INSTITUTE OF ARCHITECTURE AND CONSTRUCTION OF KAUNAS UNIVERSITY OF TECHNOLOGY

BUILDING PHYSICS LABORATORY

NACIONALINIS AKREDITACIJOS BIURAS

Bandymai / tyrimai ISO/IEC 17025

Nr. LA.01.031

TEST REPORT No. 087-2 SF/24 U

Date: 09 of August 2024

Determination of declared thermal resistance of reflective insulation product according LST EN ISO 22097:2023, LST EN ISO 8990:1999 and product technical specification LST EN 16863:2023

(test title)

Test method: LST EN ISO 22097:2023 Thermal insulation for buildings - Reflective insulation products - Determination of thermal performance (ISO 22097:2023);
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: **Type of product: reflective insulation product (Type 3)**
Names of product:
TOP COMBLES / TOP COMBLES^{S} (ISO 2000 SAS)
Declared thickness – 8.5±1 cm* according EN 16863 (3 Pa)
*according to the manufacturer declaration: report ACTIS 220106-declared thickness EN 823 (3 Pa)

(name, description and identification details of a specimen)

Customer: SA Orion financement – Avenue de la Gare – FR-11230 CHALABRE, France

(name and address)

Manufacturer: ACTIS SA : 30 Avenue de Catalogne - 11300 LIMOUX, France

(name and address)

Test results:

Name of the indicator and unit	Test method reference no.	Test result
Declared core thermal resistance of product **TOP COMBLES** $R_{D(core)}90/90$, $(m^2 \cdot K)/W$	LST EN ISO 22097:2023	**3.15**
Declared thermal resistance of system with 2 air gaps R_{system} 90/90, $(m^2 \cdot K)/W$		**4.45**
Declared thermal resistance values determined according to LST EN 16863:2023 Position of specimen: vertical (direction of heat flow – horizontal)		

Tested at: Building Physics Laboratory, Institute of Architecture and Construction of Kaunas University of Technology

(name of the test laboratory)

Specimen delivery date: 2024-03-04 – 2024-03-18 **Date of testing:** 2024-03-20 – 2024-04-01

Production date: 2023-10-03 – 2024-02-13

Sampling: The test specimens sampled by customer. Description of the sample 2023-11-22

Additional information: This report is prepared according to tests reports 077 001-2 SF/24 U; 087 002-2 SF/24 U; 087 003-2 SF/24 U; 087 004-2 SF/24 U.

(any deviations, complementary tests, exceptions and any information related with particular test)

Annexes:
Annex 1. Parameters of Guarded Hot Box measurement;
Annex 2. Specimen air gaps thermal properties;
Annex 3. $R_{D(core)}90/90$ thermal resistance values according to LST EN 16863:2023.

(indicate annex numbers and titles)

Head of Laboratory: _____ K. Banionis
(approves the test results) (signature) (n., surname)

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

S.P.

Annex 1. ***Parameters of Guarded Hot Box measurement.***

Table 1. The insulation system's specimen measured at 20°C / 0°C temperature regime

Guarded Hot Box measurement. Parameters of insulation system's specimen:			
Specimen's area A, m^2	1.831	Actual mean thickness of specimen, mm	≈ **148***
Position of a specimen	vertical	Length of specimen perimeter L, m	5.44
	Linear thermal transmittance of perimeter zone Ψ_L, W/(m·K)		0.00504

Measurement data:						
Insulation system with product:						*Result:*
Sample No.	Hot side surface temperature τ_h, °C	Cold side surface temperature τ_c, °C	Temperature difference $\Delta\tau = (\tau_h - \tau_c)$, °C	Measured heat flow density **q**, W/m^2	Corrected heat flow density **qc**, W/m^2	**R-value** of insulation system, m^2·K/W
077 001/24	20,3528	0,0435	20,3093	4,6835	**4,3796**	**4,637**±0,1866
087 002/24	20,3268	0,0440	20,2828	4,7272	**4,4238**	**4,585**±0,1845
087 003/24	20,3405	0,0488	20,2918	4,6525	**4,3489**	**4,666**±0,1878
087 004/24	20,2060	0,0618	20,1443	4,6925	**4,3911**	**4,588**±0,1848
					Average:	**4.6190**

* 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.

$$S_{R\,system} = \sqrt{\frac{\sum\left(R_i - R_{average}\right)^2}{n-1}};$$

$S_{R\,system} = 0.03937$;

$R_{system\ 90/90} = R_{average} - k_2 \cdot S_{R\,system}$; $n = 4$; $k_2 = 3.19$;

Thermal resistance of the core together with the thermal resistances of the unventilated vertical air spaces, rounded downwards to the nearest 0.05 m^2·K/W:

$$R_{\ system\ 90/90} = 4.4934 = 4.45\ m^2 \cdot K/W$$

Annex 2. **Specimen air gaps thermal properties**

Table 2. The insulation specimen products

Specimen product	Specimen surface layer	Test method reference No.	Declared emissivity, ε
TOP COMBLES	EXTER ALU	EN 22097:2023	0.05*
	HQ2000+ cuivre		0.05**

*according to the manufacturer declaration No. D3-47/12 (FIW report).

**according to the manufacturer declaration No. D3-37/11 (FIW report).

Table 3. The insulation specimen air gaps corrected R-core values calculation results according to LST EN 22097:2023 and LST EN ISO 6946:2017

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, $m^2 \cdot K/W$
077 001/24	Air gap #1	30	2.521	0.2815	1.25	0.6530
	Air gap #2	30	2.679	0.2333	1.25	0.6742
087 002/24	Air gap #1	30	2.519	0.2814	1.25	0.6530
	Air gap #2	30	2.711	0.2334	1.25	0.6741
087 003/24	Air gap #1	30	2.476	0.2815	1.25	0.6530
	Air gap #2	30	2.686	0.2334	1.25	0.6741
087 004/24	Air gap #1	30	2.479	0.2811	1.25	0.6531
	Air gap #2	30	2.707	0.2334	1.25	0.6741

Annex 3. $R_{D(core)}90/90$ thermal resistance values according to LST EN 16863:2023

Table 4. R-core thermal resistance value according to LST EN 22097:2023

Sample No.	***R(core) thermal resistance value according to LST EN 22097:2023***
077 001/24	3.310 $m^2 \cdot K/W$
087 002/24	3.258 $m^2 \cdot K/W$
087 003/24	3.339 $m^2 \cdot K/W$
087 004/24	3.260 $m^2 \cdot K/W$
Average: 3.2918 $m^2 \cdot K/W$	

Standard deviation of derived R-value of insulation product:

$$S_{R(core)} = \sqrt{\frac{\sum(R_i - R_{average})^2}{n-1}};$$

$S_{R(core)} = 0.03963;$

Declared core thermal resistance $R_{D(core)}$ 90/90:

$R_{D(core)}\ 90/90 = R_{average} - k_2 \cdot S_{R\ system}$; $n = 4$; $k_2 = 3.19$;

Thermal resistance of the core rounded downwards to the nearest 0.05 $m^2 \cdot K/W$ (LST EN 16863:2023):

$R_{D(core)}\ 90/90 = 3.1653 = 3.15\ m^2 \cdot K/W$