NETZSCH

Applications Laboratory
Thermophysical Properties Section

Thermal Conductivity
of
one multi-layered Insulating Sample

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by

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Introduction

The Thermophysical Properties Section of the NETZSCH Applications Laboratory received one multi-layered insulating sample from RINA Consulting – Centro Sviluppo Material S.p.A., Italy.

The thermal conductivity was determined using a NETZSCH model HFM 436/3/1E Lambda heat flow meter system capable of operation between -20 and 80°C (sample temperature). This device allows a fast and uncomplicated measurement of thermal conductivity. The system is ideally suited for the measurement of insulating materials with thermal conductivities up to 1.0 W/(m*K). Samples with an edge length of 300 mm and a thickness from 5 mm up to 100 mm can be investigated. Due to the patented temperature control and dual heat flux transducer arrangement the system allows measurements with outstanding precision and repeatability at short measurement times. The system works according to ASTM C 518, ISO 8301, DIN EN 12667, DIN EN 13163 and JIS A 1412. The system control can either be done by the integrated Q-test software or with a state-of-the-art MS®-Windows™-software.

Experimental

The measurements were carried out at mean sample temperature of 10 °C. The temperature difference between the plates was 20 K. The temperature in the lab was 28 °C with a relative humidity of ~ 10 %. Prior the test measurements, the instrument´s calibration was verified with an NIST-certified glass fibreboard (NIST SRM 1450d).

One single sample was very thin (~ 4.5 mm). The thermal resistance of one sample is supposed to be < 0.5 m²·K/W. To measure in accordance with DIN EN 12667, five samples were stacked to get a sufficient thermal resistance for the measurement. During the measurement, the sample was then 300 mm x 300 mm x 22 mm with a density of approx. 175 kg/m³.

The stacked sample was measured three times. After each test, the sample was removed from the instrument, turned in-plane and put back.

Results

The results of the measurements are summarized in table 1. A higher measurement uncertainty must be considered, since the stacked sample might include some air between each layer. This can affect the measured thermal conductivity and leads to lower values.

Table 1: Measurement results of the sample (5 layers)
(T = 10 °C, ΔT = 20 K)

Temperature / °C	Thermal Conductivity / W/(m·K)			**Thermal Conductivity /** mean value **W/(m·K)**	**Thermal Resistance / m²·K/W**
	Test 1	Test 2	Test 3		
10	0.03701	0.03702	0.03689	**0.0370**	**0.596**

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