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Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results		Licence Number	011-7S321 R
		Date issued	2018-02-26
		Issued by	DIN CERTCO

Licence holder	Wolf GmbH	Country	Deutschland
Brand (optional)		Web	www.wolf.eu
Street, Number	Industriestraße 1	E-mail	Michael.Klepmeir@wolf.eu
Postcode, City	84048 Mainburg	Tel	+49 875174-0

Collector Type	Evacuated tubular collector

Collector name	Gross area (A_G)	Gross length	Gross width	Gross height	Power output per collector Gb = 850 W/m²; Gd = 150 W/m² ϑm - ϑa					
					0 K	10 K	30 K	50 K	70 K	104 K
	m²	mm	mm	mm	W	W	W	W	W	W
CRK-6	1.16	1 640	707	103	644	636	617	595	569	516
Power output per m² gross area					555	548	532	513	490	445

Performance parameters test method		Steady state - outdoor							
Performance parameters (related to AG)		η0,hem	a1	a2					
Units		-	W/(m²K)	W/(m²K²)					
Test results		0.555	0.646	0.004					
Incidence angle modifier test method		Quasi dynamic - outdoor							
Bi-directional incidence angle modifiers	Yes								
Incidence angle modifier	Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
Transversal	$K_{\theta T,coll}$	1.01	1.01	1.02	1.02	0.98	1.05	1.14	0.57	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	1.00	0.99	0.98	0.95	0.89	0.76	0.38	0.00

Heat transfer medium for testing		Water	
Flow rate for testing (per gross area, A_G)	dm/dt	0.017	kg/(sm²)
Maximum temperature difference for thermal performance calculations	$(\vartheta_m-\vartheta_a)_{max}$	104	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	301	°C
Effective thermal capacity, incl. fluid (per gross area, A_G)	C/m²	7.914	kJ/(Km²)
Maximum operating temperature	$\vartheta_{max\ op}$	160	°C
Maximum operating pressure	$p_{max,op}$	1000	kPa

Testing laboratory	TZS, ITW University Stuttgart	www.itw.uni-stuttgart.de	
Test report(s)	14COL1031OEM06	Dated	26.02.2018
	14COL1032Q/1OEM06		26.02.2018
	06COL456/7		25.06.2015

Comments of testing laboratory

Datasheet version: 5.01, 2016-03-01

Data sheet based on results of test report 06COL456/7

TZS Forschungs- und Testzentrum für Solaranlagen
Institut für Thermodynamik und Wärmetechnik
Universität Stuttgart
Pfaffenwaldring 6, 70550 Stuttgart (Vaihingen)

Annex to Solar Keymark Certificate	Licence Number	011-7S321 R
Supplementary Information	Issued	2018-02-26

Annual collector output in kWh/collector at mean fluid temperature ϑ_m, based on ISO 9806:2013 test results

Standard Locations		Athens			Davos			Stockholm			Würzburg		
Collector name	ϑ_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
CRK-6		1 112	1 020	915	973	877	773	699	618	535	750	664	576
Annual output per m² gross area		958	880	789	839	756	666	602	533	461	646	573	497
Fixed or tracking collector		Fixed (slope = latitude - 15°; rounded to nearest 5°)											
Annual irradiation on collector plane		1765 kWh/m²			1714 kWh/m²			1166 kWh/m²			1244 kWh/m²		
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 ϑm (mean of in- and outlet temperatures). The calculation of the annual collector performance is performed with the official Solar Keymark spreadsheet tool Scenocalc Ver. 5.01 (March 2016). A detailed description of the calculations is available at www.solarkeymark.org/scenocalc

Additional Information

Collector heat transfer medium	Water-Glycole	
Hybrid Thermal and Photo Voltaic collector	No	
The collector is deemed to be suitable for roof integration	No	
The collector was tested successfully according to EN ISO 9806:2013 under the following conditions:		
Climate class (A, B or C)	A	--
Maximum tested positive load	2400	Pa
Maximum tested negative load	3000	Pa
Hail resistance using ice balls (diameter)	35	mm

Energy Labelling Information

	Reference Area, A_{sol} (m²)	Data required for CDR (EU) No 811/2013 - Reference Area A_{sol}		
CRK-6	1.16	Collector efficiency (η_{col})	52	%
		Remark: Collector efficiency (η_{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/m², expressed in % and rounded to the nearest integer. Deviating from the regulation η_{col} is based on reference area (A_{sol}) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2013.		
		Data required for CDR (EU) No 812/2013 - Reference Area A_{sol}		
		Zero-loss efficiency (η_0)	0.555	--
		First-order coefficient (a_1)	0.65	W/(m²K)
		Second-order coefficient (a_2)	0.004	W/(m²K²)
		Incidence angle modifier IAM (50°)	1.00	--
		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.		

Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results		Licence Number	011-7S321 R
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		Issued by	DIN CERTCO

Licence holder	Wolf GmbH	Country	Deutschland
Brand (optional)		Web	www.wolf.eu
Street, Number	Industriestraße 1	E-mail	Michael.Klepmeir@wolf.eu
Postcode, City	84048 Mainburg	Tel	+49 875174-0

Collector Type	Evacuated tubular collector

Collector name	Gross area (A_G)	Gross length	Gross width	Gross height	Power output per collector Gb = 850 W/m²; Gd = 150 W/m² ϑm - ϑa					
					0 K	10 K	30 K	50 K	70 K	104 K
	m²	mm	mm	mm	W	W	W	W	W	W
CRK-12	2.29	1 640	1 397	103	1 287	1 271	1 234	1 189	1 137	1 032
Power output per m² gross area					562	555	539	519	497	451

Performance parameters test method		Steady state - outdoor							
Performance parameters (related to AG)		η0,hem	a1	a2					
Units		-	W/(m²K)	W/(m²K²)					
Test results		0.562	0.654	0.004					
Incidence angle modifier test method		Quasi dynamic - outdoor							
Bi-directional incidence angle modifiers	Yes								
Incidence angle modifier	Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
Transversal	$K_{\theta T,coll}$	1.01	1.01	1.02	1.02	0.98	1.05	1.14	0.57	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	1.00	0.99	0.98	0.95	0.89	0.76	0.38	0.00

Heat transfer medium for testing	Water		
Flow rate for testing (per gross area, A_G)	dm/dt	0.017	kg/(sm²)
Maximum temperature difference for thermal performance calculations	$(\vartheta_m-\vartheta_a)_{max}$	104	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	301	°C
Effective thermal capacity, incl. fluid (per gross area, A_G)	C/m²	8.017	kJ/(Km²)
Maximum operating temperature	$\vartheta_{max\ op}$	160	°C
Maximum operating pressure	$p_{max,op}$	1000	kPa

Testing laboratory	TZS, ITW University Stuttgart	www.itw.uni-stuttgart.de	
Test report(s)	14COL1031OEMOEM06	Dated	26.02.2018
	14COL1032Q/1OEM06		26.02.2018
	06COL456/7		25.06.2015

Comments of testing laboratory	Datasheet version: 5.01, 2016-03-01
Data sheet based on results of test report 06COL456/7	TZS Forschungs- und Testzentrum für Solaranlagen, Institut für Thermodynamik und Wärmetechnik, Universität Stuttgart, Pfaffenwaldring 6, 70550 Stuttgart (Vaihingen)

Annex to Solar Keymark Certificate	Licence Number	011-7S321 R
Supplementary Information	Issued	2018-02-26

Annual collector output in kWh/collector at mean fluid temperature ϑ_m, based on ISO 9806:2013 test results

Standard Locations		Athens			Davos			Stockholm			Würzburg		
Collector name	ϑ_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
CRK-12		2 222	2 040	1 830	1 946	1 754	1 547	1 397	1 235	1 071	1 499	1 329	1 153
Annual output per m² gross area		970	891	799	850	766	676	610	539	468	654	580	503
Fixed or tracking collector		Fixed (slope = latitude - 15°; rounded to nearest 5°)											
Annual irradiation on collector plane		1765 kWh/m²			1714 kWh/m²			1166 kWh/m²			1244 kWh/m²		
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 ϑm (mean of in- and outlet temperatures). The calculation of the annual collector performance is performed with the official Solar Keymark spreadsheet tool Scenocalc Ver. 5.01 (March 2016). A detailed description of the calculations is available at www.solarkeymark.org/scenocalc

Additional Information

Collector heat transfer medium	Water-Glycole	
Hybrid Thermal and Photo Voltaic collector	No	
The collector is deemed to be suitable for roof integration	No	
The collector was tested successfully according to EN ISO 9806:2013 under the following conditions:		
Climate class (A, B or C)	A	--
Maximum tested positive load	2400	Pa
Maximum tested negative load	3000	Pa
Hail resistance using ice balls (diameter)	35	mm

Energy Labelling Information

	Reference Area, A_{sol} (m²)	Data required for CDR (EU) No 811/2013 - Reference Area A_{sol}		
CRK-12	2.29	Collector efficiency (η_{col})	53	%
		Remark: Collector efficiency (η_{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/m², expressed in % and rounded to the nearest integer. Deviating from the regulation η_{col} is based on reference area (A_{sol}) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2013.		
		Data required for CDR (EU) No 812/2013 - Reference Area A_{sol}		
		Zero-loss efficiency (η_0)	0.562	--
		First-order coefficient (a_1)	0.65	W/(m²K)
		Second-order coefficient (a_2)	0.004	W/(m²K²)
		Incidence angle modifier IAM (50°)	1.00	--
		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.		

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					0 K	10 K	30 K	50 K	70 K	104 K
	m²	mm	mm	mm	W	W	W	W	W	W
CRK-18	3.42	1 640	2 087	103	1 932	1 908	1 853	1 786	1 708	1 551
Power output per m² gross area					565	558	542	522	499	453

Performance parameters test method	Steady state - outdoor								
Performance parameters (related to AG)	η0,hem	a1	a2						
Units	-	W/(m²K)	W/(m²K²)						
Test results	0.565	0.657	0.004						
Incidence angle modifier test method	Quasi dynamic - outdoor								
Bi-directional incidence angle modifiers	Yes								
Incidence angle modifier	Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
Transversal	$K_{\theta T,coll}$	1.01	1.01	1.02	1.02	0.98	1.05	1.14	0.57	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	1.00	0.99	0.98	0.95	0.89	0.76	0.38	0.00

Heat transfer medium for testing	Water		
Flow rate for testing (per gross area, A_G)	dm/dt	0.018	kg/(sm²)
Maximum temperature difference for thermal performance calculations	$(\vartheta_m-\vartheta_a)_{max}$	104	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	301	°C
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CRK-18		3 337	3 063	2 749	2 922	2 634	2 324	2 097	1 855	1 609	2 250	1 996	1 732
Annual output per m² gross area		976	896	804	854	770	680	613	542	471	658	584	506
Fixed or tracking collector		Fixed (slope = latitude - 15°; rounded to nearest 5°)											
Annual irradiation on collector plane		1765 kWh/m²			1714 kWh/m²			1166 kWh/m²			1244 kWh/m²		
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		First-order coefficient (a_1)	0.66	W/(m²K)
		Second-order coefficient (a_2)	0.004	W/(m²K²)
		Incidence angle modifier IAM (50°)	1.00	--
		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.		