RECU le 02 JUIN 2016

INSTITUTE OF ARCHITECTURE AND
CONSTRUCTION OF KAUNAS
UNIVERSITY OF TECHNOLOGY

LABORATORY OF BUILDING PHYSICS

LIETUVOS NACIONALINIS AKREDITACIJOS BIURAS
BANDYMAI
ISO/IEC 17025 Nr. LA. 01.031

TEST REPORT No. 032-A SF/16 U

Date: 16 of May 2016

Determination of thermal resistance of reflective insulation product according LST EN 16012:2012+A1:2015 and LST EN ISO 8990:1999

(test title)

Test method: LST EN 16012:2012+A1:2015: Thermal insulation for buildings-Reflective insulation products-Determination of the declared thermal performance;
LST EN ISO 8990:1999 Thermal insulation - Determination of steady-state thermal transmission properties - Calibrated and guarded hot box (ISO 8990:1994).
(number of normative document or test method, description of test procedure, test uncertainty)

Specimen description: Airflex (Maxireflex): reflective insulation product
Nominal thickness (EN 823) – 13 mm
(name, description and identification details of a specimen)

Customer: XL.Mat SAS, 697 route des Chenes, ZA de Terre Neuve, 73200 Gilly Sur Isere, France
(name and address)

Manufacturer: XL.Mat SAS, 697 route des Chenes, ZA de Terre Neuve, 73200 Gilly Sur Isere, France
(name and address)

Test results:

Name of the indicator and unit	Test method reference no.	Test result
Thermal resistance *R*, $(m^2 \cdot K)/W$	LST EN ISO 8990:1999	1,640
Corrected *R-core* thermal resistance, $(m^2 \cdot K)/W$	LST EN ISO 16012:2012+A1:2015*	0,367
Position of specimen: vertical (direction of heat flow – horizontal)		
*flexible scope		

Tested at: Laboratory of Building Physics, Institute of Architecture and Construction of Kaunas University of Technology
(name of the test laboratory)

Specimen delivery date: 2016-03-21 **Date of testing:** 2016-04-07

Sampling: The test specimen sampled by customer.

Additional information: Application 2016-01-20.
(any deviations, complementary tests, exceptions and any information related with particular test)

Annexes:
Annex 1. Test results;
Annex 2. Parameters of Guarded Hot Box measurement;
Annex 3. Specimen products and air gaps thermal properties;
Annex 4. Perimeter zone's linear thermal transmittance value of the specimen;
Annex 5. Specimen design data;
Annex 6. Scheme of climate chamber „Hot box".
(indicate annex numbers and titles)

Technical manager: (approves the test results) — (signature) — J. Ramanauskas (n., surname)

Tested by: (technically responsible for testing) — (signature) — A. Burlingis (n., surname)

S.P.

Annex 1. ***Test results:***

Data element	unit	Value
Air velocity on warm side, downwards, v_i	m/s	0,13
Air velocity on cold side, upwards, v_e	m/s	2,09
Total power input to metering box, Φ_{in}	W	19,774
Heat flow density through a specimen, q_{sp}	W/m^2	5,8565
Corrected heat flow density through a specimen, q_c	W/m2	6,0623
Warm side air temperature, θ_{ci}	^{o}C	20,65
Cold side air temperature, θ_{ce}	^{o}C	9,04
Surface temperature of the warm side, θ_{ni}	^{o}C	19,789
Surface temperature of the cold side, θ_{ne}	^{o}C	9,848
Temperature difference, Δ_T	^{o}C	9,941
Thermal resistance of specimen, R	m^2·K/W	1,640
Corrected, thermal resistance of specimen, R_{core}	m^2·K/W	0,423
Uncertainty of the measurement, ΔR	m^2·K/W	± 0,05181

Tested by: A. Burlingis [signature] Date: 2016-04-07

Annex 2. ***Parameters of Guarded Hot Box measurement.***

Table 1. ***Airflex (Maxireflex)*** ***insulation system's specimen measured at 20°C/10°C temperature regime***

Guarded Hot Box measurement. Parameters of "Airflex (Maxireflex)" insulation system's specimen:			
Specimen's area A, m^2	1,831	Actual mean thickness of specimen, mm	≈ 73*
Position of a specimen	vertical	Length of specimen perimeter L, m	5,44
	Linear thermal transmittance of perimeter zone Ψ_L, W/(m·K)		-0,006975

Measurement data:									
Insulation system with product "Airflex (Maxireflex)":									*Result:*
Sample No.	Hot side ambience temperature t_h, °C	Hot side surface temperature τ_h, °C	Cold side ambience temperature t_c, °C	Cold side surface temperature τ_c, °C	Temperature difference $\Delta t = (t_h - t_c)$, °C	Temperature difference $\Delta\tau = (\tau_h - \tau_c)$, °C	Measured heat flow density **q**, W/m^2	Corrected heat flow density q_C, W/m^2	**R-value** of insulation system, m^2·K/W
1	20,713	19,7890	9,092	9,8480	11,620	9,9410	5,8565	**6,0623**	**1,640±0,0520**

* Previous test has shown that when installed on real building the average thickness of product is slightly larger than its nominal value. To keep surfaces of test sample as parallel as possible in the test setup, it is decided to install the product in a frame. After internal validation, the thickness of the frame is representative of the average thickness of an installed product, as requested by LST EN ISO 8990.

Annex 3. ***Specimen product and air gaps thermal properties***

Table 2. Airflex (Maxireflex) insulation specimen product R-core value measurement results

Product	*Thickness d, mm*	*Hot side temperature τ_h, °C*	*Cold side temperature τ_c, °C*	*Temperature diffrence $\Delta\tau$, °C*	*Heat flow density q_c, W/m^2*	*Product's R- core value, m^2·K/W*
Airflex (Maxireflex)	13	16,1315	13,5698	2,5618	6,0623	**0,423**

Table 3. Airflex (Maxireflex) insulation specimen air gaps corrected R-core values calculation results according to LST EN 16012:2012+A1:2015 and LST EN ISO 6946:2008

Sample No.	*Air gap number*	*Thickness d, mm*	*Measured temperature differences of surfaces, $\Delta\tau$, °C*	*Radiative heat transfer coefficient, h_r*	*Convective heat transfer coefficient, h_a*	*Air gap R- core value, m^2·K/W*
1	Air gap #1	30	3,6575	0,3321	1,25	0,6321
	Air gap #2	30	3,7218	0,3097	1,25	0,6412

Table 4. Airflex (Maxireflex) insulation specimen products

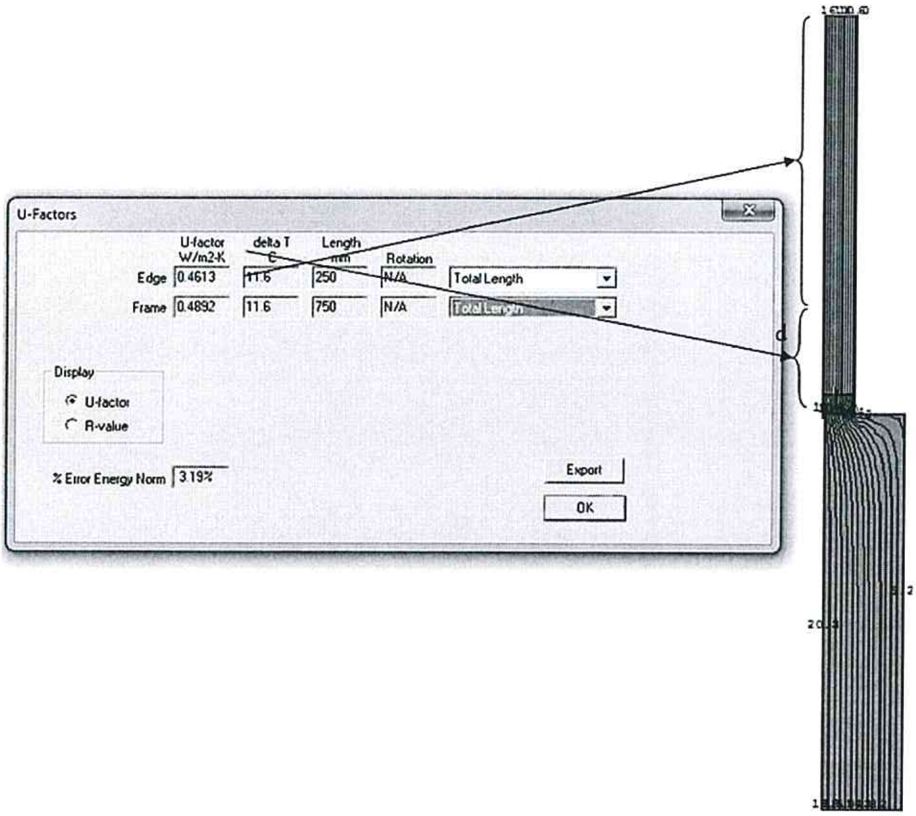
Specimen product	*Specimen surface layer*	*Test method reference No.*	*Declared emissivity, ε*
Airflex (Maxireflex)	surface 1	EN 16012	0,06 *
	surface 2		0,06 *

* *Emissivity results by Centre scientifique et technique du batiment (CSTB)Test Report No. EMI 16-26061558/B*

R-core thermal resistance value calculation according to LST EN 16012:2012+A1:2015:

$$R_{core}\text{ (LST EN 16012:2012+A1:2015)} = 1{,}640 - 0{,}6321 - 0{,}6412 = 0{,}3666\ (m^2\cdot K)/W$$

Annex 4. ***Perimeter zone's linear thermal transmittance value of the specimen***



Effective thermal conductivity of product λ_{eff} – 0,03073 W/(m²·K)
Perimeter zone's U-value: 0,4613 W/(m²·K); width "d"– 250 mm;
Central area U-value: 0,4892 W/(m²·K).
Perimeter's linear thermal transmittance: ψ= (0,4613-0,4892)·0,25 = **-0,006975** W/(m·K).

The correction of measured heat flow density value due to perimeter zone is calculated according to equation:

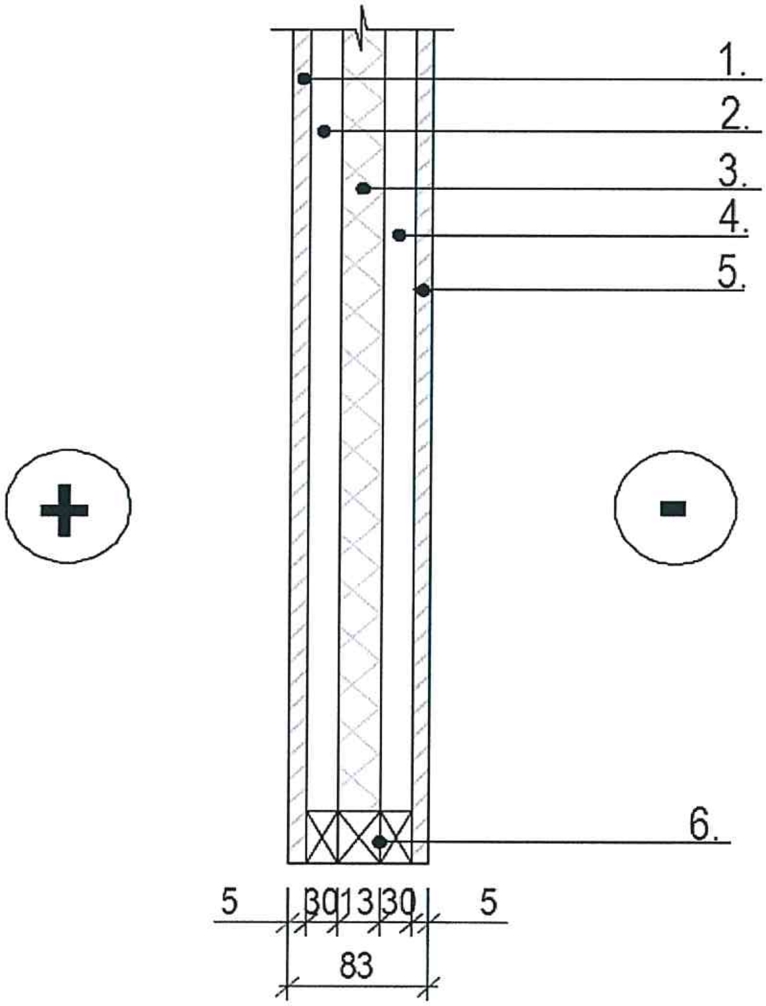
$$q_c = \frac{Q_c}{A} = \frac{Q - \psi \cdot L \cdot \Delta t}{A} = \frac{q \cdot A - \psi \cdot L \cdot \Delta t}{A} = q - \psi \cdot \left(\frac{L \cdot \Delta t}{A}\right);$$

here:
A – area of a specimen, m²;
Q – measured mean heat flow through a specimen, W;
q – measured mean heat flow density through a specimen, W/m²;
Q_C – corrected mean heat flow through a central area of specimen, W;
q_C – corrected mean heat flow density through a central area of specimen, W/m²;
L – perimeter length of a specimen, m;
Δt – ambient temperature difference across a specimen, K;
ψ - perimeter's linear thermal transmittance of a specimen, W/(m·K).

Corrected R-value: $R_c = \frac{\Delta\tau}{q_c}$;

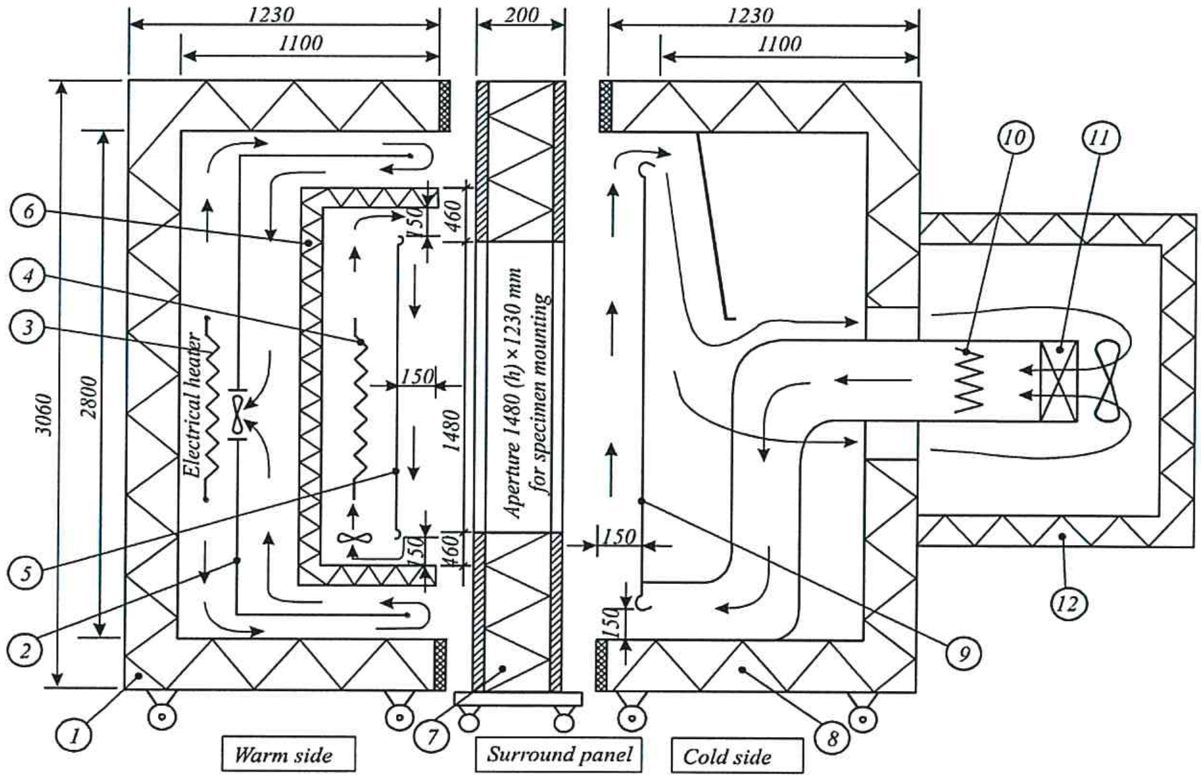
$\Delta\tau$ – temperature difference across a specimen, K.

Annex 5. ***Specimen design data***



1.	OSB 5 mm
2.	Air gap 30 mm (#1)
3.	**Airflex (Maxireflex)** 13 mm
4.	Air gap 30 mm (#2)
5.	OSB 5 mm
6.	XPS (extruded polystyrene)

Annex 6. Scheme of climate chamber „Hot box“



1. Warm side guard box:
   – internal dimensions 2800 × 2800 × 1100 mm;
   – wall thickness 130 mm, total thermal resistance about 3 $m^2 \cdot K/W$.
2. Guard air flows deflecting screen.
3. Electrical heater, power 660 W, controlled according to a set point temperature in metering box (6).
4. Electrical heater of metering box, power control from 13W to 660 W.
5. Warm side baffler (of metering box) with surface and air temperature sensors.
6. Metering box – internal dimensions 2400 × 2400 × 360 mm.
7. Surround panel: 200 mm thick, core material EPS polystyrene (faced with 3 mm thick cellular PVC plastic sheet on either side), thermal resistance about 6 $m^2 \cdot K/W$, 1484 x 1234 mm aperture for specimen mounting.
8. Cold side box:
   – internal dimensions 2800 × 2800 × 1100 mm;
   – wall thickness 130 mm, total thermal resistance about 3 $m^2 \cdot K/W$.
9. Cold side baffler with surface and air temperature sensors.
10. Cold side box controlled
11. Cold side controlled cooling air unit, max. cooling power up to 3 kW.
12. Cold side air cooling box with 5 speed motor fan. electrical heater, max. power 2 kW.