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Annex to Solar Keymark Certificate

Licence Number	**011-7S2461 R**
Date issued	**2020-10-12**
Issued by	**TÜV Rheinland Energy GmbH**

Licence holder	**Bosch Thermotechnik GmbH**	**Country**	Germany
Brand (optional)	Junkers	**Web**	www.bosch-thermotechnik.de
Street, Number	Junkersstrasse 20-24	**E-mail**	solarthermie@de.bosch.com
Postcode, City	73249 Wernau	**Tel**	49 (0)2557 9399-0 / -

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 & u = 1.3 m/s $\vartheta_m - \vartheta_a$					
					0 K	10 K	30 K	50 K	70 K	90 K
	m²	mm	mm	mm	W	W	W	W	W	W
Junkers VK120-2 CPC (2 Modules)	2.44	1 947	1 248	87	1 445	1 422	1 369	1 305	1 232	1 150
Power output per m² gross area					592	583	561	535	505	471

Performance parameters test method	Quasi dynamic									
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	0.595	0.90	0.005	0.000	0.00	18 836	0.000	0.00	0.0E+00	0.97

Incidence angle modifier test method		Quasi dynamic - outdoor								
Incidence angle modifier	Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
Transversal	$K_{\theta T,coll}$	1.00	0.99	1.01	1.00	1.00	1.01	1.00	1.00	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	0.98	0.95	0.90	0.83	0.72	0.56	0.33	0.00

Heat transfer medium for testing	Water		
Flow rate for testing (per gross area, A_G)	dm/dt	0.020	kg/(sm²)
Maximum temperature difference during thermal performance test	$(\vartheta_m-\vartheta_a)_{max}$	60	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	310	°C
Maximum operating temperature	$\vartheta_{max\ op}$	-	°C
Maximum operating pressure	$p_{max,op}$	1000	kPa

Testing laboratory	TÜV Rheinland Energy GmbH	www.tuv.com/solarenergy	
Test report(s)	21249958.001	**Dated**	15.09.2020

Comments of testing laboratory — Datasheet version: 6.1, 2019-07-11

Because of product size 2 samples were combined for testing incl. additional CPC-element.
Dimension of single element (l/w/h) [mm]: 1947 / 624 / 87
Areas of single element (Aa/Ag) [m²]: 0.98 / 1.22
Due to the design that used single elements to enlarge final collector field area; combined with additional CPC-elements; the enclosed maximum power peak-values had been documented in test report.

TÜVRheinland®
TÜV Rheinland Energy GmbH
Am Grauen Stein
51105 Köln

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Supplementary Information	Issued	2020-10-12

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
Junkers VK120-2 CPC (2 Modules)		2 449	2 191	1 905	2 100	1 837	1 565	1 526	1 307	1 089	1 638	1 405	1 172
Annual output per m² gross area		1 004	898	781	861	753	642	625	536	446	671	576	480
Annual efficiency, η_a		57%	51%	44%	53%	46%	39%	54%	46%	38%	54%	46%	39%
Fixed or tracking collector		Fixed (slope = latitude - 15°; rounded to nearest 5°)											
Annual irradiation on collector plane		1765 kWh/m²			1630 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. 6.1 (July 2019). A detailed description of the calculations is available at http://www.estif.org/solarkeymarknew/

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					2700	Pa
Maximum tested negative load					2250	Pa
Hail resistance using ice balls (diameter)					25	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	☐ Façade collector(s)

Energy Labelling Information

	Reference Area, A_{sol} (m²)
Junkers VK120-2 CPC (2 Modules)	2.44

Data required for CDR (EU) No 811/2013 - Reference Area A_{sol}

Collector efficiency (η_{col})	55%

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.

Additional Informative Technical Data

Hydraulic Designation Code	Aperature Area, A_a (m²)
1-V-1122S-A:6,21660-C:15.8,625	2.06

Data required for CDR (EU) No 812/2013 - Reference Area A_{sol}

Zero-loss efficiency (η_0)	0.59	--
First-order coefficient (a_1)	0.90	W/(m²K)
Second-order coefficient (a_2)	0.005	W/(m²K²)
Incidence angle modifier IAM (50°)	0.91	--

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.

DIN CERTCO ● Alboinstraße 56 ● 12103 Berlin, Germany
Tel: +49 30 7562-1131 ● Fax: +49 30 7562-1141 ● E-Mail: info@dincertco.de ● www.dincertco.de