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Fraunhofer ISE
TestLab Solar Thermal Systems

Annex to Solar Keymark Certificate		Licence Number	011-7S3160 R
		Date issued	2022-12-15
		Issued by	DIN CERTCO

Licence holder	**Sunex S.A.**	**Country**	Polen
Brand (optional)		**Web**	www.sunex.pl
Street, Number	ul.Piaskowa 7	**E-mail**	piotrfelinski@sunex.pl
Postcode, City	47-400, Raciborz	**Tel**	+48 32 414 92 12

Collector Type	Evacuated tubular 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	120 K
	m²	mm	mm	mm	W	W	W	W	W	W
HP30	4,89	1.990	2.455	182	1.327	1.283	1.192	1.097	998	734
HP22	3,61	1.990	1.920	182	980	947	880	810	737	542
Power output per m² gross area					271	262	244	224	204	150

Performance parameters test method	Steady state - outdoor									
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	0,272	0,89	0,001	0,000	0,00	15.700	0,000	0,00	0,0E+00	0,99

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	1,07	1,14	1,27	1,13	0,90	0,50	0,00
Longitudinal	$K_{\theta L,coll}$	1,00	1,00	0,99	0,97	0,93	0,85	0,71	0,46	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	$(\vartheta_m-\vartheta_a)_{max}$	90	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	220	°C
Maximum operating temperature	ϑ_{max_op}	150	°C
Maximum operating pressure	$p_{max,op}$	600	kPa

Testing laboratory	TestLab Solar Thermal Systems, Fraunhofer ISE	http://www.collectortest.com	
Test report(s)	ktb-2022-11 ktb-2022-12	**Dated**	14.12.2022 14.12.2022

Comments of testing laboratory Ver. 6.2 (13.01.2022)

The incidence angle modifier is given for hemispherical values (Khem)

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Supplementary Information	Issued	2022-12-15

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
HP30		2.335	1.908	1.530	1.898	1.533	1.220	1.381	1.073	825	1.493	1.159	883
HP22		1.724	1.408	1.130	1.401	1.132	901	1.020	792	609	1.102	856	652
Gross Thermal Yield per m² gross area		477	390	313	388	314	250	282	219	169	305	237	181
Annual efficiency, η_a		27%	22%	18%	24%	19%	15%	24%	19%	14%	25%	19%	15%
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)				B	--
G (W/m²) >	900	ϑ_a (°C) >	15	H_X (MJ/m²) >	540
Maximum tested positive load				1500	Pa
Maximum tested negative load				-	Pa
Hail resistance using ice balls (diameter)				25	mm

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)
HP30	4,89
HP22	3,61

Additional Informative Technical Data

Hydraulic Designation Code	Aperture Area, A_a (m²)
1-H-30S-C:20,2550	3,57
1-H-22S-C:20,1910	2,60

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

Collector efficiency (η_{col})	23%

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.

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

Zero-loss efficiency (η_0)	0,27	--
First-order coefficient (a_1)	0,89	W/(m²K)
Second-order coefficient (a_2)	0,001	W/(m²K²)
Incidence angle modifier IAM (50°)	1,09	--

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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