TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.

Annex to Solar Keymark Certificate

Licence Number	TSU 001-22		
Date issued	2022-10-10		
Issued by	TSU Piešťany, š.p		
Licence holder	EUROTERM d.o.o.	Country	Republic of North Macedonia
Brand (optional)		Web	www.solarico.eu
Street, Number	Lece Koteski 50	E-mail	tode@solarico.eu
Postcode, City	7500 Prilep	Tel	+389 48 419 415
Collector Type		Flat plate collector	

Collector name	Gross area (A_G)	Gross length	Gross width	Gross height	Power output per collector Gb = 850 W/m2, Gd = 150 W/m2 & u = 1.3 m/s $\vartheta_m - \vartheta_a$					
					0 K	10 K	30 K	50 K	70 K	90 K
	m²	mm	mm	mm	W	W	W	W	W	W
ESK 2.5 SB	2.50	2,150	1,160	90	1,780	1,681	1,473	1,253	1,021	777
					0	0	0	0	0	0
					0	0	0	0	0	0
					0	0	0	0	0	0
					0	0	0	0	0	0
					0	0	0	0	0	0
					0	0	0	0	0	0
					0	0	0	0	0	0
					0	0	0	0	0	0
					0	0	0	0	0	0
					0	0	0	0	0	0
Power output per m² gross area					712	672	589	501	408	311

Performance parameters test method	Steady state - outdoor									
Performance parameters (related to A_G)	η0, b	a1	a2	a3	a4	a5	a6	a7	a8	Kd
Units	-	W/(m²K)	W/(m²K²)	J/(m³K)	-	J/(m²K)	s/m	W/(m²K⁴)	W/(m²K⁴)	-
Test results	0.723	3.92	0.006	0.000	0.00	5,000	0.000	0.00	0.0E+00	0.90

Incidence angle modifier test method		Steady state - outdoor								
Incidence angle modifier	Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
Transversal	$K_{\theta T,coll}$	1.00	1.00	0.99	0.98	0.94	0.87	0.73	0.48	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	1.00	0.99	0.98	0.94	0.87	0.73	0.48	0.00

Heat transfer medium for testing	Water		
Flow rate for testing (per gross area, A_G)	dm/dt	0.016	kg/(sm²)
Maximum temperature difference during thermal performance test	$(\vartheta_m-\vartheta_a)_{max}$	60	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	202	°C
Maximum operating temperature	ϑ_{max_op}	100	°C
Maximum operating pressure	$p_{max,op}$	1000	kPa

Testing laboratory	Technický skúšobný ústav Piešťany, š.p	http://www.tsu.sk	
Test report(s)	210700003/PQ	Dated	6-10-2022

Comments of testing laboratory

Ver. 6.2 (13.01.2022)

TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.
Krajinská cesta 2929/9
921 01 PIEŠŤANY
-316/3-

TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.

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Supplementary Information	Issued	2022-10-10

Gross Thermal Yield in kWh/collector at mean fluid temperature ϑ_m

Standard Locations		Athens			Davos			Stockholm			Würzburg		
Collector name	ϑ_m	25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C
ESK 2.5 SB		2,827	1,947	1,252	2,104	1,425	897	1,551	986	593	1,690	1,062	630
Gross Thermal Yield per m² gross area		1,131	779	501	841	570	359	621	394	237	676	425	252
Annual efficiency, η_a		64%	44%	28%	52%	35%	22%	53%	34%	20%	54%	34%	20%
Fixed or tracking collector		Fixed (slope = latitude - 15°; rounded to nearest 5°)											
Annual irradiation on collector plane		1765 kWh/m²			1630 kWh/m²			1166 kWh/m²			1244 kWh/m²		
Mean annual ambient air temperature		18.5°C			3.2°C			7.5°C			9.0°C		
Collector orientation or tracking mode		South, 25°			South, 30°			South, 45°			South, 35°		

The collector is operated at constant temperature ϑm (mean of in- and outlet temperatures). The calculation of the annual collector performance is performed with the official Solar Keymark spreadsheet tool Scenocalc Ver. 6.2 (13.01.2022). A detailed description of the calculations is available at http://www.estif.org/solarkeymarknew/

Additional Information

Collector heat transfer medium				Water-Glycole	
The collector is deemed to be suitable for roof integration				No	
The collector was tested successfully under the following conditions:					
Climate class (A+, A, B or C)				A	--
G (W/m²) >	1000	ϑ_a (°C) >	20	H_x (MJ/m²) >	600
Maximum tested positive load				1200	Pa
Maximum tested negative load				1100	Pa
Hail resistance using steel ball (maximum drop height)				2	m

Additional collector attribute(s)

Using external power source(s) for normal operation	No	Active or passive measure(s) for self-protection	No
Co-generating thermal and electrical power	No	Façade collector(s)	No

Energy Labelling Information

	Reference Area, A_{sol} (m²)
ESK 2.5 SB	2.50

Data required for CDR (EU) No 811/2013 - Reference Area A_{sol}

Collector efficiency (η_{col})	55%

Remark: Collector efficiency (ηcol) is defined in CDR (EU) No 811/2013 as collector efficiency of the solar collector at a temperature difference between the solar collector and the surrounding air of 40 K and a global solar irradiance of 1000 W/m², expressed in % and rounded to the nearest integer. Deviating from the regulation ηcol is based on reference area (Asol) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017.

Additional Informative Technical Data

Hydraulic Designation Code	Aperture Area, A_a (m²)
12-VH-1234S-A:8,23920-C:22,1200	2.35

Data required for CDR (EU) No 812/2013 - Reference Area A_{sol}

Zero-loss efficiency (η_0)	0.71	--
First-order coefficient (a_1)	3.92	W/(m²K)
Second-order coefficient (a_2)	0.006	W/(m²K²)
Incidence angle modifier IAM (50°)	0.95	--

Remark: The data given in this section are related to collector reference area (A_{sol}) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806. Consistent data sets for either aperture or gross area can be used in calculations like in the regulation 811 and 812 and simulation programs.