TÜVRheinland®
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Precisely Right.

Annex to Solar Keymark Certificate

Licence Number	**011-7S019 F**
Date issued	**2019-11-20**
Issued by	**TÜV Rheinland Energy GmbH**

Licence holder	**Gasokol GmbH**	**Country**	Austria
Brand (optional)	-	**Web**	www.gasokol.at
Street, Number	Solarpark 1	**E-mail**	office@gasokol.at
Postcode, City	A-4351 Saxen	**Tel**	+43 726 976 600

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
sunnySol 23V	2.25	2 100	1 070	105	1 541	1 473	1 325	1 161	980	783
sunnySol 23H	2.25	1 070	2 100	105	1 541	1 473	1 325	1 161	980	783
Power output per m² gross area					685	655	589	516	436	348

Performance parameters test method	Quasi dynamic									
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	0.688	2.93	0.009	0.000	0.00	15 690	0.000	0.00	0.0E+00	0.97

Incidence angle modifier test method	Quasi dynamic - 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	0.96	0.93	0.88	0.77	0.44	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	0.99	0.98	0.96	0.93	0.88	0.77	0.44	0.00

Heat transfer medium for testing	Water		
Flow rate for testing (per gross area, A_G)	dm/dt	0.050	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}	200	°C
Maximum operating temperature	$\vartheta_{max\ op}$	-	°C
Maximum operating pressure	$p_{max,op}$	1000	kPa

Testing laboratory	TÜV Rheinland Energy GmbH	www.tuv.com/solarpower	
Test report(s)	2.04.01243.1.0-3-LT (by AIT) 2.04.01243.1.0-3-QT (by AIT)	**Dated**	20.07.2015 20.07.2015

Comments of testing laboratory — Datasheet version: 6.1, 2019-09-26

The collector had been tested according to EN ISO 9806:2013 by AIT Austrian Institute for Technology GmbH. According to an aperture area of 2.01 m², the collector parameter would be $\eta_{0,hem,a}$=0.765; a_{1a}=3.277 and a_{2a}=0.010.

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51105 Köln

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Supplementary Information	Issued	2019-11-20

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
sunnySol 23V		2 505	1 855	1 284	1 935	1 393	933	1 420	970	625	1 548	1 055	668
sunnySol 23H		2 505	1 855	1 284	1 935	1 393	933	1 420	970	625	1 548	1 055	668
Annual output per m² gross area		1 113	825	571	860	619	415	631	431	278	688	469	297
Annual efficiency, η_a		63%	47%	32%	53%	38%	25%	54%	37%	24%	55%	38%	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					No	
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					2000	Pa
Maximum tested negative load					1500	Pa
Hail resistance using steel ball (maximum drop height)					-	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)
sunnySol 23V	2.25
sunnySol 23H	2.25

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	Aperature Area, A_a (m²)
sunnySol 23V	8-V-12S-7.2,1940-20.4,2098	2.01
sunnySol 23H	8-V-12S-7.2,1935-20.4,1545	2.01

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

Zero-loss efficiency (η_0)	0.68	--
First-order coefficient (a_1)	2.93	W/(m²K)
Second-order coefficient (a_2)	0.009	W/(m²K²)
Incidence angle modifier IAM (50°)	0.93	--

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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