TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.

Annex to Solar Keymark Certificate

Licence Number	**TSU 002-20/D**
Date issued	**2020-06-29**
Issued by	**TSU Piešťany, š.p.**

Licence holder	**Thermosolar Ltd**	**Country**	Great Britain
Brand (optional)	HOTSOLARWATER.COM	**Web**	www.hotsolarwater.com
Street, Number	Unit 7, Whiteladies Road, Clifton	**E-mail**	douglas@thermosolar.co.uk
Postcode, City	BS8 2AG, Bristol	**Tel**	+44 (0)8448508508

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	110 K
	m^2	mm	mm	mm	W	W	W	W	W	W
KSA Sea Sand Resistant	2.03	2,009	1,009	75	1,463	1,402	1,272	1,131	980	647
Power output per m^2 gross area					721	691	627	557	483	319

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	-	$W/(m^2K)$	$W/(m^2K^2)$	$J/(m^3K)$	-	$J/(m^2K)$	s/m	$W/(m^2K^4)$	$W/(m^2K^4)$	-
Test results	0.730	2.95	0.006	0.000	0.00	5,120	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	0.99	0.98	0.97	0.95	0.91	0.83	0.57	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	0.99	0.98	0.97	0.95	0.91	0.83	0.57	0.00

Heat transfer medium for testing		Water	
Flow rate for testing (per gross area, A_G)	dm/dt	0.014	$kg/(sm^2)$
Maximum temperature difference during thermal performance test	$(\vartheta_m-\vartheta_a)_{max}$	80	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	224	°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)	170700008/1/PQ(D1)	**Dated**	6/29/2020

Comments of testing laboratory

Datasheet version: 6.1, 2019-09-26

TECHNICKY SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.
Krajinská cesta 2929/9
92101 PIEŠŤANY
-316/3-

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

TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.

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Supplementary Information	Issued	2020-06-29

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
KSA Sea Sand Resistant		2,362	1,782	1,282	1,844	1,366	963	1,351	948	642	1,465	1,027	683
Annual output per m² gross area		1,164	878	632	909	673	474	665	467	316	722	506	337
Annual efficiency, η_a		66%	50%	36%	56%	41%	29%	57%	40%	27%	58%	41%	27%
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)
KSA Sea Sand Resistant	2.03

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

Collector efficiency (η_{col})	59%

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)
{F}-{O}-{CL}-{A:Ø,L}-{C:Ø,L}-{D}	1.85
1-H-1234S-A:10,21000-C:18,2000	

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

Zero-loss efficiency (η_0)	0.72	--
First-order coefficient (a_1)	2.95	W/(m²K)
Second-order coefficient (a_2)	0.006	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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