

# APPLICATION NOTE

## Natural Stone – Guarded Heat-Flow Meter



# Inhomogeneous Materials – Determination of the Thermal Conductivity: A Question of Sample Size

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## Introduction

Marble is a natural stone with a variety of physical properties that allow it to be widely used in areas such as architecture, sculpture and decoration. Marble has good thermal conductivity, allowing it to effectively conduct temperature in applications such as flooring or countertops, making it widely used in kitchens and cooling chambers. However, it should be noted that different types of marble can have different physical properties, so the characteristics of the selected marble must be carefully checked before use.

Irrespective of the measurement method, the sample size is often decisive in determining whether a material is considered "inhomogeneous". In general, the larger the sample required for a method, the larger the measurement area and thus the smaller the influence of minor

differences in composition and/or structure. Samples of a material may therefore be considered representative for one method, whereas for another method using smaller samples, the material may be too inhomogeneous to be considered representative. It may be necessary to examine several samples in order to be able to come to a statistical conclusion about certain properties.

## Measurement Conditions

Determination of the thermal conductivity using the TCT 716 *Lambda* according to the GHFM (Guarded Heat Flow Meter) method is carried out on relatively large samples with a diameter of approx. 51 mm and a thickness of several millimeters to a few centimeters. Small inhomogeneities within the sample are therefore not that decisive.

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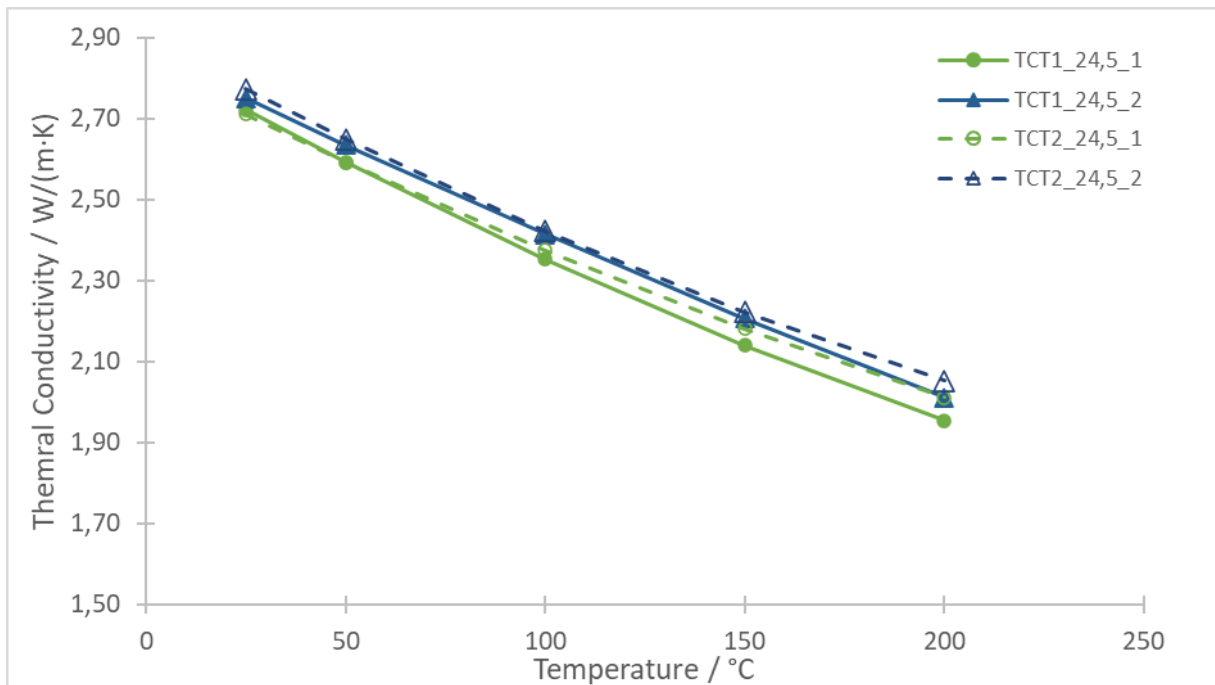
### Measurement Results

Two marble samples with a diameter of 51 mm and a thickness of 24.5 mm were examined on two different TCT measuring devices. The measurements were carried out between 25°C and 200°C.

The green circles in figure 1 show the measurements on sample 1; the blue triangles represent the measurements on sample 2. The solid line represents the measurement on the first TCT; the dashed line, the measurement on the second TCT measuring device. A comparison of samples 1 and 2 measured in the same measuring device shows a difference of approximately 1–3%, with sample 1 tending to have a lower thermal conductivity. The difference for a sample measured in both TCT devices is in a similar range, with a maximum of 3%. The difference between the samples can therefore be considered insignificant. Despite the inhomogeneity of marble, all results lie within  $\pm 3\%$ .

### Summary

The TCT 716 *Lambda* allows for measurements on relatively large sample geometries. This means that even measurements on slightly inhomogeneous material are unproblematic and yield sufficient accuracy.



1 Thermal conductivity of two marble samples between 25°C and 200°C, measured in two different TCT 716 *Lambda* measuring devices.