


<b>Summary of EN 12975 Test Results, annex to Solar KEYMARK Certificate</b>						<b>Licence Number</b>		<b>011-7S1889 R</b>													
						<b>Issued</b>		<b>2015-06-01</b>													
<b>Company holding the</b>		<b>Ritter En ergie- &amp; Umwelttechnik Solar GmbH &amp; Co KG</b>				<b>Country</b>		<b>Germany</b>													
<b>Brand (optional)</b>						<b>Website</b>		<b>www.ritter-gruppe.com</b>													
<b>Street, street number</b>		<b>Kuchenäckerstraße 2</b>				<b>E-mail</b>		<b>T.Weidemann@ritter-gruppe.com</b>													
<b>Postal Code / City, province</b>		<b>72135</b>		<b>Dettenhausen</b>		<b>Tel/Fax</b>		<b>+49 7157 5359 1280 / 7157 5359 1289</b>													
<b>Collector Type (flat plate glazed/un-glazed; evacuate tubular)</b>						<b>Evacuated tubular collector</b>															
Thermal / photo voltaic hybrid collector? (PVT collector)						No															
Integration in the roof possible ? (manufacturers declaration)						No															
						<b>Power output per collector module</b>															
						G = 1000 W/m <sup>2</sup>															
						T <sub>m</sub> -T <sub>a</sub>															
						0 K		10 K		30 K		50 K		70 K							
<b>Collector name</b>						m <sup>2</sup>		mm		mm		mm		m <sup>2</sup>							
<b>AQUA PLASMA 19/17*</b>						1.49		2 058		822		111		1.69							
<b>AQUA PLASMA 19/34*</b>						3.00		2 058		1 627		111		3.35							
<b>AQUA PLASMA 19/50*</b>						4.50		2 058		2 432		111		5.01							
<b>AQUA PLASMA 15/27*</b>						2.33		1 642		1 627		111		2.67							
<b>AQUA PLASMA 15/40*</b>						3.49		1 642		2 432		111		3.99							
<b>Performance test method</b>						<b>Glazed liquid heating collector - steady state - outdoor</b>															
<b>Performance parameters related to aperture</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>						0.687		0.613		0.003											
<b>Bi-directional incidence angle modifiers?</b>						Yes		<i>K<math>\theta</math> values are obligatory for 50°.</i>													
<b>Incidence angle modifiers K<math>\theta</math>(<math>\theta</math>T) transversal direction</b>		<b>Angle</b>		10°		20°		30°		40°		50°		60°		70°		80°		90°	
		<b>K<math>\theta</math>(<math>\theta</math>T)</b>		1.01		1.02		1.02		1.02		0.96		1.06		1.20		0.60		0.00	
<b>Incidence angle modifiers K<math>\theta</math>(<math>\theta</math>L) longitudinal direction</b>		<b>Angle</b>		10°		20°		30°		40°		50°		60°		70°		80°		90°	
		<b>K<math>\theta</math>(<math>\theta</math>L)</b>		1.00		0.99		0.97		0.94		0.90		0.86		0.85		0.43		0.00	
<b>Stagnation temperature - Weather conditions see note 2</b>						<b>T<sub>stg</sub></b>		338				°C									
<b>Effective thermal capacity</b>						<b>ceff = C/Ag</b>		8.78				kJ/(m <sup>2</sup> K)									
<b>Max. intende operation temperature - see note 3</b>						<b>T<sub>max,op</sub></b>		-				°C									
<b>Max. operation pressure - see note 3</b>						<b>p<sub>max,op</sub></b>		1000				kPa									
<b>Pressure drop table - for a collector family, the values shall be for the module with highest <math>\Delta</math>P per m<sup>2</sup> aperture area</b>						<b>Flow rate</b>		kg/(s m <sup>2</sup> )		-		-		-		-		-		-	
						<b>Pressure drop, <math>\Delta</math>P</b>		Pa		-		-		-		-		-		-	
<b>Optional weather data</b>						<b>Location</b>		-		<b>Link</b>		-									
<b>Testing Laboratory</b>						<b>TZS, ITW University Stuttgart</b>															
<b>Website</b>						<b><a href="http://www.itw.uni-stuttgart.de">http://www.itw.uni-stuttgart.de</a></b>															
<b>Test report id. number</b>						<b>11COL1008/3, 11COL1007Q/4, 11COL1007/2</b>			<b>Date of test report</b>		<b>2015.01.26</b>										
During the test GDIF/GTOT was always between						0		and		1											
<b>Comments of testing laboratory:</b>						* dimensions according to manufacturer															
<b>Note 1</b>						<b>Flow rate</b>		0.020		<b>kg/(s m<sup>2</sup>)</b>		<b>Fluid</b>		<b>Water</b>							
<b>Note 2</b>						<b>Irradiance, G = 1000 W/m<sup>2</sup>; Ambient temperature, T<sub>a</sub>=30 °C</b>															
<b>Note 3</b>						<b>Given by manufacturer</b>															
						 Forschungs- und Testzentrum für Solaranlagen Institut für Thermodynamik und Wasserwerkstoffe Universität Stuttgart Pfaffenwaldring 6, 70569 Stuttgart (Vaihingen)															
						Datasheet version: 4.06, 2014-01-15															
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Annual collector output based on EN 12975 Test Results, annex to Solar KEYMARK Certificate	Licence Number	011-7S1889 R
	Issued	01.06.2015

Annual collector output kWh/module														
Collector name	Location and collector temperature (Tm)													
	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		
AQUA PLASMA 19/17	1 762	1 653	1 529	1 560	1 444	1 320	1 122	1 022	922	1 200	1 097	989		
AQUA PLASMA 19/34	3 547	3 328	3 079	3 141	2 908	2 658	2 259	2 058	1 857	2 417	2 208	1 991		
AQUA PLASMA 19/50	5 321	4 991	4 619	4 712	4 362	3 988	3 388	3 088	2 786	3 625	3 312	2 986		
AQUA PLASMA 15/27	2 755	2 584	2 391	2 440	2 258	2 065	1 754	1 599	1 442	1 877	1 715	1 546		
AQUA PLASMA 15/40	4 127	3 871	3 582	3 654	3 383	3 093	2 628	2 395	2 160	2 811	2 568	2 316		

Collector mounting: Fixed or tracking Fixed; slope = latitude - 15° (rounded to nearest 5°)

Overview of locations				
Location	Latitude °	Gtot kWh/m <sup>2</sup>	Ta °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°

Gtot	Annual total irradiation on collector plane	kWh/m <sup>2</sup>
Ta	Mean annual ambient air temperature	°C
Tm	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 (Tm). A detailed description of the calculations is available at <http://www.sp.se/en/index/services/solar/ScenoCalc/Sidor/default.aspx>.