

Annex to Solar Keymark Certificate					Licence Number		011-7S3191 F				
					Date issued		2023-06-26				
					Issued by		DIN CERTCO				
Licence holder		THEROS E.E.			Country		Greece				
Brand (optional)					Web		www.theros.gr				
Street, Number		Ioanni Karavela Str			E-mail		pxanthakos@theros.gr				
Postcode, City		31100 Lefkada			Tel		+30 697 770 5395				
Collector Type					Flat plate collector						
Collector name	Gross area (A_G)	Gross length	Gross width	Gross height	Power output per collector						
					G _b = 850 W/m ² , G _d = 150 W/m ² & u = 1.3 m/s						
					$\vartheta_m - \vartheta_a$						
	m ²	mm	mm	mm	0 K	10 K	30 K	50 K	70 K	112 K	
					W	W	W	W	W	W	
TTA 151H	1.51	1.503	1.007	85	1.093	1.037	921	797	666	367	
TTA 171H	1.68	1.420	1.183	85	1.216	1.154	1.024	886	741	408	
TTA 191H	1.96	1.503	1.305	85	1.419	1.346	1.195	1.034	864	476	
TTA 201H	2.02	2.006	1.007	85	1.462	1.388	1.232	1.066	890	490	
TTA 231H	2.24	1.893	1.183	85	1.621	1.539	1.366	1.182	987	544	
TTA 251H	2.52	2.006	1.257	85	1.824	1.731	1.536	1.330	1.111	612	
TTA 271H	2.67	2.261	1.183	85	1.933	1.834	1.628	1.409	1.177	648	
TTA 291H	2.92	2.006	1.457	85	2.114	2.006	1.780	1.541	1.287	709	
Power output per m² gross area					724	687	610	528	441	243	
Performance parameters test method		Quasi dynamic									
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		0.725	3.62	0.006	0.000	0.00	13.660	0.000	0.00	0.00	0.99
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	1.00	1.00	0.99	0.96	0.87	0.63	0.32	0.00
Longitudinal		K _{θL, coll}	1.00	1.00	1.00	0.99	0.96	0.87	0.63	0.32	0.00
Heat transfer medium for testing					Water						
Flow rate for testing (per gross area, A_G)					dm/dt		0.020		kg/(sm ²)		
Maximum temperature difference during thermal performance test					$(\vartheta_m - \vartheta_a)_{max}$		82		K		
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)					ϑ_{stg}		230		°C		
Maximum operating temperature					$\vartheta_{max, op}$		-		°C		
Maximum operating pressure					p _{max, op}		1000		kPa		
Testing laboratory		Institut für Gebäudeenergetik, Thermotechnik und Energiespeicherung (IGTE)					http://www.igte.uni-stuttgart.de				
Test report(s)		21COL1631OEM16 21COL1631QOEM16 21COL1632OEM16					Dated		12.06.2023 12.06.2023 12.06.2023		
Comments of testing laboratory					Ver. 6.2 (13.01.2022)						
Documented performance parameters are taken from 21COL1632OEM16 (TTA 151H)					 Forschungs- und Testzentrum für Solaranlagen Institut für Thermodynamik und Wärmetechnik Universität Stuttgart Pfaffenwaldring 6, 70569 Stuttgart (Vaihingen)						
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Supplementary Information							Issued			2023-06-26			
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
TTA 151H		1.091	719	449	1.091	719	449	1.091	719	449	1.091	719	449
TTA 171H		1.994	1.431	967	1.514	1.066	707	1.109	736	466	1.214	800	500
TTA 191H		2.327	1.669	1.128	1.767	1.244	825	1.294	859	544	1.416	934	583
TTA 201H		2.398	1.720	1.163	1.821	1.282	850	1.334	885	560	1.460	962	601
TTA 231H		2.659	1.907	1.289	2.019	1.421	942	1.479	981	621	1.618	1.067	666
TTA 251H		2.992	2.146	1.451	2.272	1.599	1.060	1.664	1.104	699	1.821	1.200	750
TTA 271H		3.170	2.273	1.537	2.407	1.694	1.123	1.763	1.170	741	1.929	1.272	794
TTA 291H		3.466	2.486	1.681	2.632	1.853	1.228	1.928	1.279	810	2.110	1.391	869
Gross Thermal Yield per m² gross area		1.187	851	576	901	635	421	660	438	277	723	476	298
Annual efficiency, η_a		67%	48%	33%	55%	39%	26%	57%	38%	24%	58%	38%	24%
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 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/m²) >	1000	ϑ_a (°C) >			20			H_x (MJ/m²) >			600		
Maximum tested positive load										2750		Pa	
Maximum tested negative load										2400		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					Additional Informative Technical Data								
	Reference Area, A_{sol} (m²)				Hydraulic Designation Code					Aperture Area, A_a (m²)			
TTA 151H	1.51				8-V-1234S-7.2,1383-20.6,1060-D					1.36			
TTA 171H	1.68				10-V-1234S-7.2,1303-20.6,1240-D					1.52			
TTA 191H	1.96				11-V-1234S-7.2,1383-20.6,1370-D					1.79			
TTA 201H	2.02				8-V-1234S-7.2,1888-20.6,1060-D					1.83			
TTA 231H	2.24				10-V-1234S-7.2,1773-20.6,1240-D					2.05			
TTA 251H	2.52				11-V-1234S-7.2,1888-20.6,1310-D					2.32			
TTA 271H	2.67				10-V-1234S-7.2,2143-20.6,1240-D					2.46			
TTA 291H	2.92				12-V-1234S-7.2,1888-20.6,1510-D					2.71			
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})		57%			Zero-loss efficiency (η_0)					0.72		--	
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/m², 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)					3.62		W/(m²K)	
					Second-order coefficient (a_2)					0.006		W/(m²K²)	
					Incidence angle modifier IAM (50°)					0.98		--	
					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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