TÜVRheinland®
DIN CERTCO
Precisely Right.

ISFH CalTeC

Annex to Solar Keymark Certificate		Licence Number	011-7S2954 F
		Date issued	2022-01-27
		Issued by	DIN CERTCO

Licence holder	Hoval Aktiengesellschaft	Country	Liechtenstein
Brand (optional)		Web	www.hoval.vom
Street, Number	Austrasse 70	E-mail	info@hoval.com
Postcode, City	FL- 9490 Vaduz	Tel	+423 3 992 367

Collector Type	Flat plate 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
UltraSol® 2-V	2.53	2 102	1 202	65	1 868	1 758	1 520	1 255	964	646
UltraSol® 2-H	2.53	1 202	2 102	65	1 868	1 758	1 520	1 255	964	646
Power output per m² gross area					739	696	601	497	381	256

Performance parameters test method	Steady state - indoor									
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	0.755	4.20	0.013			5 500				0.86

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	0.97	0.95	0.91	0.83	0.68	0.20	0.00
Longitudinal	$K_{\theta L,coll}$	1.00	0.99	0.97	0.95	0.91	0.83	0.68	0.20	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}	180 °C
Maximum operating temperature		$\vartheta_{max\ op}$	100 °C
Maximum operating pressure		$p_{max,op}$	1000 kPa
Testing laboratory	ISFH CalTeC	https://isfh.de/	
Test report(s)	29-19/K 61-19/KT	Dated	10.09.2019 10.09.2019

Comments of testing laboratory	Ver. 6.2 (13.01.2022)
	Institut für Solarenergieforschung GmbH Am Ohrberg 1 D-31860 Emmerthal Tel.: 05151/999-100 Fax: 05151/999-500

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Supplementary Information	Issued	2022-01-27

Gross Thermal Yield 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
UltraSol® 2-V	2 868	1 896	1 121	2 099	1 345	755	1 555	941	514	1 694	1 009	541
UltraSol® 2-H	2 868	1 896	1 121	2 099	1 345	755	1 555	941	514	1 694	1 009	541
Gross Thermal Yield per m² gross area	1 135	751	444	831	532	299	615	373	203	671	399	214
Annual efficiency, η_a	64%	43%	25%	51%	33%	18%	53%	32%	17%	54%	32%	17%
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. 6.2 (13.01.2022). 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/m²) >	1000	ϑ_a (°C) >	20	H_x (MJ/m²) >	600
Maximum tested positive load				5600	Pa
Maximum tested negative load				2718	Pa
Hail resistance using steel ball (maximum drop height)				2	m

Additional collector attribute(s)

Using external power source(s) for normal operation	No	Active or passive measure(s) for self-protection	No
Co-generating thermal and electrical power	No	Façade collector(s)	No

Energy Labelling Information

	Reference Area, A_{sol} (m²)
UltraSol® 2-V	2.53
UltraSol® 2-H	2.53

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	Aperture Area, A_a (m²)
UltraSol® 2-V	1-V-1234S-A:9.3,14893-C:16.5,1226-	2.33
UltraSol® 2-H	1-H-1234S-A:9.3,12756-C:16.5,2126-	2.33

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

Zero-loss efficiency (η_0)	0.74	--
First-order coefficient (a_1)	4.20	W/(m²K)
Second-order coefficient (a_2)	0.013	W/(m²K²)
Incidence angle modifier IAM (50°)	0.90	--

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.