


<b>Annex to Solar Keymark Certificate</b>					<b>Licence Number</b>		<b>TSU 001-20</b>							
					<b>Date issued</b>		<b>2020-02-10</b>							
					<b>Issued by</b>		<b>TSU Piešťany, š.p</b>							
<b>Licence holder</b>			<b>Skurut Systemy Solarne Sp. z o. o.</b>			<b>Country</b>		Poland						
<b>Brand (optional)</b>						<b>Web</b>		<a href="http://www.skurut-solar.pl/">http://www.skurut-solar.pl/</a>						
<b>Street, Number</b>			ul. Wybickiego 71			<b>E-mail</b>		office@skurut-solar.pl						
<b>Postcode, City</b>			32-400 Myślenice			<b>Tel</b>		+48 12 272 -20 25 / -31 24						
<b>Collector Type</b>					Flat plate collector									
<b>Collector name</b>					<b>Power output per collector</b>									
					G <sub>b</sub> = 850 W/m <sup>2</sup> , G <sub>d</sub> = 150 W/m <sup>2</sup> & u = 1.3 m/s $\vartheta_m - \vartheta_a$									
					0 K	10 K	30 K	50 K	70 K	107 K				
					m <sup>2</sup>	mm	mm	mm	mm	mm				
<b>MAX1</b>					2.32	2,037	1,137	80	1,581	1,504	1,336	1,149	943	514
<b>SK 2.2</b>					2.39	2,098	1,137	80	1,629	1,550	1,376	1,183	972	530
<b>SK 2.52 AI</b>					2.72	2,393	1,137	80	1,854	1,764	1,566	1,347	1,106	603
					0	0	0	0	0	0	0	0	0	
					0	0	0	0	0	0	0	0	0	
					0	0	0	0	0	0	0	0	0	
					0	0	0	0	0	0	0	0	0	
					0	0	0	0	0	0	0	0	0	
<b>Power output per m<sup>2</sup> gross area</b>					682	648	576	495	407	222				
<b>Performance parameters test method</b>			Steady state - indoor											
<b>Performance parameters (related to A<sub>G</sub>)</b>			$\eta_0, b$	a1	a2	a3	a4	a5	a6	a7	a8	Kd		
<b>Units</b>			-	W/(m <sup>2</sup> K)	W/(m <sup>2</sup> K <sup>2</sup> )	J/(m <sup>3</sup> K)	-	J/(m <sup>2</sup> K)	s/m	W/(m <sup>2</sup> K <sup>4</sup> )	W/(m <sup>2</sup> K <sup>4</sup> )	-		
<b>Test results</b>			0.689	3.23	0.010	0.000	0.00	14,090	0.000	0.00	0.0E+00	0.93		
<b>Incidence angle modifier test method</b>			Quasi dynamic - outdoor											
<b>Incidence angle modifier</b>			Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°		
<b>Transversal</b>			K <sub>θT, coll</sub>	1.00	0.99	0.98	0.96	0.92	0.87	0.74	0.36	0.00		
<b>Longitudinal</b>			K <sub>θL, coll</sub>	1.00	0.99	0.98	0.96	0.92	0.87	0.74	0.36	0.00		
<b>Heat transfer medium for testing</b>					Water-Glycole									
<b>Flow rate for testing (per gross area, A<sub>G</sub>)</b>					dm/dt	0.020	kg/(sm <sup>2</sup> )							
<b>Maximum temperature difference during thermal performance test</b>					( $\vartheta_m - \vartheta_a$ ) <sub>max</sub>	77	K							
<b>Standard stagnation temperature (G = 1000 W/m<sup>2</sup>; <math>\vartheta_a = 30</math> °C)</b>					$\vartheta_{stg}$	197	°C							
<b>Maximum operating temperature</b>					$\vartheta_{max, op}$	100	°C							
<b>Maximum operating pressure</b>					p <sub>max, op</sub>	1000	kPa							
<b>Testing laboratory</b>			TZS, ITW University of Stuttgart				<a href="http://www.itw.uni-stuttgart.de">http://www.itw.uni-stuttgart.de</a>							
<b>Test report(s)</b>			14COL1235 14COL1236 14COL1236Q				<b>Dated</b>		24-11-2015 24-11-2015 24-11-2015					
<b>Comments of testing laboratory</b>					Datasheet version: 6.1, 2019-09-26									
					 <b>TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.</b> Krajinská cesta 2929/9 92101 PIEŠŤANY -316/3-									
<b>Technický skúšobný ústav Piešťany, š.p.</b> Address: Krajinská cesta 2929/9, 92101 Piešťany, Slovak Republic Phone: +421 33 79 57 111, Fax: +421 33 77 23 716, E-mail: sv@tsu.sk, web: www.tsu.eu														

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Supplementary Information		Issued		2020-02-10									
<b>Annual collector output in kWh/collector at mean fluid temperature <math>\vartheta_m</math></b>													
Collector name	Standard Locations	Athens			Davos			Stockholm			Würzburg		
	$\vartheta_m$	25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C
MAX1		2,523	1,802	1,186	1,915	1,328	843	1,409	925	565	1,536	1,001	602
SK 2.2		2,599	1,856	1,222	1,973	1,368	869	1,451	953	582	1,582	1,031	620
SK 2.52 AI		2,957	2,113	1,391	2,245	1,557	989	1,652	1,084	662	1,800	1,174	705
Annual output per m <sup>2</sup> gross area		1,087	777	511	825	572	364	607	399	243	662	432	259
Annual efficiency, $\eta_a$		62%	44%	29%	51%	35%	22%	52%	34%	21%	53%	35%	21%
Fixed or tracking collector		Fixed (slope = latitude - 15°; rounded to nearest 5°)											
Annual irradiation on collector plane		1765 kWh/m <sup>2</sup>			1630 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. 6.1 (September 2019). A detailed description of the calculations is available at <a href="http://www.estif.org/solarkeymarknew/">http://www.estif.org/solarkeymarknew/</a>													
<b>Additional Information</b>													
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/m <sup>2</sup> ) >		900		$\vartheta_a$ (°C) >		15		H <sub>x</sub> (MJ/m <sup>2</sup> ) >		540			
Maximum tested positive load										2500		Pa	
Maximum tested negative load										1750		Pa	
Hail resistance using steel ball (maximum drop height)										1.4		m	
<b>Additional collector attribute(s)</b>													
<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)									
<b>Energy Labelling Information</b>						<b>Additional Informative Technical Data</b>							
		Reference Area, A <sub>sol</sub> (m <sup>2</sup> )		Hydraulic Designation Code			Aperture Area, A <sub>a</sub> (m <sup>2</sup> )						
MAX1		2.32		1-VH-12V-A:12,15966			2.13						
SK 2.2		2.39		1-VH-12V-A:12,19966			2.20						
SK 2.52 AI		2.72		1-VH-12V-A:12,23966			2.52						
<b>Data required for CDR (EU) No 811/2013 - Reference Area A<sub>sol</sub></b>						<b>Data required for CDR (EU) No 812/2013 - Reference Area A<sub>sol</sub></b>							
Collector efficiency ( $\eta_{col}$ )		54%				Zero-loss efficiency ( $\eta_0$ )		0.68		--			
Remark: Collector efficiency ( $\eta_{col}$ ) 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 <sup>2</sup> , expressed in % and rounded to the nearest integer. Deviating from the regulation $\eta_{col}$ is based on reference area (A <sub>sol</sub> ) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017.		First-order coefficient (a <sub>1</sub> )		3.23		Second-order coefficient (a <sub>2</sub> )		0.010		W/(m <sup>2</sup> K)			
		Incidence angle modifier IAM (50°)		0.92						W/(m <sup>2</sup> K <sup>2</sup> )			
										--			
Remark: The data given in this section are related to collector reference area (A <sub>sol</sub> ) 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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