Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results

Licence Number	**OEM 10000/1**
Date issued	**2016-11-30**
Issued by	**DQS Hellas**

Licence holder	VON BARTELS GmbH	**Country**	GERMANY
Brand (optional)		**Web**	
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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	52 K
	m²	mm	mm	mm	W	W	W	W	W	W
Zeus cpc 8	1,68	2.000	840	135	748	718	653	578	494	570
Zeus cpc 9	1,91	2.000	953	135	850	817	742	657	561	648
Zeus cpc 10	2,13	2.000	1.067	135	948	911	828	733	626	723
Zeus cpc 11	2,36	2.000	1.180	135	1.050	1.009	917	812	693	801
Zeus cpc 12	2,59	2.000	1.294	135	1.153	1.107	1.006	891	761	879
Zeus cpc 13	2,81	2.000	1.407	135	1.250	1.202	1.092	967	826	953
Zeus cpc 14	3,04	2.000	1.520	135	1.353	1.300	1.181	1.046	893	1.031
Zeus cpc 15	3,27	2.000	1.634	135	1.455	1.398	1.271	1.125	961	1.109
Zeus cpc 16	3,50	2.000	1.750	135	1.558	1.497	1.360	1.204	1.028	1.187
Zeus cpc 17	3,72	2.000	1.861	135	1.655	1.591	1.446	1.280	1.093	1.262
Zeus cpc 18	3,95	2.000	1.974	135	1.758	1.689	1.535	1.359	1.161	1.340
Zeus cpc 19	4,18	2.000	2.088	135	1.860	1.787	1.624	1.438	1.228	1.418
Zeus cpc 20	4,40	2.000	2.201	135	1.958	1.881	1.710	1.514	1.293	1.493
Zeus cpc 21	4,63	2.000	2.314	135	2.060	1.980	1.799	1.593	1.360	1.571
Zeus cpc 22	4,86	2.000	2.428	135	2.163	2.078	1.889	1.672	1.428	1.649
Zeus cpc 23	5,08	2.000	2.541	135	2.261	2.172	1.974	1.748	1.493	1.723
Power output per m² gross area					445	428	389	344	294	339

Performance parameters test method		Steady state - outdoor								
Performance parameters (related to AG)		η0,hem	a1	a2						
Units		-	W/(m²K)	W/(m²K²)						
Test results		0,445	1,670	0,007						
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	$K_{\theta T,coll}$					1,01				0,00
Longitudinal	$K_{\theta L,coll}$					0,88				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 for thermal performance calculations	$(\vartheta_m-\vartheta_a)_{max}$	52	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	190	°C
Effective thermal capacity, incl. fluid (per gross area, A_G)	C/m²	6,7	kJ/(Km²)
Maximum operating temperature	$\vartheta_{max,op}$	-	°C
Maximum operating pressure	$p_{max,op}$	600	kPa

Testing laboratory	NCSR Demokritos / Solar & other Energy Systems Laboratory	www.solar.demokritos.gr	
Test report(s)	4180 DE5	**Dated**	8/2/2017
	4181 DE5		8/2/2017
	4181 DQ5		8/2/2017

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

The effective thermal capacity value was obtained from the Test Report Nr. 04-17/KT dated 30.01.2017 issued by Institut für Solarenergieforschung GmbH .

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Supplementary Information	Issued	2016-11-30

Annual collector output in kWh/collector at mean fluid temperature ϑ_m, based on 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
Zeus cpc 8	1.141	859	603	899	660	454	655	460	306	706	492	322
Zeus cpc 9	1.297	977	685	1.022	751	517	745	523	348	803	559	366
Zeus cpc 10	1.447	1.089	764	1.140	837	576	831	583	388	895	623	408
Zeus cpc 11	1.603	1.207	847	1.263	928	638	920	646	429	992	691	452
Zeus cpc 12	1.759	1.324	929	1.386	1.018	700	1.010	709	471	1.089	758	496
Zeus cpc 13	1.909	1.437	1.008	1.503	1.105	760	1.096	769	511	1.181	822	538
Zeus cpc 14	2.065	1.554	1.091	1.627	1.195	822	1.185	832	553	1.278	890	582
Zeus cpc 15	2.221	1.672	1.173	1.750	1.285	884	1.275	895	595	1.375	957	626
Zeus cpc 16	2.377	1.790	1.256	1.873	1.376	947	1.365	958	637	1.471	1.024	671
Zeus cpc 17	2.527	1.902	1.335	1.990	1.462	1.006	1.451	1.018	677	1.564	1.089	713
Zeus cpc 18	2.683	2.020	1.417	2.113	1.553	1.068	1.540	1.081	719	1.661	1.156	757
Zeus cpc 19	2.839	2.137	1.500	2.236	1.643	1.130	1.630	1.144	761	1.757	1.223	801
Zeus cpc 20	2.989	2.250	1.579	2.354	1.730	1.190	1.716	1.205	801	1.850	1.288	843
Zeus cpc 21	3.145	2.367	1.661	2.477	1.820	1.252	1.805	1.267	842	1.946	1.355	887
Zeus cpc 22	3.301	2.485	1.744	2.600	1.911	1.314	1.895	1.330	884	2.043	1.422	931
Zeus cpc 23	3.451	2.598	1.823	2.718	1.997	1.374	1.981	1.391	924	2.136	1.486	973
Annual output per m² gross area	679	511	359	535	393	270	390	274	182	420	293	192
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	No	
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	2400	Pa
Maximum tested negative load	na	Pa
Hail resistance using steel ball (maximum drop height)	0,4	m

Energy Labelling Information

	Reference Area, A_{sol} (m^2)
Zeus cpc 8	1,68
Zeus cpc 9	1,91
Zeus cpc 10	2,13
Zeus cpc 11	2,36
Zeus cpc 12	2,59
Zeus cpc 13	2,81
Zeus cpc 14	3,04
Zeus cpc 15	3,27
Zeus cpc 16	3,50
Zeus cpc 17	3,72
Zeus cpc 18	3,95
Zeus cpc 19	4,18
Zeus cpc 20	4,40
Zeus cpc 21	4,63
Zeus cpc 22	4,86
Zeus cpc 23	5,08

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

Collector efficiency (η_{col})	37	%

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)	0,445	--
First-order coefficient (a_1)	1,67	W/(m²K)
Second-order coefficient (a_2)	0,007	W/(m²K²)
Incidence angle modifier IAM (50°)	0,00	--

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.

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