

Determination of the Thermal Conductivity of Highly Transparent Materials

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Introduction

Determining the thermal conductivity of highly transparent materials, such as glasses, presents a challenge for some measurement methods. The Laser Flash Analysis (LFA) is one of the most widely used methods for determining thermal diffusivity and thermal conductivity. To perform an LFA measurement, the material must be opaque, or made so. This can necessitate special coating techniques for highly transparent samples.

The Guarded Heat Flow Meter (GHFM) measurement method (ASTM E 1530) with the TCT 716 *Lambda* instrument allows for the measurement of such samples without special pretreatment. The TCT 716 *Lambda* can measure solid and rigid samples with low and medium thermal conductivity between -10 and 300°C.

The low thermal conductivity and the ability to withstand extreme temperature fluctuations make borosilicate glass, also known by the brand name Pyrex®, an indispensable material in many fields that require high

thermal performance. Examples include laboratory equipment such as flasks or test tubes, sterilization containers in medical technology, or kitchen utensils such as baking dishes and measuring cups.

Measurement Conditions

Two samples of borosilicate glass from different manufacturers (Aachner Quarzglas Technologie Heinrich GmbH & Co. KG and Corning Inc.) were examined using the TCT 716 *Lambda*. The samples had a diameter of approximately 51 mm and a thickness of 25.4 mm and 12.7 mm, respectively, and were examined with two different TCT 716 *Lambda* measuring devices at different locations (NETZSCH-Gerätebau GmbH, Selb, and NETZSCH Instruments North America, LLC).

As with every measurement, thermal paste was applied to the samples before the test to reduce contact resistance between the sample and the plates and to align with the calibration. The samples were then measured from -10°C to 300°C, and from 25°C to 150°C, respectively.

APPLICATIONNOTE Determination of the Thermal Conductivity of Highly Transparent Materials

Measurement Results

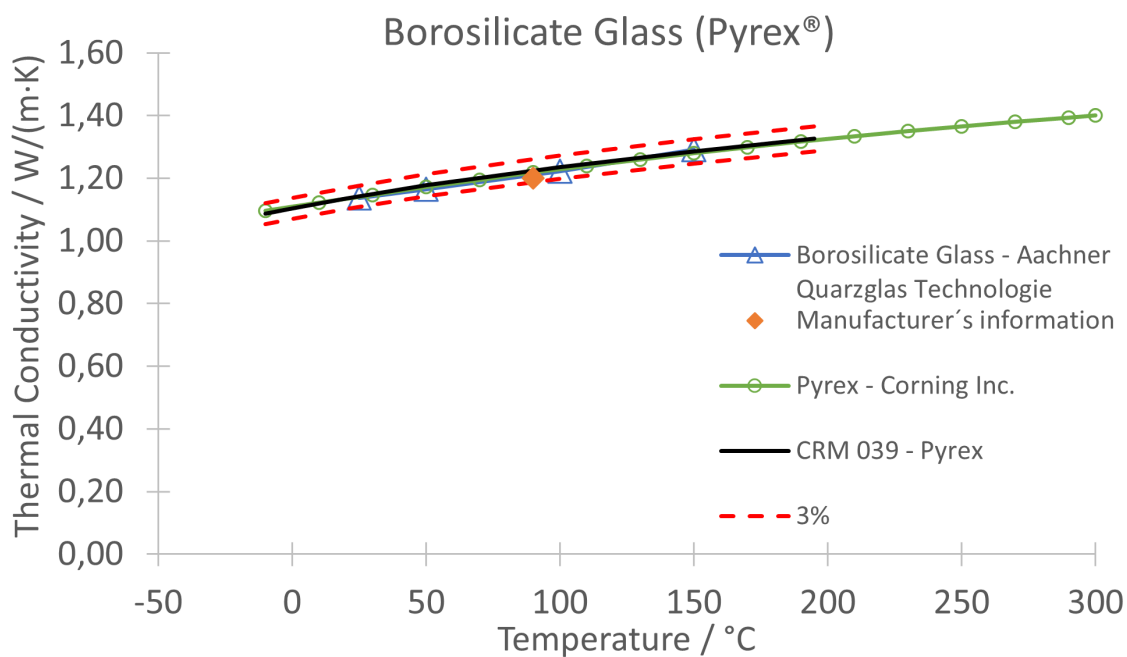
Figure 1 summarizes the measurement results. The blue triangles and green circles represent the results of the TCT measurements and show good agreement. Pyrex® is also an internationally known reference material for thermal conductivity [1]. These values are represented by the black line in Figure 1. All measurement results are within $\pm 3\%$ of the literature value.

Summary

The measurement of highly transparent materials is easily performed using the TCT 716 *Lambda* without special pretreatment of the samples and shows good agreement with literature values.

Literature

[1] I. Williams, R.E. Shawyer: Certification report for a pyrex glass reference material for thermal conductivity between -75°C and 195°C ; CCRM-039; Commission of the European communities; Luxembourg; 1991



1 Measurement results of the thermal conductivity of borosilicate glass (Pyrex®) from -10°C to 300°C using the TCT 716 *Lambda* in comparison with literature values