Annex to Solar Keymark Certificate

Licence Number	**SKM9999/2**
Date issued	**2022-07-27**
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	89 K
	m²	mm	mm	mm	W	W	W	W	W	W
FMAX_2.72	2.72	2,160	1,260	86	2,107	2,018	1,821	1,597	1,348	1,093
FMAX_2.72H	2.72	1,260	2,160	86	2,107	2,018	1,821	1,597	1,348	1,093
Power output per m² gross area					775	742	669	587	495	402

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	3.15	0.012	0.000	0.00	9,720	0.000	0.00	0.0E+00	0.92

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	1.00	0.99	0.96	0.90	0.78	0.52	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	1.00	1.00	0.99	0.96	0.90	0.78	0.52	0.00

Heat transfer medium for testing		Water	
Flow rate for testing (per gross area, A_G)	dm/dt	0.022	kg/(sm²)
Maximum temperature difference during thermal performance test	$(\vartheta_m-\vartheta_a)_{max}$	58.5	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	190.5	°C
Maximum operating temperature	ϑ_{max_op}	200	°C
Maximum operating pressure	$p_{max,op}$	1000	kPa

Testing laboratory	NCSR Demokritos / Solar & other Energy System	www.solar.demokritos.gr	
Test report(s)	4196DE2 4197DQ3	**Dated**	16/11/16 2-6-20217

Comments of testing laboratory Ver. 6.2 (13.01.2022)

N.C.S.R. "DEMOKRITOS"
SOLAR ENERGY LABORATORY
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Supplementary Information	Issued	2022-07-27

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
FMAX_2.72		3,422	2,564	1,786	2,673	1,943	1,310	1,954	1,349	874	2,121	1,461	932
FMAX_2.72H		3,422	2,564	1,786	2,673	1,943	1,310	1,954	1,349	874	2,121	1,461	932
Gross Thermal Yield per m² gross area		1,258	942	657	983	714	482	718	496	321	780	537	343
Annual efficiency, η_a		71%	53%	37%	60%	44%	30%	62%	43%	28%	63%	43%	28%
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				3000	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

	Reference Area, A_{sol} (m²)
FMAX_2.72	2.72
FMAX_2.72H	2.72

Additional Informative Technical Data

Hydraulic Designation Code	Aperture Area, A_a (m²)
11-V-1234S-A:7.2,2060-C:20.6,1320-	2.57
18-V-1234S-A:7.2,1158-C:20.6,2240-	2.57

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

Collector efficiency (η_{col})	63%

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.

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

Zero-loss efficiency (η_0)	0.77	--
First-order coefficient (a_1)	3.15	W/(m²K)
Second-order coefficient (a_2)	0.012	W/(m²K²)
Incidence angle modifier IAM (50°)	0.96	--

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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