


Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results						Licence Number		<b>011-7S2651 R</b>				
						Date issued		<b>2016-06-07</b>				
						Issued by		TÜV Rheinland Energy GmbH				
Licence holder		<b>SUNEX S.A.</b>				Country		Poland				
Brand (optional)		SUNEX				Web		<a href="http://www.sunex.pl">http://www.sunex.pl</a>				
Street, Number		ul. Piaskowa 7				E-mail		michaelkamac@sunex.pl				
Postcode, City		47-400 Racibórz				Tel		+48 32 414 92 14				
Collector Type						Evacuated tubular collector						
Collector name	Gross area (A <sub>G</sub> ) m <sup>2</sup>	Gross length mm	Gross width mm	Gross height mm	Power output per collector G <sub>b</sub> = 850 W/m <sup>2</sup> ; G <sub>d</sub> = 150 W/m <sup>2</sup> ; u = 3 m/s θ <sub>m</sub> - θ <sub>a</sub>							
					0 K	10 K	30 K	50 K	70 K	80 K		
					W	W	W	W	W	W		
HP 12	2.02	1 990	1 015	182	872	846	790	726	657	619		
HP 13	2.18	1 990	1 095	182	941	913	852	784	709	669		
HP 14	2.34	1 990	1 175	182	1 010	980	915	841	761	718		
HP 15	2.50	1 990	1 255	182	1 079	1 047	977	899	813	767		
HP 16	2.66	1 990	1 335	182	1 149	1 114	1 040	956	865	816		
HP 17	2.82	1 990	1 415	182	1 218	1 181	1 102	1 014	917	865		
HP 18	2.98	1 990	1 495	182	1 287	1 248	1 165	1 072	969	914		
HP 19	3.13	1 990	1 575	182	1 351	1 311	1 223	1 125	1 018	960		
HP 20	3.29	1 990	1 655	182	1 421	1 378	1 286	1 183	1 070	1 009		
HP 21	3.45	1 990	1 735	182	1 490	1 445	1 348	1 241	1 122	1 058		
HP 22	3.61	1 990	1 815	182	1 559	1 512	1 411	1 298	1 174	1 107		
HP 23	3.77	1 990	1 895	182	1 628	1 579	1 474	1 356	1 226	1 156		
HP 24	3.93	1 990	1 975	182	1 697	1 646	1 536	1 413	1 278	1 205		
HP 26	4.25	1 990	2 135	182	1 835	1 780	1 661	1 528	1 382	1 303		
HP 28	4.57	1 990	2 295	182	1 973	1 915	1 786	1 643	1 486	1 401		
HP 30	4.89	1 990	2 455	182	2 111	2 049	1 911	1 758	1 590	1 500		
Power output per m <sup>2</sup> gross area					432	419	391	360	325	307		
Performance parameters test method		Quasi dynamic										
Performance parameters (related to AG)		η <sub>0,b</sub>	c <sub>1</sub>	c <sub>2</sub>	c <sub>3</sub>	c <sub>4</sub>	c <sub>6</sub>	K <sub>d</sub>				
Units		-	W/(m <sup>2</sup> K)	W/(m <sup>2</sup> K <sup>2</sup> )	J/(m <sup>3</sup> K)	-	s/m	-				
Test results		0.431	1.244	0.004	0.000	0.000	0.000	1.012				
Incidence angle modifier test method		Quasi dynamic - outdoor										
Bi-directional incidence angle modifiers		Yes										
Incidence angle modifier		Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°	
Transversal		K <sub>θT, coll</sub>	1.03	1.02	1.08	1.16	1.25	1.22	1.16		0.00	
Longitudinal		K <sub>θL, coll</sub>	1.00	0.99	0.99	0.97	0.95	0.90	0.82		0.00	
Heat transfer medium for testing		Water-Glycole										
Flow rate for testing (per gross area, A <sub>G</sub> )		dm/dt	0.015	kg/(sm <sup>2</sup> )								
Maximum temperature difference for thermal performance calculations		(θ <sub>m</sub> -θ <sub>a</sub> ) <sub>max</sub>	80	K								
Standard stagnation temperature (G = 1000 W/m <sup>2</sup> ; θ <sub>a</sub> = 30 °C)		θ <sub>stg</sub>	215	°C								
Effective thermal capacity, incl. fluid (per gross area, A <sub>G</sub> )		C/m <sup>2</sup>	57	kJ/(Km <sup>2</sup> )								
Maximum operating temperature		θ <sub>max, op</sub>	150	°C								
Maximum operating pressure		p <sub>max, op</sub>	600	kPa								
Testing laboratory		Atestlab				<a href="http://www.tuv.com/st">http://www.tuv.com/st</a>						
Test report(s)		21233077.001 21233077.002				Dated		06.05.2016 06.05.2016				
Comments of testing laboratory		Datasheet version: 5.01, 2016-03-01										
The following collector sizes had been tested according to EN 12975-2:2006: HP 12 & HP 30. Furthermore, a declaration about the "same collector" for the intermediate sizes have been given by the manufacturer. The Quasi-dynamic test evaluation was repeated with gross area as basis for this data sheet. Due to limited space, the sizes RK 25/27/29 could not be displayed. The results could be interpolated.						 lab TÜV Rheinland Energy GmbH Am Grauen Stein 51105 Köln						
DIN CERTCO • Alboinstraße 56 • 12103 Berlin, Germany Tel: +49 30 7562-1131 • Fax: +49 30 7562-1141 • E-Mail: info@dincertco.de • www.dincertco.de												

<b>Annex to Solar Keymark Certificate Supplementary Information</b>	<b>Licence Number</b>	<b>011-7S2651 R</b>
	<b>Issued</b>	<b>2016-06-07</b>

**Annual collector output in kWh/collector at mean fluid temperature  $\vartheta_m$ , based on EN ISO 9806:2013 test results**

Standard Locations Collector name	$\vartheta_m$	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
HP 12		1 573	1 308	1 050	1 291	1 050	828	942	742	566	1 016	801	608
HP 13		1 698	1 411	1 134	1 393	1 133	894	1 016	800	611	1 097	864	656
HP 14		1 822	1 515	1 217	1 495	1 216	960	1 091	859	656	1 177	928	704
HP 15		1 947	1 618	1 300	1 598	1 300	1 025	1 166	918	701	1 258	991	753
HP 16		2 071	1 722	1 383	1 700	1 383	1 091	1 240	976	746	1 338	1 054	801
HP 17		2 196	1 826	1 466	1 802	1 466	1 156	1 315	1 035	791	1 419	1 118	849
HP 18		2 320	1 929	1 550	1 905	1 549	1 222	1 389	1 094	835	1 499	1 181	897
HP 19		2 437	2 026	1 628	2 000	1 627	1 284	1 459	1 149	878	1 575	1 241	942
HP 20		2 562	2 130	1 711	2 103	1 710	1 349	1 534	1 208	922	1 655	1 304	990
HP 21		2 686	2 233	1 794	2 205	1 793	1 415	1 608	1 266	967	1 736	1 368	1 038
HP 22		2 811	2 337	1 877	2 307	1 877	1 480	1 683	1 325	1 012	1 816	1 431	1 087
HP 23		2 936	2 440	1 960	2 409	1 960	1 546	1 758	1 384	1 057	1 897	1 495	1 135
HP 24		3 060	2 544	2 044	2 512	2 043	1 612	1 832	1 443	1 102	1 977	1 558	1 183
HP 26		3 309	2 751	2 210	2 716	2 209	1 743	1 981	1 560	1 192	2 138	1 685	1 279
HP 28		3 559	2 958	2 376	2 921	2 376	1 874	2 131	1 678	1 281	2 299	1 812	1 376
HP 30		3 808	3 166	2 543	3 125	2 542	2 005	2 280	1 795	1 371	2 460	1 938	1 472
Annual output per m <sup>2</sup> gross area		779	647	520	639	520	410	466	367	280	503	396	301
Fixed or tracking collector		Fixed (slope = latitude - 15°; rounded to nearest 5°)											
Annual irradiation on collector plane		1765 kWh/m <sup>2</sup>			1714 kWh/m <sup>2</sup>			1166 kWh/m <sup>2</sup>			1244 kWh/m <sup>2</sup>		
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  $\vartheta_m$  (mean of in- and outlet temperatures). The calculation of the annual collector performance is performed with the official Solar Keymark spreadsheet tool Scenocalc Ver. 5.01 (March 2016). A detailed description of the calculations is available at [www.solarkeymark.org/scenocalc](http://www.solarkeymark.org/scenocalc)

**Additional Information**

Collector heat transfer medium	Water-Glycole
Hybrid Thermal and Photo Voltaic collector	No
The collector is deemed to be suitable for roof integration	No
The collector was tested successfully according to EN ISO 9806:2013 under the following conditions:	
Climate class (A, B or C)	--
Maximum tested positive load	Pa
Maximum tested negative load	Pa
Hail resistance using steel ball (maximum drop height)	m

**Energy Labelling Information**

	Reference Area, $A_{sol}$ (m <sup>2</sup> )	Data required for CDR (EU) No 811/2013 - Reference Area $A_{sol}$		
HP 12	2.02	Collector efficiency ( $\eta_{col}$ )	38	%
HP 13	2.18	<i>Remark: Collector efficiency (<math>\eta_{col}</math>) 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<sup>2</sup>, expressed in % and rounded to the nearest integer. Deviating from the regulation <math>\eta_{col}</math> is based on reference area (<math>A_{sol}</math>) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2013.</i>		
HP 14	2.34			
HP 15	2.50			
HP 16	2.66			
HP 17	2.82			
HP 18	2.98			
HP 19	3.13			
HP 20	3.29	Data required for CDR (EU) No 812/2013 - Reference Area $A_{sol}$		
HP 21	3.45	Zero-loss efficiency ( $\eta_0$ )	0.432	--
HP 22	3.61	First-order coefficient ( $a_1$ )	1.24	W/(m <sup>2</sup> K)
HP 23	3.77	Second-order coefficient ( $a_2$ )	0.004	W/(m <sup>2</sup> K <sup>2</sup> )
HP 24	3.93	Incidence angle modifier IAM (50°)	1.13	--
HP 26	4.25	<i>Remark: The data given in this section are related to collector reference area (<math>A_{sol}</math>) 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.</i>		
HP 28	4.57			
HP 30	4.89			