TÜVRheinland®
DIN CERTCO
Precisely Right.

Annex to Solar Keymark Certificate

Licence Number	**011-7S2946 R**
Date issued	**2019-10-16**
Issued by	**DIN CERTCO**

Licence holder	**BDR THERMEA GROUP B.V.**	**Country**	Netherlands
Brand (optional)	-	**Web**	www.bdrthermeagroup.com
Street, Number	Marchantstraat, 55	**E-mail**	oleguer.fuertes@bdrthermea.com
Postcode, City	7300 AA Apeldoorn	**Tel**	+34 93 682 80 40

Collector Type	Evacuated tubular collector

Collector name	Gross height	Gross area (A_G)	Gross length	Gross width	Aperture area (A_a)	Power output per collector Gb = 850 W/m2, Gd = 150 W/m2 & u = 1.3 m/s $\vartheta_m - \vartheta_a$					
						0 K	10 K	30 K	50 K	70 K	104 K
	mm	m²	mm	mm	m²	W	W	W	W	W	W
Brötje RDF 12	103	2.29	1 640	1 397	2.00	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 A_G)	η0, b	a1	a2	a3	a4	a5	a6	a7	a8	Kd
Units	-	W/(m²K)	W/(m²K²)	J/(m³K)	-	J/(m²K)	s/m	W/(m²K⁴)	W/(m²K⁴)	-
Test results	0.566	0.654	0.004	0.000	0.00	8 017	0.000	0.00	0.0	0.95

Incidence angle modifier test method		Quasi dynamic - outdoor							
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-Glycole		
Flow rate for testing (per gross area, A_G)	dm/dt	0.020	kg/(sm²)
Maximum temperature difference during thermal performance test	$(\vartheta_m-\vartheta_a)_{max}$	74	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	301	°C
Maximum operating temperature	ϑ_{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)	14COL1031OEM08	**Dated**	15.08.2019
	14COL1032Q/2OEM08		15.08.2019
	06COL456/7		25.06.2015

Comments of testing laboratory — Datasheet version: 6.0, 2018-10-30

Documented performance parameters are taken from test report 06COL456/7

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

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Supplementary Information	Issued	2019-10-16

Annual collector output in kWh/collector at mean fluid temperature ϑ_m

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
Brötje RDF 12		2 223	2 040	1 831	1 946	1 754	1 547	1 397	1 235	1 071	1 499	1 329	1 153
Annual output per m² gross area		971	891	799	850	766	676	610	540	468	655	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. 6.0 (October 2018). A detailed description of the calculations is available at www.solarkeymark.org/scenocalc

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/m²) >	1000	ϑ_a (°C) >	20	H_x (MJ/m²) >	600
Maximum tested positive load				2400	Pa
Maximum tested negative load				3000	Pa
Hail resistance using ice balls (diameter)				35	mm

Additional collector attribute(s)

- ☐ Using external power source(s) for normal operation
- ☐ Active or passive measure(s) for self-protection
- ☐ Co-generating thermal and electrical power
- ☐ Wind and/or infrared sensitive collector(s) (WISC)
- ☐ Façade collector(s)

Energy Labelling Information

	Reference Area, A_{sol} (m²)	Hydraulic Designation Code
Brötje RDF 12	2.29	6-V-12S

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 (η_{col})	53%	Zero-loss efficiency (η_0)	0.56	--
		First-order coefficient (a_1)	0.65	W/(m²K)
		Second-order coefficient (a_2)	0.004	W/(m²K²)
		Incidence angle modifier IAM (50°)	0.99	--

Remark: Collector efficiency (ηcol) 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 ηcol is based on reference area (Asol) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017.

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
	mm	m²	mm	mm	m²	W	W	W	W	W	W
Brötje RDF 18	103	3.42	1 640	2 087	3.00	1 933	1 909	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 A_G)	η0, b	a1	a2	a3	a4	a5	a6	a7	a8	Kd
Units	-	W/(m²K)	W/(m²K²)	J/(m³K)	-	J/(m²K)	s/m	W/(m²K⁴)	W/(m²K⁴)	-
Test results	0.569	0.657	0.004	0.000	0.00	8 053	0.000	0.00	0.0	0.95

Incidence angle modifier test method	Quasi dynamic - outdoor								
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-Glycole		
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Brötje RDF 18	3 337	3 064	2 750	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	543	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		
Mean annual ambient air temperature	18.5°C			3.2°C			7.5°C			9.0°C		
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G (W/m²) >	1000	ϑ_a (°C) >	20	H_x (MJ/m²) >	600
Maximum tested positive load				2400	Pa
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Hail resistance using ice balls (diameter)				35	mm

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Energy Labelling Information

	Reference Area, A_{sol} (m²)	Hydraulic Designation Code
Brötje RDF 18	3.42	6-V-12S

Data required for CDR (EU) No 811/2013 - Reference Area A_{sol}	
Collector efficiency (η_{col})	53%

Remark: Collector efficiency (ηcol) 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 ηcol is based on reference area (Asol) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017.

Data required for CDR (EU) No 812/2013 - Reference Area A_{sol}		
Zero-loss efficiency (η_0)	0.57	--
First-order coefficient (a_1)	0.66	W/(m²K)
Second-order coefficient (a_2)	0.004	W/(m²K²)
Incidence angle modifier IAM (50°)	0.99	--

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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