TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.

Annex to Solar Keymark Certificate		Licence Number	TSU 001-21
		Date issued	2021-08-06
		Issued by	TSU Piešťany, š.p.
Licence holder	THERMO/SOLAR Žiar s.r.o.	Country	Slovak republic
Brand (optional)		Web	www.thermosolar.sk
Street, Number	Na vartičke 14	E-mail	info@thermosolar.sk
Postcode, City	965 01 Žiar nad Hronom	Tel	+421 (0)456016080

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
TS 500H	2.53	2,009	1,259	74	1,828	1,745	1,562	1,359	1,136	892
TS 300H	2.03	2,009	1,009	74	1,467	1,400	1,253	1,090	911	716
					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					723	690	617	537	449	353

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	0.731	3.21	0.010	0.000	0.00	5,375	0.000	0.00	0.0E+00	0.92

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	0.97	0.95	0.92	0.84	0.60	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	1.00	0.99	0.97	0.95	0.92	0.84	0.60	0.00

Heat transfer medium for testing		Water	
Flow rate for testing (per gross area, A_G)	dm/dt	0.010	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}	206	°C
Maximum operating temperature	ϑ_{max_op}	100	°C
Maximum operating pressure	$p_{max,op}$	600	kPa

Testing laboratory	Technický skúšobný ústav Piešťany, š.p	http://www.tsu.sk	
Test report(s)	210700001/PQ 210700001/P	Dated	5-8-2021 5-8-2021

Comments of testing laboratory	Datasheet version: 6.1, 2019-09-26
	TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p. Krajinská cesta 2929/9 92101 PIEŠŤANY -316/3-

TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.

Annex to Solar Keymark Certificate	Licence Number	TSU 001-21
Supplementary Information	Issued	2021-08-06

Annual collector output 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
TS 500H		2,960	2,166	1,476	2,274	1,619	1,067	1,673	1,127	713	1,817	1,220	759
TS 300H		2,375	1,738	1,184	1,825	1,299	856	1,342	904	572	1,458	979	609
Annual output per m² gross area		1,170	856	583	899	640	422	661	445	282	718	482	300
Annual efficiency, η_a		66%	49%	33%	55%	39%	26%	57%	38%	24%	58%	39%	24%
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. 6.1 (September 2019). 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				Yes	
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				2300	Pa
Maximum tested negative load				2500	Pa
Hail resistance using steel ball (maximum drop height)				2	m

Additional collector attribute(s)

☐ Using external power source(s) for normal operation	☐ Active or passive measure(s) for self-protection
☐ Co-generating thermal and electrical power	☑ Façade collector(s)

Energy Labelling Information

	Reference Area, A_{sol} (m²)
TS 500H	2.53
TS 300H	2.03

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

Collector efficiency (η_{col})	58%

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	Aperature Area, A_a (m²)
TS 500H	1-V-1234S-A:9,21000-C:16,1000	2.26
TS 300H	1-V-1234S-A:9,26000-C:16,1300	1.78

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

Zero-loss efficiency (η_0)	0.72	--
First-order coefficient (a_1)	3.21	W/(m²K)
Second-order coefficient (a_2)	0.010	W/(m²K²)
Incidence angle modifier IAM (50°)	0.94	--

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.

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