




Annex to Solar Keymark Certificate					Licence Number		TSU 002-21							
					Date issued		2021-08-19							
					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					Power output per collector									
					Gb = 850 W/m ² , Gd = 150 W/m ² & u = 1.3 m/s $\vartheta_m - \vartheta_a$									
					0 K	10 K	30 K	50 K	70 K	90 K				
					m ²	mm	mm	mm	mm	mm	mm			
TS 500					2.53	2,009	1,259	75	1,817	1,733	1,551	1,349	1,126	883
TS 300					2.03	2,009	1,009	75	1,458	1,391	1,244	1,082	903	709
TS 250					2.03	2,009	1,009	75	1,458	1,391	1,244	1,082	903	709
									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 m ² gross area					718	685	613	533	445	349				
Performance parameters test method		Steady state - outdoor												
Performance parameters (related to A _G)		η_0, b	a1	a2	a3	a4	a5	a6	a7	a8	Kd			
Units		-	W/(m ² K)	W/(m ² K ²)	J/(m ³ K)	-	J/(m ² K)	s/m	W/(m ² K ⁴)	W/(m ² K ⁴)	-			
Test results		0.726	3.20	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	0.011	kg/(sm ²)										
Maximum temperature difference during thermal performance test		$(\vartheta_m - \vartheta_a)_{max}$	60	K										
Standard stagnation temperature (G = 1000 W/m ² ; $\vartheta_a = 30$ °C)		ϑ_{stg}	196	°C										
Maximum operating temperature		$\vartheta_{max, op}$	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)		210700002/PQ 210700002/P					Dated		16-8-2021 16-8-2021					
Comments of testing laboratory		Datasheet version: 6.1, 2019-09-26												
		 <p>TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p. Krajinská cesta 2929/9 92101 PIEŠŤANY -316/3-</p>												
<p>Technický skúšobný ústav Piešťany, š.p. Address: Krajinská cesta 2929/9, 92101 Piešťany, Slovak Republic Phone: +421 33 79 57 111, Fax: +421 33 77 23 716, E-mail: sv@tsu.sk, web: www.tsu.eu</p>														

Annex to Solar Keymark Certificate Supplementary Information	Licence Number	TSU 002-21
	Issued	2021-08-19

Annual collector output in kWh/collector at mean fluid temperature ϑ_m													
Collector name	Standard Locations	Athens			Davos			Stockholm			Würzburg		
	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 500		2,940	2,149	1,462	2,258	1,605	1,056	1,661	1,117	706	1,804	1,210	751
TS 300		2,359	1,725	1,173	1,812	1,288	847	1,333	896	566	1,448	971	603
TS 250		2,359	1,725	1,173	1,812	1,288	847	1,333	896	566	1,448	971	603
Annual output per m ² gross area		1,162	850	578	892	635	417	657	442	279	713	478	297
Annual efficiency, η_a		66%	48%	33%	55%	39%	26%	56%	38%	24%	57%	38%	24%
Fixed or tracking collector	Fixed (slope = latitude - 15°; rounded to nearest 5°)												
Annual irradiation on collector plane		1765 kWh/m ²			1630 kWh/m ²			1166 kWh/m ²			1244 kWh/m ²		
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 ϑ_m (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/m ²) >	1000	ϑ_a (°C) >	20	H_x (MJ/m ²) >
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)				
<input type="checkbox"/>	Using external power source(s) for normal operation	<input type="checkbox"/>	Active or passive measure(s) for self-protection	
<input type="checkbox"/>	Co-generating thermal and electrical power	<input checked="" type="checkbox"/>	Façade collector(s)	

Energy Labelling Information		Additional Informative Technical Data	
	Reference Area, A_{sol} (m ²)	Hydraulic Designation Code	Aperture Area, A_a (m ²)
TS 500	2.53	1-V-1234S-A:9,26000-C:16,1300	2.26
TS 300	2.03	1-V-1234S-A:9,21000-C:16,1000	1.78
TS 250	2.03	1-V-12S-A:9,21000	1.78

Data required for CDR (EU) No 811/2013 - Reference Area A_{sol}		Data required for CDR (EU) No 812/2013 - Reference Area A_{sol}	
Collector efficiency (η_{col})	57%	Zero-loss efficiency (η_0)	0.72
Remark: Collector efficiency (η_{col}) 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/m ² , expressed in % and rounded to the nearest integer. Deviating from the regulation η_{col} is based on reference area (A_{sol}) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017.		First-order coefficient (a_1)	3.20
		Second-order coefficient (a_2)	0.010
		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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