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Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results		Licence Number	011-7S260 F
		Date issued	2016-10-07
		Issued by	TÜV Rheinland Energy GmbH

Licence holder	**Wolf GmbH**	**Country**	Germany
Brand (optional)		**Web**	**www.wolf-heiztechnik.de**
Street, Number	Industriestr. 1	**E-mail**	**info@wolf-heiztechnik.de**
Postcode, City	84048 Mainburg	**Tel**	+498751 74-1797 / 74-1736

Collector Type	Flat plate collector, glazed

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 = 3 m/s ϑm - ϑa: 0 K	10 K	30 K	50 K	70 K	70 K
	m²	mm	mm	mm	W	W	W	W	W	W
TopSon F3-1	2.30	2 100	1 100	110	1 615	1 542	1 377	1 186	969	969
Power output per m² gross area					702	671	599	515	421	421

Performance parameters test method	Quasi dynamic								
Performance parameters (related to AG)	η0,b	c1	c2	c3	c4	c6	Kd		
Units	-	W/(m²K)	W/(m²K²)	J/(m³K)	-	s/m	-		
Test results	0.709	3.037	0.014	0.000	0.000	0.000	0.937		

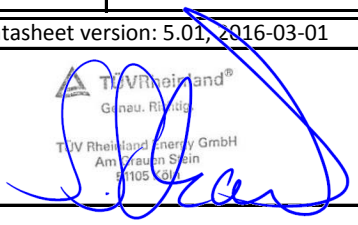
Incidence angle modifier test method		Quasi dynamic - outdoor							
Bi-directional incidence angle modifiers	No								
Incidence angle modifier	Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
Transversal	$K_{\theta T,coll}$	1.00	0.99	0.98	0.95	0.92	0.85	0.71	0.36	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	0.99	0.98	0.95	0.92	0.85	0.71	0.36	0.00

Heat transfer medium for testing		Water-Glycole	
Flow rate for testing (per gross area, A_G)	dm/dt	0.022	kg/(sm²)
Maximum temperature difference for thermal performance calculations	$(\vartheta_m-\vartheta_a)_{max}$	70	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	194	°C
Effective thermal capacity, incl. fluid (per gross area, A_G)	C/m²	8.103	kJ/(Km²)
Maximum operating temperature	ϑ_{max_op}	-	°C
Maximum operating pressure	$p_{max,op}$	1000	kPa

Testing laboratory	TÜV Rheinland Energy GmbH	www.tuv.com/solarpower	
Test report(s)	21236243.001	**Dated**	06.10.2016

Comments of testing laboratory — Datasheet version: 5.01, 2016-03-01

Additional information:
The performance parameters c1 & c2 are fixed by steady-state values out of indoor test.



Annex to Solar Keymark Certificate	Licence Number	011-7S260 F
Supplementary Information	Issued	2016-10-07

Annual collector output in kWh/collector at mean fluid temperature ϑ_m, based on EN ISO 9806:2013 test results

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
TopSon F3-1	2 582	1 875	1 237	1 981	1 383	871	1 456	967	588	1 585	1 048	627
Annual output per m² gross area	1 123	815	538	861	601	379	633	420	256	689	456	273
Fixed or tracking collector	Fixed (slope = latitude - 15°; rounded to nearest 5°)											
Annual irradiation on collector plane	1765 kWh/m²			1714 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. 5.01 (March 2016). A detailed description of the calculations is available at www.solarkeymark.org/scenocalc

Additional Information

Collector heat transfer medium	Water-Glycole	
Hybrid Thermal and Photo Voltaic collector	No	
The collector is deemed to be suitable for roof integration	Yes	
The collector was tested successfully according to EN ISO 9806:2013 under the following conditions:		
Climate class (A, B or C)	A	--
Maximum tested positive load	5400	Pa
Maximum tested negative load	2000	Pa
Hail resistance using steel ball (maximum drop height)	35	m

Energy Labelling Information

	Reference Area, A_{sol} (m^2)	Data required for CDR (EU) No 811/2013 - Reference Area A_{sol}		
TopSon F3-1	2.30	Collector efficiency (η_{col})	56	%
		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/m², 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 9806:2013.		
		Data required for CDR (EU) No 812/2013 - Reference Area A_{sol}		
		Zero-loss efficiency (η_0)	0.702	--
		First-order coefficient (a_1)	3.04	W/(m²K)
		Second-order coefficient (a_2)	0.014	W/(m²K²)
		Incidence angle modifier IAM (50°)	0.92	--
		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.		