



CENTRUM STAVEBNÍHO INŽENÝRSTVÍ, a.s.
[CENTRE OF BUILDING ENGINEERING, joint-stock company]
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Testing Department of Physical Properties of Materials,
Structures and Buildings - Zlín
Testing Laboratory no. 1007.1 accredited by the Czech
Accreditation Institute [ČIA]



Test Report No. 169/15

Determination of thermal resistance and overall coefficient of heat transfer

Order number:	563 277	Number of pages:	7
		Number of copies:	3
		Print no.:	2
Customer:	Lightway s.r.o.	Number of annexes:	4
	Ledvinova 1714		
	149 00 Prague 4	Ident. No.:	63669366
Producer:	Same as the customer		

Subject of the test:	Light guide CRYSTAL 400 HP and light guide CRYSTAL LW 600
Result of the test:	Overall coefficient of heat transfer: $U = 0.58 \text{ W/m}^2 \cdot \text{K}$ - Light guide CRYSTAL 400 HP $U = 0.51 \text{ W/m}^2 \cdot \text{K}$ - Light guide CRYSTAL LW 600

Samples received on:	08 April 2015
Date of test:	08 April - 10 April 2015
Test was carried out by:	Laboratory of building thermal technology
Technical manager of the Laboratory:	Ing. Nizar Al-Hajjar [signature]
Manager of Testing Laboratory no. 1007.1:	Ing. Miroslav Figalla [signature]

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Dated: 07 May 2015



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1. Assignment of the tests

Based on the order and contract no. 563 277, the Testing Department of Physical Properties of Materials, Structures and Buildings - Zlín no. 1007.1 conducted, for Lightway s.r.o., Ledvinova 1714, 149 00 Prague 4, a test of thermal resistance and overall coefficient of heat transfer of testing samples of light guides of types CRYSTAL 400 HP and CRYSTAL LW 600 under ČSN EN ISO 8990 within the intention of ČSN EN ISO 12567-1.

2. Description of the subject of the tests

The objective of the test is to determine the overall coefficient of heat transfer U . Using thermal resistance R obtained by measurement as per ČSN EN ISO 8990 "Thermal insulation - Determination of steady state thermal transmission properties - Calibrated and guarded hot box" by applying the *guarded hot box* method, at a steady thermal flow, the resultant standard value of the overall coefficient of heat transfer U is determined by a calculation according to the relation:

$$U = \frac{1}{R + 0,17} \quad \text{W/(m}^2\cdot\text{K)} \quad (1)$$

where: value $0.17 \text{ m}^2 \cdot \text{K/W}$ is a sum of resistances of heat transfer under ČSN 73 0540-4.

3. Description of tested products

- Sample no. 070/15: Light guide CRYSTAL 400 HP

- Sample no. 071/15: Light guide CRYSTAL LW 600

Drawings of both types of the tested samples, with indication of numbers of their components and a photograph of the arrangement of these components, are provided in Annexes nos. 1 and 2. Descriptions of individual components of both light guides are given in Annex no. 3.

The testing samples were mounted in a testing frame such that their internal surface matched the internal surface of the testing frame. Images of both samples of light guides mounted in the testing frame from both the hot and cold faces are provided in Annex no. 4.

4. Standards and testing technology applied

4.1 Standards

- ČSN EN ISO 8990	Testing standard
- ČSN EN ISO 12567-1	Testing standard
- ČSN 73 0540-2	Related standard

4.2 Appliances - equipment used

- Vertical chamber	Z 07 3008
- Steel push-pull rule (0 - 5000) mm	M 07 1104
- Inclining weighing machine up to 200 kg	M 07 1020
- Digital thickness gauge (0 - 150) mm	M 07 1098
- Digital depth gauge (0 - 200) mm	M 07 1099
- Electrical temperature gauge	M 07 1034
- ELMER, type MPE4 (Electric meter)	M 07 1132

5. Deviations from testing methods and procedures

6. Description of non-standardized methods applied

7. Results of measurements:

Average temperature of air in the laboratory during measurement:	19.7°C
Average relative humidity of air in the laboratory:	45 % r.h.
Speed of air on the cold face 1.8 m/s; direction of flow - upwards along the sample.	
Speed of air on the hot face 0.1 - 0.2 m/s; upwards along the sample.	
Surface of hot box $A_{\text{HB}} = 2.4649 \text{ m}^2$.	

Thermal resistance of the testing dividing wall in $\text{m}^2 \cdot \text{K}/\text{W}$:

where λ_{sur} is thermal conductivity of the testing dividing wall in $\text{W}/(\text{m} \cdot \text{K})$;
 d_{sur} thickness of the testing dividing wall, the value of which is 0.250 m;
 $\theta_{me,sur}$ medial temperature of both surfaces of the testing dividing wall in $^{\circ}\text{C}$.

Thickness of the frame is $w = 120 \text{ mm}$.

Table of values of measurement

Value measured	Physical unit	Results of measurements - sample no.		
		070/15	071/15	
Temperature of internal air	θ_{im}	$^{\circ}\text{C}$	21.14	21.25
Temperature of external air	θ_{em}	$^{\circ}\text{C}$	-0.66	-0.77
Temperature of internal surface	$\theta_{si,m}$	$^{\circ}\text{C}$	19.27	19.66
Temperature of external surface	$\theta_{se,m}$	$^{\circ}\text{C}$	-0.33	-0.38
Medial temperature of sample	θ_m	$^{\circ}\text{C}$	9.47	9.64
Thermal flow through measuring box	ϕ_{in}	W	10.098	13.695
Thermal flow through dividing wall	ϕ_{sur}	W	6.030	4.768
Thermal flow through edges	ϕ_{edge}	W	0.091	0.116
Thermal flow through specific surface of sample	p	W	3.976	8.811
Linear coefficient of heat transfer	ψ_{edge}	$\text{W}/(\text{m} \cdot \text{K})$	0.00187	0.00149
Standardized coefficient of heat transfer	U	$\text{W}/(\text{m}^2 \cdot \text{K})$	0.583	0.512
Time of measurement in steady state		Hour	8	8
Specific surface	A_m	m^2	0.3136	0.7832
Thermal resistance	R	$\text{m}^2/\text{K}/\text{W}$	1.546	1.781
Overall resistance of heat transfer at measurement $R_{s,t}$		$\text{m}^2/\text{K}/\text{W}$	0.174	0.176

The plan of the testing equipment is shown in figure no. 1.

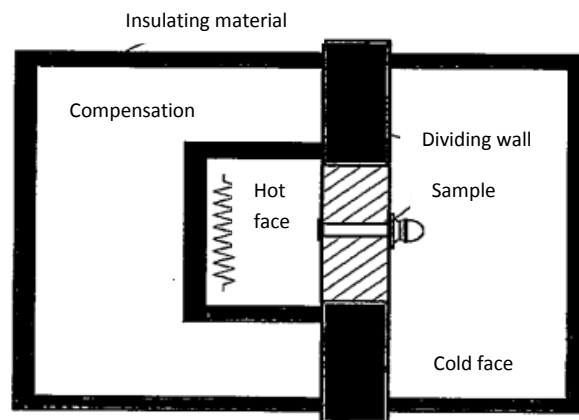


Figure 1: Plan of the testing equipment

8. Assessment - table of results evaluated

Serial no.	Parameter	Testing method	Sample no.	Test results
1.	Overall coefficient of heat transfer $U[\text{W}/(\text{m}^2 \cdot \text{K})]$	ČSN EN ISO 8990	070/15	0.58
		ČSN EN ISO 12567-1	071/15	0.51

Extended uncertainty of measurement of the overall coefficient of heat transfer $U_u = \pm 3.0\%$.

Test was performed by: Petr Pokorný

Report was prepared by: Ing: Nizar Al-Hajjar