Annex to Solar Keymark Certificate

Licence Number	SKM 10126.1
Date issued	2022-07-26
Issued by	DQS Hellas

Licence holder	PAPAEMMANOUEL S.A.	Country	Greece
Brand (optional)		Web	www.papaemmanouel.gr
Street, Number	1o Km Inofyta – St. Thomas, Inofyta Viotia	E-mail	exports@papaemmanouel.gr
Postcode, City	32011, Viotia	Tel	+30 22620 31931

Collector Type	Flat plate 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 & u = 1.3 m/s $\vartheta_m - \vartheta_a$					
					0 K	10 K	30 K	50 K	70 K	91 K
	m²	mm	mm	mm	W	W	W	W	W	W
ASL-1.50m²	1.50	1,480	1,011	86	1,158	1,097	960	802	624	412
ASL-1.82m²	1.82	1,480	1,230	86	1,405	1,331	1,165	973	757	500
ASL-2.00m²	2.00	1,980	1,010	86	1,544	1,463	1,280	1,069	832	549
ASL-2.37m²	2.39	1,935	1,234	86	1,846	1,748	1,529	1,278	994	656
ASL-2.72m²	2.74	2,164	1,266	86	2,116	2,004	1,753	1,465	1,140	752
Power output per m² gross area					772	732	640	535	416	274

Performance parameters test method	Steady state - outdoor									
Performance parameters (related to A_G)	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	0.784	3.90	0.017	0.000	0.00	10,800	0.000	0.00	0.0E+00	0.90

Incidence angle modifier test method		Steady state - outdoor								
Incidence angle modifier	Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
Transversal	$K_{\theta T,coll}$	1.00	1.00	0.99	0.97	0.93	0.85	0.71	0.46	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	1.00	0.99	0.97	0.93	0.85	0.71	0.46	0.00

Heat transfer medium for testing		Water	
Flow rate for testing (per gross area, A_G)		dm/dt	0.021 kg/(sm²)
Maximum temperature difference during thermal performance test		$(\vartheta_m-\vartheta_a)_{max}$	61.3 K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)		ϑ_{stg}	187 °C
Maximum operating temperature		ϑ_{max_op}	180 °C
Maximum operating pressure		$p_{max,op}$	kPa

Testing laboratory	NCSR Demokritos / Solar & other Energy System	www.solar.demokritos.gr	
Test report(s)	4308 DE2 4309 DE1 4310 DQ2	Dated	23/09/21 03/08/21 23/09/21

Comments of testing laboratory	Ver. 6.2 (13.01.2022)

N.C.S.R. "DEMOKRITOS"
SOLAR ENERGY LABORATORY
Tel: +210 6503815 - Fax: +210 6544592
P.O. BOX 60037, 15310 Ag. Paraskevi, Greece

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Supplementary Information	Issued	2022-07-26

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
ASL-1.50m²		1,836	1,266	777	1,373	909	528	1,014	635	357	1,104	685	379
ASL-1.82m²		2,227	1,536	943	1,666	1,103	640	1,230	771	434	1,340	832	460
ASL-2.00m²		2,448	1,688	1,036	1,831	1,212	704	1,352	847	476	1,472	914	506
ASL-2.37m²		2,925	2,018	1,238	2,188	1,449	841	1,616	1,012	569	1,759	1,092	604
ASL-2.72m²		3,353	2,313	1,419	2,509	1,661	964	1,852	1,160	653	2,017	1,252	693
Gross Thermal Yield per m² gross area		1,224	844	518	916	606	352	676	423	238	736	457	253
Annual efficiency, η_a		69%	48%	29%	56%	37%	22%	58%	36%	20%	59%	37%	20%
Fixed or tracking collector		Fixed (slope = latitude - 15°; rounded to nearest 5°)											
Annual irradiation on collector plane		1765 kWh/m²			1630 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. 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/m²) >	1000	ϑ_a (°C) >	20	H_X (MJ/m²) >	600
Maximum tested positive load				3000	Pa
Maximum tested negative load				2000	Pa
Hail resistance using steel ball (maximum drop height)				1.8	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

	Reference Area, A_{sol} (m²)
ASL-1.50m²	1.50
ASL-1.82m²	1.82
ASL-2.00m²	2.00
ASL-2.37m²	2.39
ASL-2.72m²	2.74

Data required for CDR (EU) No 811/2013 - Reference Area

Collector efficiency (η_{col})	59%

Remark: Collector efficiency (ηcol) 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 ηcol is based on reference area (Asol) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017.

Additional Informative Technical Data

Hydraulic Designation Code	Aperture Area, A_a (m²)
10-V-1234S-A:7.2,1380-C:20.6,1080-	1.39
12-V-1234S-A:7.2,1380-C:20.6,1300-	1.72
12-V-1234S-A:7.2,1880-C:20.6,1080-	1.87
14-V-1234S-A:7.2,1830-C:20.6,1300-	2.24
12-V-1234S-A:7.2,2060-C:20.6,1330-	2.55

Data required for CDR (EU) No 812/2013 - Reference Area A_{sol}

Zero-loss efficiency (η_0)	0.77	--
First-order coefficient (a_1)	3.90	W/(m²K)
Second-order coefficient (a_2)	0.017	W/(m²K²)
Incidence angle modifier IAM (50°)	0.94	--

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.