




Annex to Solar Keymark Certificate					Licence Number		TSU 003-20							
					Date issued		2020-10-12							
					Issued by		TSU Piešťany, š.p.							
Licence holder		VacuSol, spol. s r.o.			Country		Slovak republic							
Brand (optional)					Web		www.vacuosol.cz							
Street, Number		Dolní Rožinka 149			E-mail		info@vacuosol.cz							
Postcode, City		592 51 Dolní Rožinka			Tel		+421 (0)456016080							
Collector Type					Evacuated tubular collector									
Collector name					Power output per collector									
					Gb = 850 W/m <sup>2</sup> , Gd = 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	90 K				
					m <sup>2</sup>	mm	mm	mm	W	W	W			
VS 10T					1.45	2,150	675	120	672	655	618	577	533	486
Power output per m <sup>2</sup> gross area					464	452	426	398	368	335				
Performance parameters test method		Steady state - outdoor												
Performance parameters (related to A <sub>G</sub> )		$\eta_0, b$	a1	a2	a3	a4	a5	a6	a7	a8	Kd			
Units		-	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> )	-			
Test results		0.470	1.16	0.003	0.000	0.00	2,750	0.000	0.00	0.0E+00	0.91			
Incidence angle modifier test method		Steady state - outdoor												
Incidence angle modifier		Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°			
Transversal		K <sub>θT, coll</sub>	1.01	1.02	1.03	1.03	1.01	0.98	0.85	0.50	0.00			
Longitudinal		K <sub>θL, coll</sub>	0.99	0.99	0.97	0.94	0.89	0.80	0.62	0.35	0.00			
Heat transfer medium for testing					Water									
Flow rate for testing (per gross area, A <sub>G</sub> )					dm/dt	0.008	kg/(sm <sup>2</sup> )							
Maximum temperature difference during thermal performance test					( $\vartheta_m - \vartheta_a$ ) <sub>max</sub>	60	K							
Standard stagnation temperature (G = 1000 W/m <sup>2</sup> ; $\vartheta_a = 30$ °C)					$\vartheta_{stg}$	178	°C							
Maximum operating temperature					$\vartheta_{max, op}$	100	°C							
Maximum operating pressure					p <sub>max, op</sub>	600	kPa							
Testing laboratory		Technický skúšobný ústav Piešťany, š.p					http://www.tsu.sk							
Test report(s)		190700007/PQ					Dated		12-10-2020					
Comments of testing laboratory					Datasheet version: 6.1, 2019-09-26									
					 <p>TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p. Krajinská cesta 2929/9 92101 PIEŠŤANY -316/3-</p>									
<p align="center"><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</p>														

<b>Annex to Solar Keymark Certificate Supplementary Information</b>	<b>Licence Number</b>	<b>TSU 003-20</b>
	<b>Issued</b>	<b>2020-10-12</b>

Annual collector output in kWh/collector at mean fluid temperature $\vartheta_m$													
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
VS 10T		1,116	941	774	929	771	627	672	539	425	723	580	454
Annual output per m <sup>2</sup> gross area		770	649	534	641	532	433	463	372	293	498	400	313
Annual efficiency, $\eta_a$		44%	37%	30%	39%	33%	27%	40%	32%	25%	40%	32%	25%
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>													

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/m <sup>2</sup> ) >	1000	$\vartheta_a$ (°C) >	20	$H_x$ (MJ/m <sup>2</sup> ) >	600
Maximum tested positive load	2300		Pa		
Maximum tested negative load	1600		Pa		
Hail resistance using steel ball (maximum drop height)	1.6		m		
Additional collector attribute(s)					
<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 checked="" type="checkbox"/> Façade collector(s)				

Energy Labelling Information		Additional Informative Technical Data	
	Reference Area, $A_{sol}$ (m <sup>2</sup> )	Hydraulic Designation Code	Aperture Area, $A_a$ (m <sup>2</sup> )
VS 10T	1.45	10-V-12S-9,1940-16,725-D	1.01

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 ( $\eta_{col}$ )	41%	Zero-loss efficiency ( $\eta_0$ )	0.46
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 ( $A_{sol}$ ) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017.		First-order coefficient ( $a_1$ )	1.16
		Second-order coefficient ( $a_2$ )	0.003
		Incidence angle modifier IAM (50°)	0.89
		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.	

**Technický skúšobný ústav Piešťany, š.p.**

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