameter.

The Standard HLQ and Mini HLQ probes require a plane and smooth surface with a diameter matching the size of the probe body. Moderate pressure has to be applied to ensure good contact between probe and sample. Hence probes for plane surfaces should not be used with compressible materials, because compaction increases the density of the sample and falsifies the test results.

## Fluid content

In soil samples or other porous or loose materials containing high amounts of fluid the water might start to circulate induced by the heating process. If this happens, results are falsified by the convective heat transport. Convection is less likely to occur with probes for plane surfaces because temperature distribution is more stable with the heating source placed on top of the sample.

## Recommendations

Choose the needle probe (Standard VLQ) for the following materials:

- Soft sample materials which allow the needle probe to be pushed directly into the sample. Preparation is zero, and contact usually is very good.
- Compressible, porous or loose material which would be compacted by the moderate pressure applied with a HLQ probe.

Choose a probe for plane surfaces (Standard HLQ, Mini HLQ) in the following cases:

- Sample materials too hard or too brittle to drill a narrow, long hole with constant diameter.
- 2-phase measurements of powder or fragments with water for determining the matrix thermal conductivity (see application note *Testing fragments and powders*).
- Sample materials with high fluid content which showed convection in tests with the Standard VLQ.

For all other samples, choose freely between HLQ and VLQ probe or even use both on the same sample.