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Annex to Solar Keymark Certificate

Licence Number	**011-7S3177 F**
Date issued	**2023-05-05**
Issued by	**DIN CERTCO**

Licence holder	**Versol Ltd Sp Zoo**	**Country**	Poland
Brand (optional)	Versol	**Web**	www.versolgroup.com
Street, Number	ul Elektoralna, 13 lok	**E-mail**	info@versolgroup.com
Postcode, City	00-137, Warszawa	**Tel**	+44 7472353032

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	89 K
	m^2	mm	mm	mm	W	W	W	W	W	W
FP2.0Cu/Al	2.00	2,000	1,000	80	1,468	1,374	1,168	936	678	414
FP2.5Cu/Al	2.50	2,000	1,250	80	1,835	1,718	1,460	1,170	848	518
FP3.0Cu/Al	3.00	2,000	1,500	80	2,202	2,061	1,752	1,404	1,018	621
Power output per m² gross area					734	687	584	468	339	207

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	0.754	4.518	0.016	0.000	0.000	5,800	0.000	0.000	0.000	0.822

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	0.96	0.94	0.85	0.75	0.59	0.36	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	0.99	0.96	0.94	0.85	0.75	0.59	0.36	0.00

Heat transfer medium for testing		Water	
Flow rate for testing (per gross area, A_G)	dm/dt	0.020	kg/(sm²)
Maximum temperature difference during thermal performance test	$(\vartheta_m-\vartheta_a)_{max}$	58.72	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	160	°C
Maximum operating temperature	$\vartheta_{max\ op}$	120	°C
Maximum operating pressure	$p_{max,op}$	1200	kPa

Testing laboratory	Intertek Testing Services Shenzhen Ltd. Guangzhou Branch	http://www.intertek.com	
Test report(s)	230404060GZU-001	**Dated**	2023/4/18

Comments of testing laboratory Ver. 6.2 (13.01.2022)

None

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Supplementary Information	Issued	2023-05-05

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
FP2.0Cu/Al	2,185	1,375	750	1,564	949	482	1,165	666	334	1,269	711	351
FP2.5Cu/Al	2,732	1,719	938	1,955	1,187	603	1,456	833	418	1,586	889	439
FP3.0Cu/Al	3,278	2,063	1,125	2,347	1,424	724	1,748	999	502	1,903	1,067	526
Gross Thermal Yield per m² gross area	1,093	688	375	782	475	241	583	333	167	634	356	175
Annual efficiency, η_a	62%	39%	21%	48%	29%	15%	50%	29%	14%	51%	29%	14%
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	
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)				B	--
G (W/m²) >	900	ϑ_a (°C) >	15	H_x (MJ/m²) >	540
Maximum tested positive load				5900	Pa
Maximum tested negative load				3000	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)
FP2.0Cu/Al	2.00
FP2.5Cu/Al	2.50
FP3.0Cu/Al	3.00

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

Collector efficiency (η_{col})	53%

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)
8-VH-1234S-A:9,1885-C22,1060-D	1.85
8-VH-1234S-A:9,1885-C22,1310-D	2.34
8-VH-1234S-A:9,1885-C22,1560-D	2.83

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

Zero-loss efficiency (η_0)	0.73	--
First-order coefficient (a_1)	4.52	W/(m²K)
Second-order coefficient (a_2)	0.016	W/(m²K²)
Incidence angle modifier IAM (50°)	0.87	--

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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