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Test Report
Order no. 2619208

Client:	KASTAMONU INTEGRATED WOOD INDUSTRY LLC SEZ "Alabuga", SH-3 street, building 3/3 423600 Yelabuga, Tatarstan Russian Federation
Date of order:	8 August, 2019
Order:	Determination of thermal conductivity according to EN 12667
Contractor:	Entwicklungs- und Prueflabor Holztechnologie GmbH
Engineer in charge:	Dipl.-Ing. (FH) Ute Bogatzki

Dipl.-Ing. Jens Gecks
Head of Laboratory for Material and Product Testing

1 Terms of Reference

The Entwicklungs- und Prueflabor Holztechnologie GmbH (EPH) was ordered by KASTAMONU INTEGRATED WOOD INDUSTRY LLC to determine the thermal conductivity and the thermal resistance of MDF boards, HDF boards and HDLAM boards acc. to EN 12667.

2 Test Material

The sampling and the supply of test materials were carried out by the Client. The test materials arrived to the laboratory (EPH) on 8 August, 2019.

The test pieces were labelled as follows:

- Sample of MDF board 5.5 mm - 8 pcs
- Sample of MDF board 10 mm - 4 pcs
- Sample of MDF board 19 mm - 4 pcs
- Sample of MDF board 38 mm - 2 pcs
- Sample of HDF board 6 mm - 8 pcs
- Sample of HDF board 8 mm - 8 pcs
- Sample of HDF board 12 mm - 4 pcs
- Sample of HDLAM board 7 mm - 8 pcs
- Sample of HDLAM board 8 mm - 8 pcs
- Sample of HDLAM board 10 mm - 4 pcs
- Sample of HDLAM board 12 mm - 4 pcs

The test samples were cut to a size of (500 x 500) mm by the Client.

Furthermore, the Contractor labelled the specimens as follows:

Table 1 Specimen information

Variant	Description	Dimension in mm x mm x mm	Sample No.
1	MDF board	500 x 500 x 5.5	1_1 - 1_8
2	MDF board	500 x 500 x 10	2_1 - 2_4
3	MDF board	500 x 500 x 19	3_1 - 3_4
4	MDF board	500 x 500 x 38	4_1 - 4_2
5	HDF board	500 x 500 x 6	5_1 - 5_8
6	HDF board	500 x 500 x 8	6_1 - 6_6
7	HDF board	500 x 500 x 12	7_1 - 7_4
8	HDLAM board	500 x 500 x 7	8_1 - 8_8
9	HDLAM board	500 x 500 x 8	9_1 - 9_6
10	HDLAM board	500 x 500 x 10	10_1 - 10_4
11	HDLAM board	500 x 500 x 12	11_1 - 11_4

3 Implementation

The determination of the thermal conductivity and the thermal resistance was carried out according to EN 12667:2001.

The test materials were categorised as a material, which is rectangular layered to the heat flow. The determination of the thermal conductivity was carried out according to this categorisation. The heat flow was orthogonally orientated to the plane of the boards.

A two-plate device, type TLP 900-GX 2, was used for determination of the thermal conductivity.

The test specimens were arranged in many tiers, due to the minimum thickness for the measurement.

Variants 2, 3, 7, 10, 11	2 specimens on top of each other
Variants 6, 9	3 specimens on top of each other
Variants 1, 5, 8	4 specimens on top of each other

The mean density and thickness were determined on the test specimens by measuring the dimensions and the mass.

The test materials were conditioned at a temperature of 23 °C and a relative humidity of 50 % until the tests were started. After conditioning, the test pieces were placed into the test device immediately between silicone compensating mats.

The measurements were carried out at mean temperatures of 10 °C, of 20 °C and of 30 °C. The thermal conductivity at a reference temperature of 10 °C was calculated from the measurement values.

4 Test results

Table 2 Measured values Variant 1 (Test date: 13 September, 2019)

Measurement no.	ϑ_{wm} [°C]	ϑ_{km} [°C]	ϑ_{wm}-ϑ_{km} [K]	ϑ_m [°C]	λ_g [W/(mK)]
1	15.5	5.1	10.4	10.3	0.1200
2	25.1	14.7	10.4	19.9	0.1218
3	34.8	24.4	10.4	29.6	0.1236

Table 3 Measured values Variant 2 (Test date: 5 September, 2019)

Measurement no.	ϑ_{wm} [°C]	ϑ_{km} [°C]	ϑ_{wm}-ϑ_{km} [K]	ϑ_m [°C]	λ_g [W/(mK)]
1	16.5	6.1	10.4	11.3	0.1158
2	26.1	15.7	10.3	20.9	0.1170
3	35.8	25.4	10.3	30.6	0.1180

Table 4 Measured values Variant 3 (Test date: 3 September, 2019)

Measurement no.	ϑ_{wm} [°C]	ϑ_{km} [°C]	ϑ_{wm}-ϑ_{km} [K]	ϑ_m [°C]	λ_g [W/(mK)]
1	15.0	4.6	10.3	9.8	0.1133
2	24.6	14.3	10.3	19.4	0.1153
3	34.2	23.9	10.3	29.1	0.1177

Table 5 Measured values Variant 4 (Test date: 2 September, 2019)

Measurement no.	ϑ_{wm} [°C]	ϑ_{km} [°C]	ϑ_{wm}-ϑ_{km} [K]	ϑ_m [°C]	λ_g [W/(mK)]
1	15.0	4.7	10.3	9.9	0.1082
2	24.7	14.4	10.3	19.5	0.1103
3	34.2	23.9	10.3	29.1	0.1124

Table 6 Measured values Variant 5 (Test date: 16 September, 2019)

Measurement no.	ϑ_{wm} [°C]	ϑ_{km} [°C]	ϑ_{wm}-ϑ_{km} [K]	ϑ_m [°C]	λ_g [W/(mK)]
1	15.6	5.2	10.4	10.4	0.1364
2	25.2	14.8	10.4	20.0	0.1380
3	34.9	24.5	10.3	29.7	0.1400

Table 7 Measured values Variant 6 (Test date: 12 September, 2019)

Measurement no.	ϑ_{wm} [°C]	ϑ_{km} [°C]	ϑ_{wm}-ϑ_{km} [K]	ϑ_m [°C]	λ_g [W/(mK)]
1	15.7	5.3	10.4	10.5	0.1259
2	25.4	15.0	10.4	20.2	0.1284
3	35.0	24.6	10.4	29.8	0.1305

Table 8 Measured values Variant 7 (Test date: 6 September, 2019)

Measurement no.	ϑ_{wm} [°C]	ϑ_{km} [°C]	ϑ_{wm}-ϑ_{km} [K]	ϑ_m [°C]	λ_g [W/(mK)]
1	16.1	5.8	10.3	11.0	0.1279
2	25.8	15.4	10.3	20.6	0.1303
3	35.4	25.1	10.3	30.3	0.1327

Table 9 Measured values Variant 8 (Test date: 17 September, 2019)

Measurement no.	ϑ_{wm} [°C]	ϑ_{km} [°C]	ϑ_{wm}-ϑ_{km} [K]	ϑ_m [°C]	λ_g [W/(mK)]
1	15.5	5.1	10.4	10.3	0.1449
2	25.2	14.8	10.4	20.0	0.1471
3	34.8	24.4	10.3	29.6	0.1493

Table 10 Measured values Variant 9 (Test date: 11 September, 2019)

Measurement no.	ϑ_{wm} [°C]	ϑ_{km} [°C]	ϑ_{wm}-ϑ_{km} [K]	ϑ_m [°C]	λ_g [W/(mK)]
1	15.6	5.2	10.4	10.4	0.1343
2	25.3	14.9	10.4	20.1	0.1367
3	34.9	24.6	10.4	29.7	0.1392

Table 11 Measured values Variant 10 (Test date: 10 September, 2019)

Measurement no.	ϑ_{wm} [°C]	ϑ_{km} [°C]	ϑ_{wm}-ϑ_{km} [K]	ϑ_m [°C]	λ_g [W/(mK)]
1	15.9	5.5	10.4	10.7	0.1367
2	25.5	15.1	10.4	20.3	0.1386
3	35.1	24.8	10.3	30.0	0.1403

Table 12 Measured values Variant 11 (Test date: 9 September, 2019)

Measurement no.	ϑ_{wm} [°C]	ϑ_{km} [°C]	ϑ_{wm}-ϑ_{km} [K]	ϑ_m [°C]	λ_g [W/(mK)]
1	15.6	5.3	10.3	10.4	0.1364
2	25.2	14.9	10.3	20.0	0.1383
3	34.8	24.5	10.3	29.7	0.1400

Explanation of symbols in the table:

ϑ_{wm} Mean temperature on the surface of the specimen on the heating plate
ϑ_{km} ... Mean temperature on the surface of the specimen on the cooling plate
ϑ_{wm}-ϑ_{km} Mean difference of temperatures
ϑ_m ... Temperature in the middle of the specimen
λ_g ... Mean thermal conductivity

The results of thickness measurements, density calculations and the measured values of thermal conductivity are given in Table 13.

Table 13 Test results

Variant	Material	Mean Thickness in mm	Mean Density in kg/m³	$\lambda^{10}_{23/50}$ in W/(m*K)	$R^{10}_{23/50}$ in (m²K)/W	Change in mass during the measurement in g and %
1	MDF board 5.5 mm	5.6	838	0.120	0.0467	0.4 g 0 %
2	MDF board 10 mm	10.1	813	0.116	0.0871	-0.7 g 0 %
3	MDF board 19 mm	19.2	801	0.113	0.170	-0.6 g 0 %
4	MDF board 38 mm	38.0	760	0.108	0.352	0.0 g 0 %
5	HDF board 6 mm	5.9	900	0.136	0.0434	0.0 g 0 %
6	HDF board 8 mm	7.4	883	0.126	0.0587	0.4 g 0 %
7	HDF board 12 mm	11.5	877	0.128	0.0898	-0.1 g 0 %
8	HDLAM board 7 mm	6.8	963	0.145	0.0469	-0.1 g 0 %
9	HDLAM board 8 mm	7.8	923	0.134	0.0582	-0.2 g 0 %
10	HDLAM board 10 mm	9.7	913	0.137	0.0708	-0.1 g 0 %
11	HDLAM board 12 mm	11.8	901	0.136	0.0868	0.0 g 0 %

$\lambda^{10}_{23/50}$ Thermal conductivity at a mean temperature of 10 °C

$R^{10}_{23/50}$ Thermal resistance at a mean temperature of 10 °C for the individual layer of the test specimens

The values of the specified of thermal resistance and of thermal conductivity are single measurements.

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