
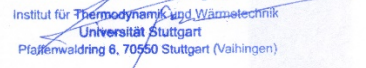


Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results					Licence Number		011-7S2012 F											
					Date issued		2017-10-25											
					Issued by		DIN CERTCO											
Licence holder		ZRAK SOLAR DOOEL			Country		Macedonia											
Brand (optional)					Web		www.zrak.com.mk											
Street, Number		Brakja Beshiroski 9			E-mail		zrakpp@yahoo.com											
Postcode, City		7500 Prilep			Tel		+389 48 419 905											
Collector Type					Flat plate collector, glazed													
Collector name					Gross area (A_G)		Gross length		Gross width		Gross height		Power output per collector G _b = 850 W/m ² ; G _d = 150 W/m ² ; u = 3 m/s ϑ _m - ϑ _a					
					m ²	mm	mm	mm	mm	0 K	10 K	30 K	50 K	70 K	112 K			
SUN PANEL S.002					2.53	2,008	1,258	85	1,734	1,643	1,450	1,243	1,022	512				
SUN PANEL S.001					2.02	2,006	1,007	85	1,386	1,314	1,159	994	817	409				
Power output per m² gross area					686	650	574	492	405	203								
Performance parameters test method					Quasi dynamic													
Performance parameters (related to AG)					η _{0,b}	c1	c2	c3	c4	c6	Kd							
Units					-	W/(m ² K)	W/(m ² K ²)	J/(m ³ K)	-	s/m	-							
Test results					0.687	3.534	0.007	0.000	0.000	0.000	0.993							
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 _{θT, coll}	1.00	0.99	0.98	0.96	0.92	0.86	0.73	0.34	0.00				
Longitudinal					K _{θL, coll}	1.00	0.99	0.98	0.96	0.92	0.86	0.73	0.34	0.00				
Heat transfer medium for testing					Water													
Flow rate for testing (per gross area, A_G)					dm/dt	0.018	kg/(sm ²)											
Maximum temperature difference for thermal performance calculations					(ϑ _m -ϑ _a) _{max}	112	K											
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)					ϑ _{stg}	199	°C											
Effective thermal capacity, incl. fluid (per gross area, A_G)					C/m ²	11.515	kJ/(Km ²)											
Maximum operating temperature					ϑ _{max, op}	n.a.	°C											
Maximum operating pressure					p _{max, op}	1600	kPa											
Testing laboratory					TZS, ITW University Stuttgart					www.itw.uni-stuttgart.de								
Test report(s)					10COL933/1OEM09 10COL934/1OEM09 10COL934Q/1OEM09					Dated		17.09.2012 17.09.2012 17.09.2012						
Comments of testing laboratory					Datashet version: 5.01, 2016-03-01													
This data sheet replaces the data sheet issued on 17.09.2012					 Forschungs- und Testzentrum für Solaranlagen Institut für Thermodynamik und Wärmetechnik Universität Stuttgart Pfaffenwaldring 8, 70560 Stuttgart (Vaihingen)													
Documented performance parameters are taken from 10COL933/1OEM09 (SUN PANEL S.001)																		
The address is updated																		
The max. operating pressue was corrected from 1000 kPa to 1600 kPa																		
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Annex to Solar Keymark Certificate Supplementary Information	Licence Number	011-7S2012 F
	Issued	2017-10-25

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

Standard Locations Collector name	ϑ_m	Athens			Davos			Stockholm			Würzburg		
		25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C
SUN PANEL S.002		2,810	1,981	1,300	2,108	1,448	921	1,556	1,008	615	1,704	1,096	658
SUN PANEL S.001		2,247	1,584	1,040	1,686	1,158	736	1,244	806	492	1,362	877	526
Annual output per m ² gross area		1,113	784	515	835	573	365	616	399	243	674	434	260
Fixed or tracking collector		Fixed (slope = latitude - 15°; rounded to nearest 5°)											
Annual irradiation on collector plane		1765 kWh/m ²			1714 kWh/m ²			1166 kWh/m ²			1244 kWh/m ²		
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 ϑ_m (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)	B	--
Maximum tested positive load	1750	Pa
Maximum tested negative load	1750	Pa
Hail resistance using steel ball (maximum drop height)	n.a.	m

Energy Labelling Information

	Reference Area, A_{sol} (m ²)	Data required for CDR (EU) No 811/2013 - Reference Area A_{sol}	
SUN PANEL S.002	2.53	Collector efficiency (η_{col})	53 %
SUN PANEL S.001	2.02	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/m ² , 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)	0.686 --
		First-order coefficient (a_1)	3.53 W/(m ² K)
		Second-order coefficient (a_2)	0.007 W/(m ² K ²)
		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.	