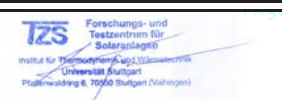




<b>Summary of EN 12975 Test Results, annex to Solar KEYMARK Certificate</b>						<b>Licence Number</b>		<b>011-7S1889 R</b>							
						<b>Issued</b>		<b>2015-06-01</b>							
<b>Company holding the</b>		Ritter En ergie-& Umwelttechnik Solar GmbH & Co KG				<b>Country</b>		Germany							
<b>Brand (optional)</b>						<b>Website</b>		www.ritter-gruppe.com							
<b>Street, street number</b>		Kuchenäckerstraße 2				<b>E-mail</b>		T.Weidemann@ritter-gruppe.com							
<b>Postal Code / City, province</b>		72135	Dettenhausen			<b>Tel/Fax</b>		+49 7157 5359 1280 / 7157 5359 1289							
<b>Collector Type (flat plate glazed/un-glazed; evacuate tubular)</b>						Evacuated tubular collector									
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>									
						Tm-Ta									
						0 K	10 K	30 K	50 K	70 K					
<b>Collector name</b>						W	W	W	W	W					
						m <sup>2</sup>	mm	mm	mm	m <sup>2</sup>					
AQUA PLASMA 19/17*						1.49	2 058	822	111	1.69					
AQUA PLASMA 19/34*						3.00	2 058	1 627	111	3.35					
AQUA PLASMA 19/50*						4.50	2 058	2 432	111	5.01					
AQUA PLASMA 15/27*						2.33	1 642	1 627	111	2.67					
AQUA PLASMA 15/40*						3.49	1 642	2 432	111	3.99					
<b>Performance test method</b>						Glazed liquid heating collector - steady state - outdoor									
<b>Performance parameters related to aperture</b>						η0	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>Kθ values are obligatory for 50°.</i>									
<b>Incidence angle modifiers Kθ(θT) transversal direction</b>						Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
						Kθ(θT)	1.01	1.02	1.02	1.02	0.96	1.06	1.20	0.60	0.00
<b>Incidence angle modifiers Kθ(θL) longitudinal direction</b>						Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
						Kθ(θL)	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>						Tstg	338	°C							
<b>Effective thermal capacity</b>						ceff = C/Ag	8.78	kJ/(m <sup>2</sup> K)							
<b>Max. intended operation temperature - see note 3</b>						Tmax,op	-	°C							
<b>Max. operation pressure - see note 3</b>						pmax,op	1000	kPa							
<b>Pressure drop table - for a collector family, the values shall be for the module with highest ΔP per m<sup>2</sup> aperture area</b>						Flow rate	kg/(s m <sup>2</sup> )	-	-	-	-	-	-	-	-
						Pressure drop, ΔP	Pa	-	-	-	-	-	-	-	-
<b>Optional weather data</b>						Location	-	Link	-						
<b>Testing Laboratory</b>						TZS, ITW University Stuttgart									
<b>Website</b>						http://www.itw.uni-stuttgart.de									
<b>Test report id. number</b>						11COL1008/3, 11COL1007Q/4, 11COL1007/2		<b>Date of test report</b>		2015.01.26					
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	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									
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www.dincertco.de															



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 (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
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 °	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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	4.06, 2014-01-15
	ScenoCalc version:
	Ver. 4.06 (Jan, 2014)

<b>Summary of EN 12975 Test Results,</b> <b>annex to Solar KEYMARK Certificate</b>						<b>Licence Number</b>		<b>011-7S089 R</b>							
						<b>Issued</b>		<b>2015-11-30</b>							
<b>Company holding the</b>			Ritter Energie- und Umwelttechnik GmbH & Co. KG			<b>Country</b>		Deutschland							
<b>Brand (optional)</b>						<b>Website</b>		www.ritter-gruppe.com							
<b>Street, street number</b>			Kuchenäcker 2			<b>E-mail</b>		info@ritter-gruppe.com							
<b>Postal Code / City, province</b>			D-72135 Dettenhausen			<b>Tel/Fax</b>		49 (0)7157 5359 -1200 / -1209							
<b>Collector Type (flat plate glazed/un-glazed; evacuate tubular)</b>						Evacuated tubular collector									
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>						W	W	W	W	W					
						m <sup>2</sup>	mm	mm	mm	m <sup>2</sup>					
Star 15/26						2.33	1 616	1 627	122	2.63	1 501	1 482	1 438	1 384	1 321
Star 15/39						3.49	1 616	2 432	122	3.93	2 248	2 220	2 153	2 073	1 979
Star 19/33						3.00	2 033	1 627	122	3.31	1 932	1 908	1 851	1 782	1 701
Star 19/49						4.50	2 033	2 432	122	4.94	2 898	2 862	2 777	2 673	2 552
Performance test method						Glazed liquid heating collector - steady state - outdoor									
Performance parameters related to aperture area						η <sub>0</sub>	a <sub>1</sub>	a <sub>2</sub>							
Units						-	W/(m <sup>2</sup> K)	W/(m <sup>2</sup> K <sup>2</sup> )							
Test results - Flow rate and fluid see note 1						0.644	0.749	0.005							
Bi-directional incidence angle modifiers? <b>Yes</b>						<i>Kθ values are obligatory for 50°.</i>									
Incidence angle modifiers Kθ(θT) transversal direction						Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
						Kθ(θT)	1.01	1.01	1.02	1.02	0.98	1.05	1.14	0.57	0.00
Incidence angle modifiers Kθ(θL) longitudinal direction						Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
						Kθ(θL)	1.00	1.00	0.99	0.98	0.95	0.89	0.76	0.38	0.00
Stagnation temperature - Weather conditions see note 2						T <sub>stg</sub>		301		°C					
Effective thermal capacity						c <sub>eff</sub> = C/Ag		9.18		kJ/(m <sup>2</sup> K)					
Max. intended operation temperature - see note 3						T <sub>max,op</sub>		160		°C					
Max. operation pressure - see note 3						p <sub>max,op</sub>		1000		kPa					
Pressure drop table - for a collector family, the values shall be for the module with highest ΔP per m <sup>2</sup> aperture area															
Flow rate		kg/(s m <sup>2</sup> )	-	-	-	-	-	-	-	-					
Pressure drop, ΔP		Pa	-	-	-	-	-	-	-	-					
Optional weather data		Location				Link									
Testing Laboratory		TZS, ITW University of Stuttgart													
Website		www.itw.uni-stuttgart.de/institut/abteilungen/tzs/													
Test report id. number		14COL1031, 14COL1032Q			Date of test report		2015.11.30								
During the test GDIF/GTOT was always between		0	and	1											
<b>Comments of testing laboratory:</b>															
No comment.															
Note 1		Flow rate	0.020 kg/(s m <sup>2</sup> )	Fluid	Water										
Note 2		Irradiance, G = 1000 W/m <sup>2</sup> ; Ambient temperature, T <sub>a</sub> =30 °C													
Note 3		Given by manufacturer													
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	011-7S089 R
	Issued	30.11.2015

Annual collector output kWh/module															
Collector name	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			
Star 15/26	2 589	2 374	2 123	2 266	2 037	1 789	1 626	1 435	1 239	1 746	1 544	1 333			
Star 15/39	3 879	3 556	3 180	3 394	3 051	2 680	2 436	2 150	1 855	2 615	2 313	1 997			
Star 19/33	3 334	3 057	2 733	2 918	2 623	2 304	2 094	1 848	1 595	2 248	1 988	1 717			
Star 19/49	5 001	4 585	4 100	4 377	3 934	3 456	3 141	2 772	2 392	3 372	2 982	2 575			

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

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