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Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results		Licence Number	011-7S2463 R
		Date issued	2017-07-11
		Issued by	TÜV Rheinland Energy GmbH

Licence holder	**Consolar Solare Energiesysteme GmbH**	**Country**	Germany
Brand (optional)	Consolar	**Web**	www.consolar.com
Street, Number	Kasseler Straße 1a	**E-mail**	- - -
Postcode, City	60486 Frankfurt a. M.	**Tel**	+49 (0)69-7409328-0

Collector Type	Evacuated tubular 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 ϑm - ϑa: 0 K	10 K	30 K	50 K	70 K	70 K
	m²	mm	mm	mm	W	W	W	W	W	W
Consolar TUBO II C (*)	2.44	1 947	1 248	87	1 366	1 348	1 296	1 225	1 134	1 134
Power output per m² gross area					560	552	531	502	465	465

Performance parameters test method	Steady state - indoor								
Performance parameters (related to AG)	η0,hem	a1	a2						
Units	-	W/(m²K)	W/(m²K²)						
Test results	0.560	0.660	0.010						

Incidence angle modifier test method	Quasi dynamic - outdoor								
Bi-directional incidence angle modifiers	Yes								
Incidence angle modifier	Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
Transversal	$K_{\theta T,coll}$	1.00	0.99	0.99	0.97	0.95	0.91	0.93	0.42	0.00
Longitudinal	$K_{\theta L,coll}$	1.01	1.00	0.96	1.03	1.09	1.18	1.36	0.68	0.00

Heat transfer medium for testing	Water		
Flow rate for testing (per gross area, A_G)	dm/dt	0.018	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}	260	°C
Effective thermal capacity, incl. fluid (per gross area, A_G)	C/m²	7.34	kJ/(Km²)
Maximum operating temperature	ϑ_{max_op}	- - -	°C
Maximum operating pressure	$p_{max,op}$	1000	kPa

Testing laboratory	TÜV Rheinland Energy GmbH	http://www.tuv.com/solarthermie	
Test report(s)	21229230.003	**Dated**	07.07.2016

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

(*) Because of product size 2 samples were combined for testing incl. additional CPC-element.
Dimension of single element (l/w/h) [mm]: 1947 / 624 / 87
Areas of single element (Aa/Ag) [m²]: 0.98 / 1.22

Due to the design that used single elements to enlarge final collector field area; combined with additional CPC-elements; the enclosed maximum power peak-values had been documented in test report.

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Supplementary Information	Issued	2017-07-11

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
Consolar TUBO II C (*)	1 566	1 332	1 064	1 566	1 332	1 064	1 566	1 332	1 064	1 566	1 332	1 064
Annual output per m² gross area	642	546	436	642	546	436	642	546	436	642	546	436
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	2688	Pa
Maximum tested negative load	2210	Pa
Hail resistance using ice balls (diameter)	--	mm

Energy Labelling Information

	Reference Area, A_{sol} (m^2)	Data required for CDR (EU) No 811/2013 - Reference Area A_{sol}		
Consolar TUBO II C (*)	2.44	Collector efficiency (η_{col})	52	%
		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)	0.560	--
		First-order coefficient (a_1)	0.66	W/(m²K)
		Second-order coefficient (a_2)	0.010	W/(m²K²)
		Incidence angle modifier IAM (50°)	1.00	--
		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.		