


<b>Summary of EN 12975 Test Results, annex to Solar KEYMARK Certificate</b>						<b>Licence Number</b>		<b>TSU 002-15</b>			
						<b>Issued</b>		<b>2015-10-30</b>			
<b>Company holding the</b>		T.W.I. spol. s r.o.				<b>Country</b>		Czech republic			
<b>Brand (optional)</b>						<b>Website</b>		www.twi.cz			
<b>Street, street number</b>		Mnichov 146				<b>E-mail</b>		z.pravda@twi.cz			
<b>Postal Code / City, province</b>		793 26	Vrbno pod Pradědem			<b>Tel/Fax</b>		420 737258600			
<b>Collector Type (flat plate glazed/un-glazed; evacuate tubular)</b>						Flat plate collector - glazed					
Thermal / photo voltaic hybrid collector? (PVT collector)						No					
Integration in the roof possible ? (manufacturers declaration)						No					
<b>Collector name</b>	<b>Aperture area (Aa)</b>	<b>Gross length</b>	<b>Gross width</b>	<b>Gross height</b>	<b>Gross area (AG)</b>	<b>Power output per collector module</b>					
						G = 1000 W/m <sup>2</sup>					
						Tm-Ta					
						0 K	10 K	30 K	50 K	70 K	
	m <sup>2</sup>	mm	mm	mm	m <sup>2</sup>	W	W	W	W	W	
SUN WING T4 Alu 1,9	1,81	1 774	1 092	82	1,90	1 491	1 424	1 274	1 101	907	
SUN WING T4 Alu 2,2	2,10	2 015	1 092	82	2,20	1 730	1 652	1 478	1 278	1 053	
SUN WING T4 Alu 2,5	2,35	2 294	1 092	82	2,50	1 936	1 849	1 654	1 430	1 178	
SUN WING T4 Alu 2,66	2,50	2 433	1 092	82	2,66	2 060	1 967	1 759	1 521	1 253	
<b>Performance test method</b>						Glazed liquid heating collector - steady state - outdoor					
<b>Performance parameters related to aperture area</b>						$\eta_0$	a1	a2			
<b>Units</b>						-	W/(m <sup>2</sup> K)	W/(m <sup>2</sup> K <sup>2</sup> )			
<b>Test results - Flow rate and fluid see note 1</b>						0,824	3,560	0,015			
<b>Bi-directional incidence angle modifiers?</b>						No <i>K<math>\theta</math> values are obligatory for 50°.</i>					
<b>Incidence angle modifiers K<math>\theta</math>(<math>\theta</math>)</b>		Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
		K $\theta$ ( $\theta$ )					0,95				0,00
<b>Incidence angle modifier not bi-directional - leave fields blank</b>											
<b>Stagnation temperature - Weather conditions see note 2</b>						Tstg		201 °C			
<b>Effective thermal capacity</b>						ceff = C/Ag		4,6 kJ/(m <sup>2</sup> K)			
<b>Max. intended operation temperature - see note 3</b>						Tmax,op		110 °C			
<b>Max. operation pressure - see note 3</b>						pmax,op		600 kPa			
<b>Pressure drop table - for a collector family, the values shall be for the module with highest <math>\Delta P</math> per m<sup>2</sup> aperture area</b>											
<b>Flow rate</b>	kg/(s m <sup>2</sup> )										
<b>Pressure drop, <math>\Delta P</math></b>	Pa										
<b>Optional weather data</b>		Location				Link					
<b>Testing Laboratory</b>		Technický skúšobný ústav Piešťany, š.p.									
<b>Website</b>		www.tsu.eu									
<b>Test report id. number</b>		150700004/1/PQ, 150700004/2/P				<b>Date of test report</b>		2015.10.28			
During the test GDIF/GTOT was always between		0,09	and	0,12							
<b>Comments of testing laboratory:</b>											
Tested according to EN ISO 9806											
<b>Note 1</b>	<b>Flow rate</b>	0,018	kg/(s m <sup>2</sup> )	<b>Fluid</b>	Water						
<b>Note 2</b>	Irradiance, G = 1000 W/m <sup>2</sup> ; Ambient temperature, Ta=30 °C										
<b>Note 3</b>	Given by manufacturer										
						 Datasheet version: 4.06, 2014-01-15					
<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											

<b>Annual collector output based on EN 12975 Test Results, annex to Solar KEYMARK Certificate</b>	<b>Licence Number</b>	<b>TSU 002-15</b>
	Issued	30.10.2015

<b>Annual collector output kWh/module</b>													
<b>Collector name</b>	Location and collector temperature (T <sub>m</sub> )												
	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	
SUN WING T4 Alu 1,9	2 410	1 762	1 181	1 854	1 308	840	1 364	913	564	1 481	989	600	
SUN WING T4 Alu 2,2	2 796	2 044	1 370	2 151	1 518	974	1 583	1 059	655	1 718	1 147	697	
SUN WING T4 Alu 2,5	3 129	2 287	1 533	2 407	1 699	1 090	1 772	1 185	732	1 923	1 284	780	
SUN WING T4 Alu 2,66	3 329	2 433	1 631	2 561	1 807	1 160	1 885	1 261	779	2 046	1 366	829	

<b>Collector mounting: Fixed or tracking</b>	<b>Fixed; slope = latitude - 15° (rounded to nearest 5°)</b>
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<b>Overview of locations</b>				
Location	Latitude °	G <sub>tot</sub> kWh/m <sup>2</sup>	T <sub>a</sub> °C	Collector orientation or tracking mode
Athens	38	1 765	18,5	South, 25°
Davos	47	1 714	3,2	South, 30°
Stockholm	59	1 166	7,5	South, 45°
Würzburg	50	1 244	9,0	South, 35°

G <sub>tot</sub>	Annual total irradiation on collector plane	kWh/m <sup>2</sup>
T <sub>a</sub>	Mean annual ambient air temperature	°C
T <sub>m</sub>	Constant collector operating temperature (mean of in- and outlet temperatures)	°C

The calculation of the annual collector performance is performed with the official Solar Keymark spreadsheet tool ScenoCalc. The collector output is calculated hour by hour according to the efficiency parameters from the Keymark test using constant collector operating temperature (T<sub>m</sub>). A detailed description of the calculations is available at <http://www.sp.se/en/index/services/solar/ScenoCalc/Sidor/default.aspx>.

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	ScenoCalc version: Ver. 4.06 (Jan, 2014)