



Annex to Solar Keymark Certificate					Licence Number		SKM 10107.1												
					Date issued		2021-07-10												
					Issued by		DQS Hellas												
Licence holder		NOBEL INTERNATIONAL EAD			Country		BULGARIA												
Brand (optional)		SOLFOS			Web		http://nobel.bg												
Street, Number		48, VITOSHA BLV			E-mail		info@nobel.bg												
Postcode, City		2100 ELIN PELIN			Tel		+359 2 4210232												
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 θ _m - θ _a										
									0 K	10 K	30 K	50 K	70 K	87 K					
Solfos CuS 2000					2.01	2,002	1,005	63	1,449	1,378	1,208	1,000	752	512					
Solfos CuS 2300					2.27	2,002	1,132	63	1,636	1,556	1,364	1,129	850	578					
Solfos CuS 2600					2.53	2,002	1,266	63	1,824	1,735	1,521	1,258	947	644					
Power output per m² gross area									721	686	601	497	374	255					
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		0.741	3.27	0.024	0.000	0.00	0	0.000	0.00	0.0E+00	0.82								
Incidence angle modifier test method		Quasi dynamic - outdoor																	
Incidence angle modifier		Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°								
Transversal		K _{θT, coll}	1.00	0.99	0.96	0.92	0.85	0.74	0.58	0.35	0.00								
Longitudinal		K _{θL, coll}	1.00	0.99	0.96	0.92	0.85	0.74	0.58	0.35	0.00								
Heat transfer medium for testing		Water																	
Flow rate for testing (per gross area, A_G)		dm/dt	0.021	kg/(sm ²)															
Maximum temperature difference during thermal performance test		(θ _m -θ _a) _{max}	57	K															
Standard stagnation temperature (G = 1000 W/m²; θ_a = 30 °C)		θ _{stg}	158	°C															
Maximum operating temperature		θ _{max, op}	180	°C															
Maximum operating pressure		p _{max, op}	1000	kPa															
Testing laboratory		NCSR Demokritos									www.solar.demokritos.gr								
Test report(s)		4286 DQ3 4291 DE3 4292 DE3									Dated 06/07/21 06/07/21 06/07/21								
Comments of testing laboratory		Datasheet version: 6.1, 2019-09-26																	
		<p>N.C.S.R. "DEMOKRITOS" SOLAR ENERGY LABORATORY Tel: +210 6503815 - Fax: +210 6544592 P.O. BOX 60037, 15310 Ag. Paraskevi, Greece</p>																	
<p>Central Offices: Kalavriton 4, 145 64 kifisia, Athens, Tel: +301 6233493-4 , Fax: +301 6233495, http://www.dqs.gr, e-mail: i.alexiou@dqs.gr</p>																			



Annex to Solar Keymark Certificate Supplementary Information	Licence Number	SKM 10107.1
	Issued	2021-07-10

Annual collector output in kWh/collector at mean fluid temperature ϑ_m															
Collector name	Standard Locations			Athens			Davos			Stockholm			Würzburg		
	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		
Solfos CuS 2000		2,165	1,483	868	1,626	1,052	569	1,201	742	397	1,302	795	416		
Solfos CuS 2300		2,445	1,675	981	1,837	1,188	642	1,357	838	448	1,470	897	470		
Solfos CuS 2600		2,725	1,867	1,093	2,047	1,324	716	1,512	934	499	1,638	1,000	523		
Annual output per m ² gross area		1,077	738	432	809	524	283	598	369	197	648	395	207		
Annual efficiency, η_a		61%	42%	24%	50%	32%	17%	51%	32%	17%	52%	32%	17%		
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. 6.1 (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/m ²) >	1000	ϑ_a (°C) >	20	H_x (MJ/m ²) >	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)	
<input type="checkbox"/> Using external power source(s) for normal operation	<input type="checkbox"/> Active or passive measure(s) for self-protection
<input type="checkbox"/> Co-generating thermal and electrical power	<input type="checkbox"/> Façade collector(s)

Energy Labelling Information		Additional Informative Technical Data	
	Reference Area, A_{sol} (m ²)	Hydraulic Designation Code	Aperture Area, A_a (m ²)
Solfos CuS 2000	2.01	7-VH-1234S-A:7.2,1842-C:20.6,1060-	1.85
Solfos CuS 2300	2.27	9-VH-1234S-A:7.2,1842-C:20.6,1190-	2.10
Solfos CuS 2600	2.53	10-VH-1234S-A:7.2,1842-	2.36

Data required for CDR (EU) No 811/2013 - Reference Area	Data required for CDR (EU) No 812/2013 - Reference Area A_{sol}		
Collector efficiency (η_{col})	55%		
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.	Zero-loss efficiency (η_0)	0.72	--
	First-order coefficient (a_1)	3.27	W/(m ² K)
	Second-order coefficient (a_2)	0.024	W/(m ² K ²)
	Incidence angle modifier IAM (50°)	0.84	--
	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.		