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IGTE

Annex to Solar Keymark Certificate		Licence Number	011-7S2921 P
		Date issued	2024-02-20
		Issued by	DINCERTCO

Licence holder	**Triple Solar BV**	**Country**	Netherlands
Brand (optional)		**Web**	https://triplesolar.eu/
Street, Number	Programmeurstraat 6-B	**E-mail**	renate.van.drimmelen@triplesolar.e
Postcode, City	NL 1033 MT Amsterdam	**Tel**	+31 651844927

Collector Type	WISC (Wind and/or infrared sensitive 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	40 K
	m²	mm	mm	mm	W	W	W	W	W	W
PVT heat pump panel 410 P	2.00	1 730	1 156	53	767	115	0	--	--	0
PVT heat pump panel 410 L	1.99	1 143	1 743	53	763	115	0	--	--	0
PVT heat pump panel 500 XL	2.42	1 143	2 115	53	927	139	0	--	--	0
Power output per m² gross area					383	58	0	--	--	0

Performance parameters test method	Quasi dynamic									
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	0.329	40.94	0.000	4.928	0.14	42 730	0.045	0.00	0.0E+00	0.83

Incidence angle modifier test method		Quasi dynamic - 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	1.00	1.00	1.00	1.00	0.50	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50	0.00

Heat transfer medium for testing	Water		
Flow rate for testing (per gross area, A_G)	dm/dt	0.020	kg/(sm²)
Maximum temperature difference during thermal performance test	$(\vartheta_m-\vartheta_a)_{max}$	10	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	70	°C
Maximum operating temperature	$\vartheta_{max\ op}$	80	°C
Maximum operating pressure	$p_{max,op}$	600	kPa

Testing laboratory	Institut für Gebäudeenergetik, Thermotechnik und Energiespeicherung (IGTE)	http://www.igte.uni-stuttgart.de	
Test report(s)	23COL1710 23COL1711 23COL1711Q	**Dated**	09.02.2024 09.02.2024 09.02.2024

Comments of testing laboratory Ver. 6.2 (13.01.2022)

Documented performance parameters are taken from 23COL1710
(PVT heat pump panel 410 P)

TZS Forschungs- und Testzentrum für Solaranlagen
Institut für Thermodynamik und Wärmetechnik
Universität Stuttgart
Pfaffenwaldring 6, 70550 Stuttgart (Vaihingen)

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Supplementary Information	Issued	2024-02-20

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
PVT heat pump panel 410 P		1 115			54			149			212		
PVT heat pump panel 410 L		1 109			53			148			211		
PVT heat pump panel 500 XL		1 349			65			180			257		
Gross Thermal Yield per m² gross area		557	--	--	27	--	--	75	--	--	106	--	--
Annual efficiency, η_a		32%	--	--	2%	--	--	6%	--	--	9%	--	--
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. 6.2 (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					3250	Pa
Maximum tested negative load					2750	Pa
Hail resistance using steel ball (maximum drop height)					1.2	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

	Reference Area, A_{sol} (m²)
PVT heat pump panel 410 P	2.00
PVT heat pump panel 410 L	1.99
PVT heat pump panel 500 XL	2.42

Data required for CDR (EU) No 811/2013 - Reference Area A_{sol}

Collector efficiency (η_{col})	-92%

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.

Additional Informative Technical Data

	Hydraulic Designation Code	Aperture Area, A_a (m²)
PVT heat pump panel 410 P	1-H-1234S-11.4,23120-20.5,1151-D	2.00
PVT heat pump panel 410 L	1-H-1234S-11.4,20630-20.5,1739-D	1.99
PVT heat pump panel 500 XL	1-H-1234S-11.4,25260-20.5,2111-D	2.42

Data required for CDR (EU) No 812/2013 - Reference Area A_{sol}

Zero-loss efficiency (η_0)	0.38	--
First-order coefficient (a_1)	32.56	W/(m²K)
Second-order coefficient (a_2)	0.000	W/(m²K²)
Incidence angle modifier IAM (50°)	0.97	--

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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