


<b>Annex to Solar Keymark Certificate</b>					<b>Licence Number</b>		<b>011-7S 477 F</b>							
					<b>Date issued</b>		<b>2021-01-29</b>							
					<b>Issued by</b>		<b>TÜV Rheinland Energy GmbH</b>							
<b>Licence holder</b>		<b>Vaillant GmbH</b>			<b>Country</b>		<b>Germany</b>							
<b>Brand (optional)</b>		<b>Vaillant</b>			<b>Web</b>		<b>www.vaillant.com</b>							
<b>Street, Number</b>		<b>Berghauser Str. 40</b>			<b>E-mail</b>		<b>info@vaillant.com</b>							
<b>Postcode, City</b>		<b>42859 Remscheid</b>			<b>Tel</b>		<b>+49 2191180-0</b>							
<b>Collector Type</b>					<b>Flat plate collector</b>									
<b>Collector name</b>					<b>Gross area (A<sub>G</sub>)</b> m <sup>2</sup>	<b>Gross length</b> mm	<b>Gross width</b> mm	<b>Gross height</b> mm	<b>Power output per collector</b> G <sub>b</sub> = 850 W/m <sup>2</sup> , G <sub>d</sub> = 150 W/m <sup>2</sup> & u = 1.3 m/s $\vartheta_m - \vartheta_a$					
									0 K W	10 K W	30 K W	50 K W	70 K W	100 K W
<b>VFK 135/3 VD</b>					2.51	2 033	1 233	80	1 831	1 744	1 548	1 325	1 073	644
<b>VFK 135/3 D</b>					2.51	1 233	2 033	80	1 831	1 744	1 548	1 325	1 073	644
<b>Power output per m<sup>2</sup> gross area</b>									729	695	617	528	428	256
<b>Performance parameters test method</b>		<b>Quasi dynamic</b>												
<b>Performance parameters (related to A<sub>G</sub>)</b>		$\eta_{0, b}$	a1	a2	a3	a4	a5	a6	a7	a8	Kd			
<b>Units</b>		-	W/(m <sup>2</sup> K)	W/(m <sup>2</sup> K <sup>2</sup> )	J/(m <sup>3</sup> K)	-	J/(m <sup>2</sup> K)	s/m	W/(m <sup>2</sup> K <sup>4</sup> )	W/(m <sup>2</sup> K <sup>4</sup> )	-			
<b>Test results</b>		0.736	3.33	0.014	0.000	0.00	5 222	0.000	0.00	0.0E+00	0.94			
<b>Incidence angle modifier test method</b>		<b>Quasi dynamic - outdoor</b>												
<b>Incidence angle modifier</b>		Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°			
<b>Transversal</b>		K <sub>θT, coll</sub>	1.00	1.00	0.99	0.93	0.88	0.78	0.58	0.29	0.00			
<b>Longitudinal</b>		K <sub>θL, coll</sub>	1.00	1.00	0.99	0.93	0.88	0.78	0.58	0.29	0.00			
<b>Heat transfer medium for testing</b>					<b>Water</b>									
<b>Flow rate for testing (per gross area, A<sub>G</sub>)</b>					dm/dt	0.021	kg/(sm <sup>2</sup> )							
<b>Maximum temperature difference during thermal performance test</b>					( $\vartheta_m - \vartheta_a$ ) <sub>max</sub>	70	K							
<b>Standard stagnation temperature (G = 1000 W/m<sup>2</sup>; <math>\vartheta_a = 30</math> °C)</b>					$\vartheta_{stg}$	220	°C							
<b>Maximum operating temperature</b>					$\vartheta_{max, op}$	n.n.	°C							
<b>Maximum operating pressure</b>					p <sub>max, op</sub>	1000	kPa							
<b>Testing laboratory</b>		<b>TÜV Rheinland Energy GmbH</b>			<b>http://www.tuv.com/solar</b>									
<b>Test report(s)</b>		21250538.001rev02 21250538.002			<b>Dated</b>		29.01.2021 29.01.2021							
<b>Comments of testing laboratory</b>					<b>Datasheet version: 6.1, 2019-07-11</b>									
														
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<b>Supplementary Information</b>	<b>Issued</b>	<b>2021-01-29</b>

Annual collector output in kWh/collector at mean fluid temperature $\vartheta_m$													
Collector name	Standard Locations	Athens			Davos			Stockholm			Würzburg		
	$\vartheta_m$	25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C
VFK 135/3 VD		2 897	2 071	1 344	2 204	1 517	942	1 619	1 059	635	1 766	1 146	677
VFK 135/3 D		2 897	2 071	1 344	2 204	1 517	942	1 619	1 059	635	1 766	1 146	677
Annual output per m <sup>2</sup> gross area		1 154	825	535	878	604	375	645	422	253	704	457	270
Annual efficiency, $\eta_a$		65%	47%	30%	54%	37%	23%	55%	36%	22%	57%	37%	22%
Fixed or tracking collector	Fixed (slope = latitude - 15°; rounded to nearest 5°)												
Annual irradiation on collector plane		1765 kWh/m <sup>2</sup>			1630 kWh/m <sup>2</sup>			1166 kWh/m <sup>2</sup>			1244 kWh/m <sup>2</sup>		
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  $\vartheta_m$  (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	Yes				
The collector was tested successfully under the following conditions:					
Climate class (A+, A, B or C)	A+		--		
G (W/m <sup>2</sup> ) >	1100	$\vartheta_a$ (°C) >	40	H <sub>x</sub> (MJ/m <sup>2</sup> ) >	700
Maximum tested positive load	5400		Pa		
Maximum tested negative load	3000		Pa		
Hail resistance using ice balls (diameter)	45		mm		

Additional collector attribute(s)			
<input type="checkbox"/>	Using external power source(s) for normal operation	<input type="checkbox"/>	Active or passive measure(s) for self-protection
<input type="checkbox"/>	Co-generating thermal and electrical power	<input type="checkbox"/>	Façade collector(s)

Energy Labelling Information		Additional Informative Technical Data	
	Reference Area, A <sub>sol</sub> (m <sup>2</sup> )	Hydraulic Designation Code	Aperture Area, A <sub>a</sub> (m <sup>2</sup> )
VFK 135/3 VD	2.51	1-H-12345-A:9.2,20630-C:10.5,1180	2.35
VFK 135/3 D	2.51	1-H-145-A:9.2,20142-C:0,0-D	2.35

Data required for CDR (EU) No 811/2013 - Reference Area A <sub>sol</sub>		Data required for CDR (EU) No 812/2013 - Reference Area A <sub>sol</sub>	
Collector efficiency ( $\eta_{col}$ )	57%	Zero-loss efficiency ( $\eta_0$ )	0.73
Remark: Collector efficiency ( $\eta_{col}$ ) 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/m <sup>2</sup> , expressed in % and rounded to the nearest integer. Deviating from the regulation $\eta_{col}$ is based on reference area (A <sub>sol</sub> ) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017.		First-order coefficient (a <sub>1</sub> )	3.33
		Second-order coefficient (a <sub>2</sub> )	0.014
		Incidence angle modifier IAM (50°)	0.88
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Remark: The data given in this section are related to collector reference area (A <sub>sol</sub> ) 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.			