

TEST REPORT No. 154 SF/24 U

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Date: 09 of August 2024

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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).

Specimen description: (number of normative document or test method, description of test procedure, test uncertainty)
Type of product: reflective insulation product (Type 3)
Names of product:
TRISO-SUPER 12+ / TS12+ / TS12 MAX / TRISO-SUPER 12 MAX / TRISO-SUPER 12 PLUS / ISO+ COMBLES / REFLECTISO COMBLES / TRISO SUPER 12 MULTI / TRISO 12 MULTISTRATO / TS 12 MULTISTRATO
Declared thickness – 12.0±1 cm* according EN 16863 (3 Pa)
*according to the manufacturer declaration: report ACTIS 221206-declared thickness EN 823 (3 Pa) – TRISO-SUPER 12+
(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 TRISO SUPER 12+ $R_{D(core)90/90}$, (m²·K)/W	LST EN ISO 22097:2023	4.40
Declared thermal resistance of system with 2 air gaps $R_{system\ 90/90}$, (m²·K)/W		5.70
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)

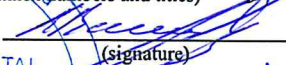
Specimen delivery date: 2024-05-20 – 2024-06-07 **Date of testing:** 2024-05-26 – 2024-06-12

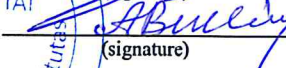
Production date:

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

Additional information: This report is prepared according to tests reports 130 001-1 SF/24 U; 130 002-1 SF/24 U; 130 003-1 SF/24 U; 154 004-1 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: (approves the test results)  K. Banionis
(n., surname)

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

S.P.

Validity – the named data and results refer exclusively to the tested and described specimens.
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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			≈ 185*
Position of a specimen		vertical	Length of specimen perimeter L, m			5.44
		Linear thermal transmittance of perimeter zone Ψ _L , W/(m·K)				0.00546
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 Δτ = (τ _h - τ _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
130 001/24	19,9818	0,0443	19,9375	3,6557	3,3325	5,983±0,2258
130 002/24	20,0543	0,1020	19,9523	3,4918	3,1684	6,297±0,2378
130 003/24	20,0290	0,0925	19,9365	3,5026	3,1795	6,270±0,2368
154 004/24	20,1030	0,0603	20,0428	3,5579	3,2331	6,199±0,2339
Average:						6.1873

* 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.

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

$$S_{R \text{ system}} = 0.14230;$$

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

Thermal resistance of the core together with the thermal resistances of the unventilated vertical air spaces, rounded downwards to the nearest 0.05 m²·K/W:

$$R_{\text{system } 90/90} = 5.7333 = 5.70 \text{ m}^2 \cdot \text{K/W}$$

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
TRISO-SUPER 12+	HQ2000+ cuivre	EN 22097:2023	0.05**
	HQ2000+ cuivre		0.05**

** Declaration number: D3-37/11 (FIW report).

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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, $m^2 \cdot K/W$
130 001/24	Air gap #1	30	1.922	0.2813	1.25	0.6531
	Air gap #2	30	2.141	0.2327	1.25	0.6745
130 002/24	Air gap #1	30	1.896	0.2815	1.25	0.6529
	Air gap #2	30	2.142	0.2328	1.25	0.6744
130 003/24	Air gap #1	30	1.954	0.2814	1.25	0.6530
	Air gap #2	30	2.134	0.2328	1.25	0.6744
154 004/24	Air gap #1	30	1.974	0.2815	1.25	0.6529
	Air gap #2	30	2.180	0.2327	1.25	0.6744

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
130 001/24	4.655 $m^2 \cdot K/W$
130 002/24	4.970 $m^2 \cdot K/W$
130 003/24	4.943 $m^2 \cdot K/W$
154 004/24	4.872 $m^2 \cdot K/W$
Average: 4.8600 $m^2 \cdot K/W$	

Standard deviation of derived R-value of insulation product:

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

$$S_{R(core)} = 0.14278;$$

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

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

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

$$R_{D(core)90/90} = 4.4045 = 4.40 \, m^2 \cdot K/W$$

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