

## Annex to Solar Keymark Certificate

Licence Number	011-7S2463 R
Date issued	2021-03-11
Issued by	TÜV Rheinland Energy GmbH

<b>Licence holder</b>	Consolar Solare Energiesysteme GmbH	<b>Country</b>	Germany
<b>Brand (optional)</b>	Consolar	<b>Web</b>	www.consolar.com
<b>Street, Number</b>	Kasseler Straße 1a	<b>E-mail</b>	info@consolar.de
<b>Postcode, City</b>	60486 Frankfurt a.M.	<b>Tel</b>	49 (0)7621 42228-500

Collector Type	Evacuated tubular collector
----------------	-----------------------------

Collector name	Gross area (A <sub>G</sub> ) m <sup>2</sup>	Gross length mm	Gross width mm	Gross height mm	Power output per collector G <sub>b</sub> = 850 W/m <sup>2</sup> , G <sub>d</sub> = 150 W/m <sup>2</sup> & u = 1.3 m/s θ <sub>m</sub> - θ <sub>a</sub>					
					0 K	10 K	30 K	50 K	70 K	90 K
					W	W	W	W	W	W
Consolar TUBO II C (2 Modules)	2.44	1 947	1 248	87	1 445	1 422	1 369	1 305	1 232	1 150
Power output per m <sup>2</sup> gross area					592	583	561	535	505	471

Performance parameters test method	Quasi dynamic									
Performance parameters (related to A <sub>G</sub> )	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	0.595	0.90	0.005	0.000	0.00	18 836	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	1.01	1.00	1.00	1.01	1.00	1.00	0.00
Longitudinal	$K_{\theta L, coll}$	1.00	0.98	0.95	0.90	0.83	0.72	0.56	0.33	0.00

Heat transfer medium for testing	Water		
Flow rate for testing (per gross area, $A_g$ )	$\dot{m}/dt$	0.020	kg/(sm <sup>2</sup> )
Maximum temperature difference during thermal performance test	$(\vartheta_m - \vartheta_a)_{\max}$	60	K
Standard stagnation temperature ( $G = 1000 \text{ W/m}^2$ ; $\vartheta_a = 30 \text{ }^\circ\text{C}$ )	$\vartheta_{\text{stg}}$	310	$^\circ\text{C}$
Maximum operating temperature	$\vartheta_{\max \text{ op}}$	-	$^\circ\text{C}$
Maximum operating pressure	$p_{\max \text{ op}}$	1000	kPa

Testing laboratory	TÜV Rheinland Energy GmbH	www.tuv.com/solarenergy	
Test report(s)	21249958.001 21249958.003 (EN 12975-1 Doc-check)	Dated	15.09.2020 11.03.2021

Comments of testing laboratory


Datasheet version: 6.1. 2019-07-11

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 ( $A_a/A_g$ ) [ $m^2$ ]: 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.

 TÜV Rheinland®  
Genau. Richtig.  
TÜV Rheinland Energie GmbH  
Am Graubühl 1  
53105 Köln

DIN CERTCO • Alboinstraße 56 • 12103 Berlin, Germany

Tel: +49 30 7562-1131 • Fax: +49 30 7562-1141 • E-Mail: [info@dincertco.de](mailto:info@dincertco.de) • [www.dincertco.de](http://www.dincertco.de)

Annex to Solar Keymark Certificate	Licence Number	011-7S2463 R
Supplementary Information	Issued	2021-03-11

Annual collector output in kWh/collector at mean fluid temperature $\vartheta_m$													
Standard Locations		Athens			Davos			Stockholm			Würzburg		
Collector name	$\vartheta_m$	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 (2 Modules)		2 449	2 191	1 905	2 100	1 837	1 565	1 526	1 307	1 089	1 638	1 405	1 172
Annual output per m <sup>2</sup> gross area		1 004	898	781	861	753	642	625	536	446	671	576	480
Annual efficiency, $\eta_a$		57%	51%	44%	53%	46%	39%	54%	46%	38%	54%	46%	39%
Fixed or tracking collector		Fixed (slope = latitude - 15°; rounded to nearest 5°)											
Annual irradiation on collector plane		1765 kWh/m <sup>2</sup>			1630 kWh/m <sup>2</sup>			1166 kWh/m <sup>2</sup>			1244 kWh/m <sup>2</sup>		
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 $\vartheta_m$ (mean of in- and outlet temperatures). The calculation of the annual collector performance is performed with the official Solar Keymark spreadsheet tool Scenalc Ver. 6.1 (July 2019). A detailed description of the calculations is available at <a href="http://www.estif.org/solarkeymarknew/">http://www.estif.org/solarkeymarknew/</a>													

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)				A	--
G (W/m <sup>2</sup> ) >	1000	Θ <sub>a</sub> (°C) >	20	H <sub>X</sub> (MJ/m <sup>2</sup> ) >	600
Maximum tested positive load					2700 Pa
Maximum tested negative load					2250 Pa
Hail resistance using ice balls (diameter)					25 mm

Additional collector attribute(s)	
<input type="checkbox"/> Using external power source(s) for normal operation	<input type="checkbox"/> Active or passive measure(s) for self-protection
<input type="checkbox"/> Co-generating thermal and electrical power	<input type="checkbox"/> Façade collector(s)

[illegible]

Data required for CDR (EU) No 811/2013 - Reference Area $A_{sol}$		Data required for CDR (EU) No 812/2013 - Reference Area $A_{sol}$	
Collector efficiency ( $\eta_{col}$ )	55%	Zero-loss efficiency ( $\eta_0$ )	0.59 --
Remark: Collector efficiency ( $\eta_{col}$ ) 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/m <sup>2</sup> , expressed in % and rounded to the nearest integer. Deviating from the regulation $\eta_{col}$ is based on reference area ( $A_{sol}$ ) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017.		First-order coefficient ( $a_1$ )	0.90 W/(m <sup>2</sup> K)
		Second-order coefficient ( $a_2$ )	0.005 W/(m <sup>2</sup> K <sup>2</sup> )
		Incidence angle modifier IAM (50°)	0.91 --
		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 <u>or</u> 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.	