


Annex to Solar Keymark Certificate					Licence Number		011-7S3132 F							
					Date issued		2022-07-11							
					Issued by		DIN CERTCO							
Licence holder		SUNDWARE SOLAR IKE			Country		Greece							
Brand (optional)					Web		www.sundwaresolar.com							
Street, Number		Vakhou 22-24			E-mail		export@sundwaresolar.com							
Postcode, City		P.c. 54629 Theassaloniki			Tel		+30 6985970085							
Collector Type					Flat plate collector									
Collector name					Power output per collector									
					$G_b = 850 \text{ W/m}^2, G_d = 150 \text{ W/m}^2 \text{ \& } u = 1.3 \text{ m/s}$ $\vartheta_m - \vartheta_a$									
					0 K	10 K	30 K	50 K	70 K	112 K				
					m ²	mm	mm	mm	mm	mm	mm			
					W	W	W	W	W	W				
PRO 15/PRO+V15					1.51	1 503	1 007	85	1 093	1 037	921	797	666	367
PRO 17/PRO+V17					1.68	1 420	1 183	85	1 216	1 154	1 024	886	741	408
PRO 19/PRO+V19					1.96	1 503	1 305	85	1 419	1 346	1 195	1 034	864	476
PRO 20/PRO+V20					2.02	2 006	1 007	85	1 462	1 388	1 232	1 066	890	490
PRO 23/PRO+V23					2.24	1 893	1 183	85	1 621	1 539	1 366	1 182	987	544
PRO 25/PRO+V25					2.52	2 006	1 257	85	1 824	1 731	1 536	1 330	1 111	612
PRO 27/PRO+V27					2.67	2 261	1 183	85	1 933	1 834	1 628	1 409	1 177	648
PRO 29/PRO+V29					2.92	2 006	1 457	85	2 114	2 006	1 780	1 541	1 287	709
Power output per m² gross area					724	687	610	528	441	243				
Performance parameters test method		Quasi dynamic												
Performance parameters (related to A_G)		η_0, b	a1	a2	a3	a4	a5	a6	a7	a8	Kd			
Units		-	W/(m ² K)	W/(m ² K ²)	J/(m ³ K)	-	J/(m ² K)	s/m	W/(m ² K ⁴)	W/(m ² K ⁴)	-			
Test results		0.725	3.62	0.006	0.000	0.00	13 660	0.000	0.00	0.0	0.99			
Incidence angle modifier test method		Quasi dynamic - outdoor												
Incidence angle modifier		Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°			
Transversal		K _{GT, coll}	1.00	1.00	1.00	0.99	0.96	0.87	0.63	0.32	0.00			
Longitudinal		K _{GL, coll}	1.00	1.00	1.00	0.99	0.96	0.87	0.63	0.32	0.00			
Heat transfer medium for testing		Water-Glycole												
Flow rate for testing (per gross area, A_G)		dm/dt		0.020	kg/(sm ²)									
Maximum temperature difference during thermal performance test		$(\vartheta_m - \vartheta_a)_{max}$		82	K									
Standard stagnation temperature (G = 1000 W/m²; $\vartheta_a = 30 \text{ }^\circ\text{C}$)		ϑ_{stg}		230	°C									
Maximum operating temperature		$\vartheta_{max, op}$		-	°C									
Maximum operating pressure		$p_{max, op}$		1000	kPa									
Testing laboratory		Institut für Gebäudeenergetik, Thermotechnik und Energiespeicherung (IGTE)					http://www.igte.uni-stuttgart.de							
Test report(s)		21COL1631OEM03 21COL1631QOEM03 21COL1632OEM03					Dated		04.07.2022 04.07.2022 04.07.2022					
Comments of testing laboratory		Ver. 6.2 (13.01.2022)												
Documented performance parameters are taken from 21COL1632OEM03 (PRO15/Pro+V15)		 <p>Forschungs- und Testzentrum für Solaranlagen Institut für Thermodynamik und Wärmetechnik Universität Stuttgart Pfaiferwaldring 6, 70550 Stuttgart (Vaihingen)</p>												
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Supplementary Information		Issued		2022-07-11										
Gross Thermal Yield in kWh/collector at mean fluid temperature ϑ_m														
	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	
PRO 15/PRO+V15		1 792	1 285	868	1 361	958	635	996	661	418	1 090	719	449	
PRO 17/PRO+V17		1 993	1 430	966	1 514	1 065	706	1 109	735	465	1 213	800	499	
PRO 19/PRO+V19		2 326	1 668	1 127	1 766	1 243	824	1 293	858	543	1 415	933	582	
PRO 20/PRO+V20		2 397	1 719	1 162	1 820	1 281	849	1 333	884	559	1 459	961	600	
PRO 23/PRO+V23		2 658	1 906	1 288	2 018	1 421	941	1 478	980	620	1 618	1 066	666	
PRO 25/PRO+V25		2 990	2 144	1 449	2 271	1 598	1 059	1 663	1 103	698	1 820	1 199	749	
PRO 27/PRO+V27		3 168	2 272	1 535	2 406	1 693	1 122	1 762	1 169	739	1 928	1 271	793	
PRO 29/PRO+V29		3 465	2 485	1 679	2 631	1 852	1 227	1 927	1 278	809	2 109	1 390	868	
Gross Thermal Yield per m ² gross area		1 187	851	575	901	634	420	660	438	277	722	476	297	
Annual efficiency, η_a		67%	48%	33%	55%	39%	26%	57%	38%	24%	58%	38%	24%	
Fixed or tracking collector		Fixed (slope = latitude - 15°; rounded to nearest 5°)												
Annual irradiation on collector plane		1765 kWh/m ²			1630 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. 6.2 (13.01.2022). A detailed description of the calculations is available at http://www.estif.org/solarkeymarknew/														
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 ²) >		1000		ϑ_a (°C) >		20		H _x (MJ/m ²) >		600				
Maximum tested positive load											2750		Pa	
Maximum tested negative load											2400		Pa	
Hail resistance using steel ball (maximum drop height)											2		m	
Additional collector attribute(s)														
Using external power source(s) for normal operation											No		Active or passive measure(s) for self-protection	No
Co-generating thermal and electrical power											No		Façade collector(s)	No
Energy Labelling Information						Additional Informative Technical Data								
		Reference Area, A _{sol} (m ²)		Hydraulic Designation Code				Aperture Area, A _a (m ²)						
PRO 15/PRO+V15		1.51		8-V-1234S-7.2,1383-20.6,1060-D				1.36						
PRO 17/PRO+V17		1.68		10-V-1234S-7.2,1303-20.6,1240-D				1.52						
PRO 19/PRO+V19		1.96		11-V-1234S-7.2,1383-20.6,1370-D				1.79						
PRO 20/PRO+V20		2.02		8-V-1234S-7.2,1888-20.6,1060-D				1.83						
PRO 23/PRO+V23		2.24		10-V-1234S-7.2,1773-20.6,1240-D				2.05						
PRO 25/PRO+V25		2.52		11-V-1234S-7.2,1888-20.6,1310-D				2.32						
PRO 27/PRO+V27		2.67		10-V-1234S-7.2,2143-20.6,1240-D				2.46						
PRO 29/PRO+V29		2.92		12-V-1234S-7.2,1888-20.6,1510-D				2.71						
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 (η_{col})		57%				Zero-loss efficiency (η_0)		0.72		--				
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 9806:2017.				First-order coefficient (a ₁)		3.62		W/(m ² K)						
				Second-order coefficient (a ₂)		0.006		W/(m ² K ²)						
				Incidence angle modifier IAM (50°)		0.98		--						
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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