Annex to Solar Keymark Certificate

Licence Number	**SKM 10109.2**
Date issued	**2020-12-10**
Issued by	**DQS Hellas**

Licence holder	**VENMAN S.A.**	**Country**	Greece
Brand (optional)		**Web**	http://www.venman.gr
Street, Number	7th Km Old National Road Thessaloniki –	**E-mail**	info@venman.gr
Postcode, City	57022, Thessaloniki	**Tel**	+30 2310 784684

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
H86 2.0	1.91	1,970	968	80	1,401	1,308	1,098	859	588	298
H86 2.5	2.40	1,971	1,217	80	1,760	1,643	1,380	1,079	739	375
Power output per m² gross area					734	685	575	450	308	156

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	0.743	4.68	0.020	0.000	0.00	0	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	0.98	0.95	0.89	0.76	0.51	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	1.00	1.00	0.98	0.95	0.89	0.76	0.51	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	$(\vartheta_m-\vartheta_a)_{max}$	59.3	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	169	°C
Maximum operating temperature	ϑ_{max_op}		°C
Maximum operating pressure	$p_{max,op}$		kPa

Testing laboratory	NCSR Demokritos	http://www.solar.demokritos.gr	
Test report(s)	4285 DQ3 4289 DE3 4300 DE1	**Dated**	17/12/2020 21/1/2021 25/11/2020

Comments of testing laboratory

Datasheet version: 6.1, 2019-09-26

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Supplementary Information	Issued	2020-12-10

Annual collector output 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
H86 2.0		2,226	1,397	735	1,584	939	444	1,185	664	310	1,297	715	331
H86 2.5		2,797	1,755	923	1,990	1,180	558	1,489	834	390	1,630	898	416
Annual output per m² gross area		1,165	731	385	829	492	232	621	348	162	679	374	173
Annual efficiency, η_a		66%	41%	22%	51%	30%	14%	53%	30%	14%	55%	30%	14%
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. 6.1 (September 2019). 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
☐ Active or passive measure(s) for self-protection
☐ Co-generating thermal and electrical power
☐ Façade collector(s)

Energy Labelling Information

	Reference Area, A_{sol} (m²)
H86 2.0	1.91
H86 2.5	2.40

Additional Informative Technical Data

Hydraulic Designation Code	Aperature Area, A_a (m²)
13-VH-1234S-A:7.2,1890-C:20,1030-	1.80
16-VH-1234S-A:7.2,1890-C:20,1280-	2.29

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

Collector efficiency (η_{col})	51%

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)	0.73	--
First-order coefficient (a_1)	4.68	W/(m²K)
Second-order coefficient (a_2)	0.020	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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