



Annex to Solar Keymark Certificate					Licence Number		OEM 9965/1/3							
					Date issued		2023-08-10							
					Issued by		DQS Hellas							
Licence holder		MBM GROUP S.R.L.			Country		Italy							
Brand (optional)					Web									
Street, Number		Via di Vorno, 4			E-mail		info@zenithsolare.it							
Postcode, City		55060 Capannori (LU)			Tel		+390 0583 25028							
Collector Type					Flat plate collector									
Collector name					Power output per collector									
					Gb = 850 W/m <sup>2</sup> , Gd = 150 W/m <sup>2</sup> & u = 1.3 m/s $\vartheta_m - \vartheta_a$									
					0 K	10 K	30 K	50 K	70 K	76 K				
					m <sup>2</sup>	mm	mm	mm	mm	mm	mm			
STAR 1500					1,52	1.510	1.010	110	1.054	992	860	718	567	520
STAR 2000					2,03	2.010	1.010	110	1.408	1.325	1.148	959	757	694
STAR 2600					2,53	2.010	1.270	110	1.755	1.651	1.431	1.196	944	865
Power output per m <sup>2</sup> gross area					694	653	566	473	373	342				
Performance parameters test method					Steady state - outdoor									
Performance parameters (related to A <sub>G</sub> )					$\eta_0, b$	a1	a2	a3	a4	a5	a6	a7	a8	Kd
Units					-	W/(m <sup>2</sup> K)	W/(m <sup>2</sup> K <sup>2</sup> )	J/(m <sup>3</sup> K)	-	J/(m <sup>2</sup> K)	s/m	W/(m <sup>2</sup> K <sup>4</sup> )	W/(m <sup>2</sup> K <sup>4</sup> )	-
Test results					0,704	4,02	0,008	0,000	0,00	7.860	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	0,98	0,94	0,87	0,73	0,48	0,00
Longitudinal					$K_{\theta L, coll}$	1,00	1,00	0,99	0,98	0,94	0,87	0,73	0,48	0,00
Heat transfer medium for testing					Water									
Flow rate for testing (per gross area, A <sub>G</sub> )					dm/dt		0,022	kg/(sm <sup>2</sup> )						
Maximum temperature difference during thermal performance test					$(\vartheta_m - \vartheta_a)_{max}$		46	K						
Standard stagnation temperature (G = 1000 W/m <sup>2</sup> ; $\vartheta_a = 30$ °C)					$\vartheta_{stg}$		174	°C						
Maximum operating temperature					$\vartheta_{max, op}$		100	°C						
Maximum operating pressure					$p_{max, op}$		1000	kPa						
Testing laboratory					NCSR Demokritos			www.solar.demokritos.gr						
Test report(s)					4188DE1 4189DE1 4023DQ2, 4046DQ2			Dated		27/7/2016 27/7/2016 5/9/2013				
Comments of testing laboratory					Ver. 6.2 (13.01.2022)									
Central Offices: Kalavriton 2, 145 64 kifisia, Athens, Tel: +30 210 6233493-4 , Fax: +30 210 6233495, http://www.dqs.gr, e-mail: i.alexou@dqs.gr														



Annex to Solar Keymark Certificate Supplementary Information	Licence Number	OEM 9965/1/3
	Issued	2023-08-10

Gross Thermal Yield in kWh/collector at mean fluid temperature $\vartheta_m$													
Collector name	$\vartheta_m$	Athens			Davos			Stockholm			Würzburg		
		25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C
STAR 1500		1.670	1.121	689	1.226	804	478	908	559	319	990	602	338
STAR 2000		2.230	1.497	920	1.638	1.074	638	1.213	746	426	1.322	804	452
STAR 2600		2.779	1.866	1.147	2.041	1.339	796	1.511	930	531	1.648	1.002	563
Gross Thermal Yield per m <sup>2</sup> gross area		1.099	737	453	807	529	314	597	368	210	651	396	222
Annual efficiency, $\eta_a$		62%	42%	26%	49%	32%	19%	51%	32%	18%	52%	32%	18%
Fixed or tracking collector		Fixed (slope = latitude - 15°; rounded to nearest 5°)											
Annual irradiation on collector plane		1765 kWh/m <sup>2</sup>			1630 kWh/m <sup>2</sup>			1166 kWh/m <sup>2</sup>			1244 kWh/m <sup>2</sup>		
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  $\vartheta_m$  (mean of in- and outlet temperatures). The calculation of the annual collector performance is performed with the official Solar Keymark spreadsheet tool Scenocalc Ver. 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/m <sup>2</sup> ) >	1000	$\vartheta_a$ (°C) >	20
		$H_x$ (MJ/m <sup>2</sup> ) >	600
Maximum tested positive load	1000	Pa	
Maximum tested negative load	1000	Pa	
Hail resistance using steel ball (maximum drop height)	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		Additional Informative Technical Data	
	Reference Area, $A_{sol}$ (m <sup>2</sup> )	Hydraulic Designation Code	Aperture Area, $A_a$ (m <sup>2</sup> )
STAR 1500	1,52	10-V-1234S-A:7.2,1342-C:20.6,1060-D	1,34
STAR 2000	2,03	10-V-1234S-A:7.2,1842-C:20.6,1060-D	1,81
STAR 2600	2,53	13-V-1234S-A:7.2,1842-C:20.6,1320-D	2,32

Data required for CDR (EU) No 811/2013 - Reference Area $A_{sol}$		Data required for CDR (EU) No 812/2013 - Reference Area $A_{sol}$	
Collector efficiency ( $\eta_{col}$ )	52%	Zero-loss efficiency ( $\eta_0$ )	0,69
Remark: Collector efficiency ( $\eta_{col}$ ) 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 <sup>2</sup> , expressed in % and rounded to the nearest integer. Deviating from the regulation $\eta_{col}$ is based on reference area ( $A_{sol}$ ) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017.		First-order coefficient ( $a_1$ )	4,02
		Second-order coefficient ( $a_2$ )	0,008
		Incidence angle modifier IAM (50°)	0,94
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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.			