



Annex to Solar Keymark Certificate	Licence Number	OEM 9965.1.3
	Date issued	2024-08-10
	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	Gross area (A_G) m ²	Gross length mm	Gross width mm	Gross height mm	Power output per collector G _b = 850 W/m ² , G _d = 150 W/m ² & u = 1.3 m/s $\vartheta_m - \vartheta_a$					
					0 K	10 K	30 K	50 K	70 K	76 K
					W	W	W	W	W	W
STAR 1500	1,52	1.510	1.010	110	1.054	992	860	718	567	520
STARCS 2000	2,03	2.010	1.010	110	1.408	1.325	1.148	959	757	694
STARCS 2600	2,53	2.010	1.270	110	1.755	1.651	1.431	1.196	944	865
Power output per m ² gross area					694	653	566	473	373	342

Performance parameters test method	Steady state - outdoor									
Performance parameters (related to A_G)	η_0 , b	a1	a2	a3	a4	a5	a6	a7	a8	Kd
Units	-	W/(m ² K)	W/(m ² K ²)	J/(m ³ K)	-	J/(m ² K)	s/m	W/(m ² K ⁴)	W/(m ² K ⁴)	-
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_G)	dm/dt	0,022 kg/(sm ²)
Maximum temperature difference during thermal performance test	$(\vartheta_m - \vartheta_a)_{max}$	46 K
Standard stagnation temperature (G = 1000 W/m ² ; ϑ_a = 30 °C)	ϑ_{stg}	174 °C
Maximum operating temperature	$\vartheta_{max, op}$	100 °C
Maximum operating pressure	$\rho_{max, op}$	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)
--------------------------------	-----------------------



Annex to Solar Keymark Certificate Supplementary Information	Licence Number	OEM 9965.1.3
	Issued	2024-08-10

Gross Thermal Yield in kWh/collector at mean fluid temperature ϑ_m													
Collector name	Standard Locations ϑ_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
STARCS 2000		2.230	1.497	920	1.638	1.074	638	1.213	746	426	1.322	804	452
STARCS 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 ² gross area		1.099	737	453	807	529	314	597	368	210	651	396	222
Annual efficiency, η_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 ²			1630 kWh/m ²			1166 kWh/m ²			1244 kWh/m ²		
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 ϑ_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 ²) >	1000	ϑ_a (°C) >	20	H_x (MJ/m ²) >	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 ²)	Hydraulic Designation Code	Aperture Area, A_a (m ²)
STAR 1500	1,52	10-V-1234S-A:7.2,1342-C:20.6,1060-D	1,34
STARCS 2000	2,03	10-V-1234S-A:7.2,1842-C:20.6,1060-D	1,81
STARCS 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 (η_{col})	52%	Zero-loss efficiency (η_0)	0,69
Remark: Collector efficiency (η_{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 ² , expressed in % and rounded to the nearest integer. Deviating from the regulation η_{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
			--
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.			