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. 138 SF/23 U

Date: 03 of July 2023

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:
ATI PRO LIN-3
Thickness of product installed in the „Hot box" – 85 mm;
Declared thickness of product – 70 mm +/- 15 mm*
*Declaration numbers: 230505 ATI PRO LIN.2-1 epaisseur ; 230519 ATI PRO LIN.3-1 epaisseur; 230526 ATI PRO LIN.3-2 epaisseur; 230602 ATI PRO LIN.3-3 epaisseur; 230609 ATI PRO LIN.3-4 epaisseur;

(name, description and identification details of a specimen)

Customer: SAS ATI FRANCE, 146 avenue du bicentenaire 01120 Dagneux, France

(name and address)

Manufacturer: SAS ATI FRANCE, 146 avenue du bicentenaire 01120 Dagneux, France

(name and address)

Test results:

Name of the indicator and unit	Test method reference no.	Test result
Declared thermal resistance of the core of product **ATI PRO LIN-3** R_{core}*90/90*, (m²·K)/W	LST EN ISO 16012:2012+A1:2015	**2.54**
Declared thermal resistance of system with 2 air spaces R_{sys} *90/90*, (m²·K)/W		**3.20**
Declared thermal resistance values determined according to EN ISO 10456:2008 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 dates: 2023-05-05; 2023-06-16 **Date of testing:** 2023-05-19 ÷ 2023-06-28

Production date: 2023-05-03 ÷ 2023-06-07

Sampling: The test specimens sampled by customer. Description of the sample: 2023-05-05; 2023-06-09

Additional information: Application 2023-06-09. This report is prepared according to tests reports: 091 SF/23 U; 138-1 SF/23 U; 138-2 SF/23 U; 138-3 SF/23 U; 138-4 SF/23 U.

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

Annexes: ***Annex 1.*** Parameters of Guarded Hot Box measurement and R_{sys} *90/90*;
Annex 2. Specimen air gaps thermal properties;
Annex 3. R_{core} *90/90* thermal resistance value according to LST EN 16012:2012+A1:2015.

(indicate annex numbers and titles)

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

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

S.P.

Architektūros ir statybos instituto DOKUMENTAI Kauno technologijos universitetas

Annex 1. Parameters of Guarded Hot Box measurement and R_{sys} 90/90

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

Guarded Hot Box measurement. Parameters of insulation system's specimen:			
Specimen's area A, m²	1.831	Actual mean thickness of specimen, mm	≈ 145*
Position of a specimen	vertical	Length of specimen perimeter L, m	5.44
	Linear thermal transmittance of perimeter zone Ψ_L, W/(m·K)		0.00987 and 0.01201

Measurement data:						
Insulation system with product "ATI PRO LIN-3":						*Result:*
Sample No.	Hot side surface temperature τ_h, °C	Cold side surface temperature τ_c, °C	Temperature difference $\Delta t = (t_h - t_c)$, °C	Measured heat flow density q, W/m²	Corrected heat flow density q_c, W/m²	**R-value** of insulation system, m²·K/W
091/23	20,0098	9,7895	10,2203	3,3048	**3,0053**	**3,401**±0,1072
138-1/23	20,0450	9,7695	10,2755	3,4701	**3,1037**	**3,311**±0,1004
138-2/23	19,9995	9,7858	10,2138	3,4768	**3,1127**	**3,281**±0,09996
138-3/23	20,0075	9,7988	10,2088	3,3242	**3,0251**	**3,375**±0,1063
138-4/23	19,9945	9,8005	10,1940	3,3319	**3,0332**	**3,361**±0,1059
					Average:	**3,346**±0,1040

* 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.

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

$$S_{R-sys} = 0.048839;$$

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

$$k_2 = 2.74;$$

$$R_{90/90-sys} = 3.2120 = 3.20\ m^2 \cdot K/W$$

Annex 2. Specimen air gaps thermal properties

Table 2. Insulation specimen products

Specimen product	*Specimen surface layer*	*Test method reference No.*	*Declared emissivity, ε*
ATI PRO LIN-3	External reflective perforated layer	EN 16012:2012+A1:2015	0.15*
	External black membrane		0.85**

* Declaration number: 230505 Emissivité Film armé micro-perforé
** Declaration number: 230505 Emissivité Ecran HPV noir

Table 3. Insulation specimen air gaps for corrected R-core values calculation results according to LST 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, $m^2 \cdot K/W$*
091/23	Air gap #1	30	1.589	0.8362	1.25	0.4793
	Air gap #2	30	0.681	4.0042	1.25	0.1903
138-1/23	Air gap #1	30	1.833	0.8355	1.25	0.4795
	Air gap #2	30	0.678	4.0033	1.25	0.1904
138-2/23	Air gap #1	30	1.965	0.8344	1.25	0.4797
	Air gap #2	30	0.697	4.0044	1.25	0.1903
138-3/23	Air gap #1	30	1.903	0.8349	1.25	0.4796
	Air gap #2	30	0.682	4.0046	1.25	0.1903
138-4/23	Air gap #1	30	1.868	0.8349	1.25	0.4796
	Air gap #2	30	0.686	4.0048	1.25	0.1903

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

Table 4. R-core thermal resistance values according to LST EN 16012:2012+A1:2015

Sample No.	Thickness of sample *d*, mm	***R-core thermal resistance value according to LST EN 16012***
091/23	85	2.731 $m^2 \cdot K/W$
138-1/23	85	2.641 $m^2 \cdot K/W$
138-2/23	85	2.611 $m^2 \cdot K/W$
138-3/23	85	2.705 $m^2 \cdot K/W$
138-4/23	85	2.691 $m^2 \cdot K/W$
Average: 2.676 $m^2 \cdot K/W$		

Standard deviation of derived R-value of insulation product:

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

$S_{R-core} = 0.043711;$

Declared derived R-value of insulation product

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

$k_2 = 2.74;$

$$R_{90/90-core} = 2.5420 = 2.54\, m^2 \cdot K/W$$