Annex to Solar Keymark Certificate

Licence Number	**SKM 10087**
Date issued	**2022-07-28**
Issued by	**DQS Hellas**

Licence holder	**PAPAEMMANOUEL S.A.**	**Country**	Greece
Brand (optional)	MTEC-2.72	**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	85 K
	m²	mm	mm	mm	W	W	W	W	W	W
MTEC-2.72V	2.73	2,162	1,261	101	2,220	2,119	1,904	1,671	1,420	1,220
MTEC-2.72H	2.73	2,162	1,261	101	2,220	2,119	1,904	1,671	1,420	1,220
Power output per m² gross area					813	776	697	612	520	447

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	0.820	3.61	0.008	0.000	0.00	8542	0.000	0.00	0.0E+00	0.94

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	0.84	0.69	0.44	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	1.00	0.99	0.97	0.93	0.84	0.69	0.44	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	$(\vartheta_m-\vartheta_a)_{max}$	55	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	200	°C
Maximum operating temperature	ϑ_{max_op}	210	°C
Maximum operating pressure	$p_{max,op}$	1000	kPa

Testing laboratory	NCSR Demokritos / Solar & other Energy System	www.solar.demokritos.gr	
Test report(s)	4248 DQ1 4254 DE1	**Dated**	01/08/19 11/07/19

Comments of testing laboratory Ver. 6.2 (13.01.2022)

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Supplementary Information	Issued	2022-07-28

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
MTEC-2.72V	3,569	2,628	1,831	2,756	1,989	1,355	2,018	1,377	899	2,196	1,492	959
MTEC-2.72H	3,569	2,628	1,831	2,756	1,989	1,355	2,018	1,377	899	2,196	1,492	959
Gross Thermal Yield per m² gross area	1,307	963	671	1,010	729	496	739	505	329	805	547	351
Annual efficiency, η_a	74%	55%	38%	62%	45%	30%	63%	43%	28%	65%	44%	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)
MTEC-2.72V	2.73
MTEC-2.72H	2.73

Additional Informative Technical Data

	Hydraulic Designation Code	Aperture Area, A_a (m²)
MTEC-2.72V	2-H-1234S-A:7.2,38500-	2.57
MTEC-2.72H	2-H-1234S-A:7.2,37600-	2.57

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

Collector efficiency (η_{col})	66%

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)	0.81	--
First-order coefficient (a_1)	3.61	W/(m²K)
Second-order coefficient (a_2)	0.008	W/(m²K²)
Incidence angle modifier IAM (50°)	0.93	--

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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