INSTITUTE OF ARCHITECTURE AND CONSTRUCTION OF KAUNAS UNIVERSITY OF TECHNOLOGY

BUILDING PHYSICS LABORATORY

LIETUVOS NACIONALINIS AKREDITACIJOS BIURAS

BANDYMAI ISO/IEC 17025 Nr. LA.01.031

TEST REPORT No. 199 SF/21 U

Date: 14 of February 2022

Determination of declared 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:
Type of product: reflective insulation product (Type 3)
Names of product:
- **TRISO HYBRID / TRISO HYBRID^{S} / TRISO HYBRID^{MAX}** (ACTIS SA)
- **TOP COMBLES / TOP COMBLES^{S}** (ISO 2000 SAS)

Declared thickness – 8.5±1 cm*
*according to the manufacturer declaration: 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 corrected $R_{core}90/90$ thermal resistance of product **TRISO HYBRID**, $(m^2 \cdot K)/W$	LST EN ISO 16012:2012+A1:2015	**3.15**
Declared thermal resistance of system with 2 air gaps R_{TOTAL} 90/90, $(m^2 \cdot K)/W$		**4.45**
Declared thermal resistance values determined according to EN ISO 10456:2008** Position of specimen: vertical (direction of heat flow – horizontal) **not accredited activity		

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

(name of the test laboratory)

Specimen delivery date: 2021-12-23 **Date of testing:** 2022-01-30 – 2022-02-12

Production date: 2021-11-25 – 2021-12-14

Sampling: The test specimens sampled by customer. Description of the sample 2021-12-20

Additional information: Application 2021-11-24. This report is prepared according to tests reports 199-1 SF/21 U, 199-2 SF/21 U, 199-3 SF/21 U, 199-4 SF/21 U, 199-5 SF/21 U, 199-6 SF/21 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_{core} 90/90 and R_{TOTAL} 90/90 thermal resistance values according to LST EN 16012:2012+A1:2015.

(indicate annex numbers and titles)

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

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

S.P.

Lietuvos Respublika DOKUMENTAI Architektūros ir statybos institutas Kauno technologijos universitetas

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

Table 1. TRISO HYBRID insulation system's specimen measured at 20°C/10°C temperature regime

Guarded Hot Box measurement. Parameters of "TRISO HYBRID" insulation system's specimen:			
Specimen's area A, m^2	1.831	Actual mean thickness of specimen, mm	**≈ 146***
Position of a specimen	vertical	Length of specimen perimeter L, m	5.44
	Linear thermal transmittance of perimeter zone Ψ_L, W/(m·K)		0.006475

Measurement data:						
Insulation system with product "TRISO HYBRID":						*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/m²	Corrected heat flow density **qc**, W/m²	**R-value** of insulation system, m²·K/W
199-1	19.9970	9.4203	10.5773	2.5439	**2.3405**	**4.519**±0.1592
199-2	20.0175	9.4023	10.6153	2.4677	**2.2636**	**4.689**±0.1672
199-3	19.9590	9.4058	10.5533	2.5041	**2.3012**	**4.586**±0.1629
199-4	19.9698	9.3998	10.5700	2.4718	**2.2686**	**4.659**±0.1663
199-5	19.9398	9.3985	10.5413	2.4595	**2.2569**	**4.671**±0.1674
199-6	19.9095	9.3990	10.5105	2.4651	**2.2630**	**4.644**±0.1665
					Average:	**4.628**

* 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.

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

$S_{R-sys} = 0.063925$;

$R_{90/90-sys} = R_{average} - k_2 \cdot S_{R-sys}$;

$k_2 = 2.49$;

$$\boxed{R_{90/90-sys} = 4.4688 = 4.45\ m^2 \cdot K/W}$$

Table 2. TRISO HYBRID insulation specimen products

Specimen product	*Specimen surface layer*	*Test method reference No.*	*Declared emissivity, ε*
TRISO HYBRID	EXTER ALU	EN 16012:2012+A1:2015	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).

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

Table 3. TRISO HYBRID insulation specimen air gaps corrected R-core values calculation results according to EN 16012:2012+A1:2015 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, $m^2 \cdot K/W$*
199-1	Air gap #1	30	1.6370	0.2817	1.25	0.6529
	Air gap #2	30	1.7310	0.2568	1.25	0.6637
199-2	Air gap #1	30	1.6513	0.2818	1.25	0.6528
	Air gap #2	30	1.7198	0.2567	1.25	0.6637
199-3	Air gap #1	30	1.6000	0.2817	1.25	0.6529
	Air gap #2	30	1.6718	0.2567	1.25	0.6637
199-4	Air gap #1	30	1.5913	0.2817	1.25	0.6529
	Air gap #2	30	1.6713	0.2566	1.25	0.6637
199-5	Air gap #1	30	1.5705	0.2817	1.25	0.6529
	Air gap #2	30	1.6728	0.2566	1.25	0.6637
199-6	Air gap #1	30	1.5935	0.2815	1.25	0.6529
	Air gap #2	30	1.7190	0.2567	1.25	0.6637

Annex 3. ***$R_{core}90/90$ and $R_{TOTAL}90/90$ thermal resistance values according to EN 16012:2012+A1:2015***

Table 4. TRISO HYBRID R-core thermal resistance value according to EN 16012:2012+A1:2015

Sample No.	***R-core thermal resistance value***
199-1	3.2024 $m^2 \cdot K/W$
199-2	3.3725 $m^2 \cdot K/W$
199-3	3.2694 $m^2 \cdot K/W$
199-4	3.3424 $m^2 \cdot K/W$
199-5	3.3544 $m^2 \cdot K/W$
199-6	3.3274 $m^2 \cdot K/W$
Average: 3.3114 $m^2 \cdot K/W$	

Standard deviation of derived R-value of insulation product:

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

$S_{R-prod} = 0.063944$;

Declared derived R-value of insulation product according to EN ISO 10456:2008:

$R_{90/90-prod} = R_{average} - k_2 \cdot S_{R-prod}$; $k_2 = 2.49$;

$$R_{90/90-prod} = 3.1522 = 3.15\ m^2 \cdot K/W$$