



Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results					Licence Number		SKM 10028																	
					Date issued		2018-10-31																	
					Issued by		DQS Hellas																	
Licence holder		MAGDALINI SAMOUIL & PARTNERS C.O.			Country		Greece																	
Brand (optional)		SIGMA			Web		www.sigma-sa.com																	
Street, Number		A' INDUSTRIAL AREA			E-mail		sigma@sigma-sa.com																	
Postcode, City		38500 VOLOS			Tel		+30 24210.66.551																	
Collector Type					Flat plate collector, glazed																			
Collector name					Gross area (A_G)		Gross length		Gross width		Gross height		Power output per collector $G_b = 850 \text{ W/m}^2$; $G_d = 150 \text{ W/m}^2$ $\vartheta_m - \vartheta_a$											
					m ²		mm		mm		mm		0 K		10 K		30 K		50 K		70 K		45 K	
Sigma Plus 15					1.43		1,465		980		75		997		945		828		691		534		727	
Sigma Plus 16					1.50		1,500		1,010		75		1,046		992		868		725		560		763	
Sigma Plus 20					1.94		1,960		990		75		1,352		1,282		1,123		937		725		987	
Sigma Plus 21					2.00		2,000		1,010		75		1,394		1,322		1,158		966		747		1,017	
Sigma Plus 23					2.24		1,960		1,145		75		1,561		1,481		1,297		1,082		837		1,139	
Sigma Plus 25					2.43		1,980		1,225		75		1,694		1,606		1,406		1,174		908		1,236	
Power output per m ² gross area													697		661		579		483		374		509	
Performance parameters test method					Steady state - outdoor																			
Performance parameters (related to AG)					$\eta_{0,hem}$		a1		a2															
Units					-		W/(m ² K)		W/(m ² K ²)															
Test results					0.697		3.430		0.017															
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					$K_{\theta T, coll}$								0.92										0.00	
Longitudinal					$K_{\theta L, coll}$								0.92										0.00	
Heat transfer medium for testing					Water																			
Flow rate for testing (per gross area, A_G)					dm/dt		0.022		kg/(sm ²)															
Maximum temperature difference for thermal performance calculations					$(\vartheta_m - \vartheta_a)_{max}$		44.94		K															
Standard stagnation temperature ($G = 1000 \text{ W/m}^2$; $\vartheta_a = 30 \text{ }^\circ\text{C}$)					ϑ_{stg}		148.45		°C															
Effective thermal capacity, incl. fluid (per gross area, A_G)					C/m^2		10.83		kJ/(Km ²)															
Maximum operating temperature					$\vartheta_{max, op}$		120		°C															
Maximum operating pressure					$p_{max, op}$		1000		kPa															
Testing laboratory		NCSR Demokritos / Solar & other Energy System Laboratory					www.solar.demokritos.gr																	
Test report(s)		4224 DE1 4225 DQ1 4227 DE1					Dated		11/7/2018 13/7/2018 11/7/2018															
Comments of testing laboratory					Datasheet version: 5.01, 2016-03-01																			
					N.C.S.R "DEMOKRITOS" SOLAR ENERGY LABORATORY Head: Dr Vassilis Belesiotis Tel: +210 6503815 - Fax: +210 6544599 153 16 Ag. Paraskevi - Attiki - Greece																			
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Annex to Solar Keymark Certificate Supplementary Information		Licence Number		SKM 10028									
		Issued		2018-10-31									
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
Sigma Plus 15		1,550	1,067	648	1,160	764	436	857	536	297	931	576	315
Sigma Plus 16		1,626	1,119	679	1,217	802	457	899	562	312	977	604	330
Sigma Plus 20		2,103	1,447	879	1,574	1,037	591	1,162	727	403	1,263	782	427
Sigma Plus 21		2,168	1,492	906	1,623	1,069	610	1,198	749	416	1,303	806	440
Sigma Plus 23		2,428	1,671	1,014	1,818	1,197	683	1,342	839	466	1,459	902	493
Sigma Plus 25		2,634	1,813	1,100	1,972	1,298	741	1,456	910	505	1,583	979	535
Annual output per m ² gross area		1,084	746	453	812	534	305	599	375	208	651	403	220
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)											A		--
Maximum tested positive load											2400		Pa
Maximum tested negative load											2400		Pa
Hail resistance using steel ball (maximum drop height)											2		m
Energy Labelling Information													
	Reference Area, A_{sol} (m ²)	Data required for CDR (EU) No 811/2013 - Reference Area A_{sol}											
Sigma Plus 15	1.43	Collector efficiency (η_{col})								53		%	
Sigma Plus 16	1.50	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.											
Sigma Plus 20	1.94												
Sigma Plus 21	2.00												
Sigma Plus 23	2.24												
Sigma Plus 25	2.43												
		Data required for CDR (EU) No 812/2013 - Reference Area A_{sol}											
		Zero-loss efficiency (η_0)								0.697		--	
		First-order coefficient (a_1)								3.43		W/(m ² K)	
		Second-order coefficient (a_2)								0.017		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.											
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