Summary of	EN12976-2	SOLAR SYSTEM test results	Licence Number	011-7S 2974 A
Annex to Solar KEYMARK Certificate			Issued	2021-11-30

Company	Bosch Solarthermie GmbH	Country	Germany
Brand (optional)	Vulcano, Junkers, Bosch	Website	www.bosch-thermotechnology.com
Street	Prozessionsweg 10	E-mail	solarthermie@de.bosch.com
Postal Code	48493 Wettringen	Tel. / Fax	- -

System classification	
Application(s)	Hot water
Solar loop, circulation principle	Thermosyphon
Direct solar loop / heat exchanger	Heat exchanger
Open, vented or closed solar loop	Closed
Drain back/down	Always filled (no drain)
Store location	Outdoor
Store orientation (of main axis)	Horizontal
Type of auxiliary heating (internal back-up heat)	Electric (optional)
If other auxiliary/internal back-up heating, please specifiy:	
Solar+supplementary OR Solar-only / Solar pre-heat	Solar only / Solar preheat

Collector(s)				Heat store(s)						
Company	Bosch Solarthermie GmbH			Company	Bosch Solarthermie GmbH					
Keymark lic.no. if available	*011-7S2243 F**			*Keymark lic.no. if available*	-					
Collector name	Per module			Store name	Total nominal volume	Gross height	Gross width	Gross depth	Auxiliary heated volume	Electrical aux. heating power
	Gross Area (AG)	Gross length	Gross width							
	m²	mm	mm		litres	mm	mm	mm	litres	kW
Vulcano FKC-2S	2.37	2017	1175	TS200-2E//TS200-2	195	1320	580	580	-	2.0
Junkers FKC-2S	2.37	2017	1175							
Bosch FKC-2S	2.37	2017	1175							

Solar loop controller		Solar loop fluid	
Keymark lic.no. if available	-	Recommended/required	Required
Company	-	Company	-
Name	-	Name	water glycol mixture
Solar loop pump - power range	- W to - W	Freezing point	-14 °C

System family overview

Collector name	Number of collectors in each configuration for each store				
	Store name				
	TS200-2E//TS200-2				
Vulcano FKC-2S	1				
Junkers FKC-2S	1				
Bosch FKC-2S	1				

Testing Laboratory	TÜV Rheinland Energy GmbH
Website	www.tuv.com/solar
Test report id. number	21237826.002Rev01; 21249444.001rev1
Date of test report	19.11.2020; 02.10.2020

Comments of test lab

These systems will also be distributed under the following brands:
TSS200-2/FKC-2 Junkers;
TSS200-2/FKC-2 Bosch;
Freeze protection: According to the installation manual, no freeze protection necessary, if ambient temperature is permanently above +5°C;
*Keymark lic.no. of the other brands 011-7S1612 F

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Version 4.5, 2017-10-24

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Annex to Solar KEYMARK Certificate			Issued	2021-11-30

Company	Bosch Solarthermie GmbH		Country	Germany	
Brand (optional)	Vulcano, Junkers, Bosch		Website	www.bosch-thermotechnology.com	
Street	Prozessionsweg 10		E-mail	solarthermie@de.bosch.com	
Postal Code	48493	Wettringen	Tel. / Fax	-	-

Parameters for systems extrapolation (Annex D)

Collector of measured system		Storage tank of measured system	
A_{ref} [m^2]	2.25	Volume [l]	195
η_0	0.766	A_{hx} [m^2]	1.056
a_1 [W/Km^2]	3.216	Piping	
a_2 [W/Km^2]	0.015	$U_{loop,p}$	1.38
IAM (50º)	0.092		

System parameters

Name of System Configuration	Tested/Extrapol	A_c* [m^2]	u_c* [W/Km^2]	U_s [W/K]	C_s [MJ/K]	S_c [-]	D_L [-]	f_{aux} [-]
TSS200-2E/FKC-2 Junkers		1.49	7.18	4.91	0.79	0.16	0.03	-

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Date of test report	19.11.2020; 02.10.2020
Test method	ISO 9459-5 (DST)

Comments of test lab

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All values are subject to some uncertainty; e.g. the uncertainty on system output is typically in the range of ± 5 % to ± 15 %

Version 4.5, 2017-10-24

Summary of	EN12976-2	test results	Certification No.	011-7S 2974 A
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Company	Bosch Solarthermie GmbH		Country	Germany	
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Postal Code	48493	Wettringen	Tel. / Fax	-	-

System family overview

Collector name	For each storage and collector size, give number of collectors																											
	TS150-2E						TS200-2E						TS300-2E															
Vulcano FKC-2S	1																											
Junkers FKC-2S	1																											
Bosch FKC-2S	1																											

Name of system configuration						TSS200-2E/FKC-2 Vulcano	
Collector name	Vulcano FKC-2S	No. Collectors	1	Storage name	TS200-2E		

Calculated annual results for "solar-only / preheat system"

Location	Qd,sh	Daily drawoff	170 l			Daily drawoff	200 l			Daily drawoff	250 l		
		Qd,hw	QL	Qpar	fsol	Qd,hw	QL	Qpar	fsol	Qd,hw	QL	Qpar	fsol
	MJ/y	MJ/y	MJ/y	MJ/y	%	MJ/y	MJ/y	MJ/y	%	MJ/y	MJ/y	MJ/y	%
Stockholm SE	0	9492	4163	-	44	11164	4478	-	40	13939	4667	-	34
WürzburgDE	0	9114	4320	-	47	10691	4699	-	44	13371	4951	-	37
Davos CH	0	10281	5992	-	58	12110	6402	-	53	15137	6559	-	43
Athens GR	0	7064	5424	-	77	8326	6023	-	73	10407	6654	-	64

Perf. indicators for the table above

Qd,sh	MJ/y	**Not relevant for solar domestic hot water system**
Qd	MJ/y	**Annual heat demand for domestic hot water**
QL	MJ/y	**Annual heat energy delivered by the solar system**
Qpar	MJ/y	**Annual parasitic energy: (electricity for pumps/controllers)**
$f_{sol}=Q_L/Q_d$	-	**Solar fraction**

Ref. conditions		Stockholm SE	Würzburg DE	Davos CH	Athens GR
	G	1 157	1 230	1 684	1 736
	Ta,ave	7.5	9.0	3.2	18.5
	Tc,ave	8.5	10.0	5.4	17.8
	± ΔTc	6.4	3.0	0.8	7.4

G	kWh/m²	**Annual irradiation South, 45°**
Ta,ave	°C	**Annual average outdoor air temperature**
Tc,ave	°C	**Annual average mains cold water temp.**
ΔTc	K	**Seasonal variation of Tc**
Th	45 °C	**Desired hot water temperature (mixing valve temperature).**

Max. operating press. - collector side	250	kPa	Max. operating press. - tank side	800	kPa

Testing Laboratory	TÜV Rheinland Energy GmbH
Website	www.tuv.com/solar
Test report id. number	21237826.002Rev01; 21249444.001rev1
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Comments of test lab

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Version 4.5, 2017-10-24

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Annex to Solar KEYMARK Certificate			Issued	2021-11-30

Company	Bosch Solarthermie GmbH		Country	Germany	
Brand (optional)	Vulcano, Junkers, Bosch		Website	www.bosch-thermotechnology.com	
Street	Prozessionsweg 10		E-mail	solarthermie@de.bosch.com	
Postal Code	48493	Wettringen	Tel. / Fax	-	-

System family overview

Collector name	For each storage and collector size, give number of collectors: TS200-2E//TS200-2
Vulcano FKC-2S	1
Junkers FKC-2S	1
Bosch FKC-2S	1

Name of system configuration					TSS200-2E/FKC-2 Junkers
Collector name	Junkers FKC-2S	No. Collectors	1	Storage name	TS200-2E//TS200-2

Calculated annual results for "solar-only / preheat system"

Location	Qd,sh	Daily drawoff 170 l				Daily drawoff 200 l				Daily drawoff 250 l			
		Qd,hw	QL	Qpar	fsol	Qd,hw	QL	Qpar	fsol	Qd,hw	QL	Qpar	fsol
	MJ/y	MJ/y	MJ/y	MJ/y	%	MJ/y	MJ/y	MJ/y	%	MJ/y	MJ/y	MJ/y	%
Stockholm SE	0	9492	4163	-	44	11164	4478	-	40	13939	4667	-	34
WürzburgDE	0	9114	4320	-	47	10691	4699	-	44	13371	4951	-	37
Davos CH	0	10281	5992	-	58	12110	6402	-	53	15137	6559	-	43
Athens GR	0	7064	5424	-	77	8326	6023	-	73	10407	6654	-	64

Perf. indicators for the table above

Qd,sh	MJ/y	**Not relevant for solar domestic hot water system**
Qd	MJ/y	**Annual heat demand for domestic hot water**
QL	MJ/y	**Annual heat energy delivered by the solar system**
Qpar	MJ/y	**Annual parasitic energy: (electricity for pumps/controllers)**
$f_{sol}=Q_L/Q_d$	-	**Solar fraction**

Ref. conditions		Stockholm SE	Würzburg DE	Davos CH	Athens GR
	G	1 157	1 230	1 684	1 736
	Ta,ave	7.5	9.0	3.2	18.5
	Tc,ave	8.5	10.0	5.4	17.8
	± ΔTc	6.4	3.0	0.8	7.4

G	kWh/m²	**Annual irradiation South, 45°**
Ta,ave	°C	**Annual average outdoor air temperature**
Tc,ave	°C	**Annual average mains cold water temp.**
ΔTc	K	**Seasonal variation of Tc**
Th	45 °C	**Desired hot water temperature (mixing valve temperature).**

Max. operating press. - collector side	250	kPa	Max. operating press. - tank side	800	kPa

Testing Laboratory	TÜV Rheinland Energy GmbH
Website	www.tuv.com/solar
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Date of test report	19.11.2020; 02.10.2020
Test method	ISO 9459-5 (DST)

Comments of test lab

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Company	Bosch Solarthermie GmbH		Country	Germany	
Brand (optional)	Vulcano, Junkers, Bosch		Website	www.bosch-thermotechnology.com	
Street	Prozessionsweg 10		E-mail	solarthermie@de.bosch.com	
Postal Code	48493	Wettringen	Tel. / Fax	-	-

System family overview

Collector name	For each storage and collector size, give number of collectors: TS200-2E//TS200-2
Vulcano FKC-2S	1
Junkers FKC-2S	1
Bosch FKC-2S	1

Name of system configuration					TSS200-2E/FKC-2 Bosch
Collector name	Bosch FKC-2S	No. Collectors	1	Storage name	TS200-2E//TS200-2

Calculated annual results for "solar-only / preheat system"

Location	Qd,sh	Daily drawoff 170 l				Daily drawoff 200 l				Daily drawoff 250 l			
		Qd,hw	QL	Qpar	fsol	Qd,hw	QL	Qpar	fsol	Qd,hw	QL	Qpar	fsol
	MJ/y	MJ/y	MJ/y	MJ/y	%	MJ/y	MJ/y	MJ/y	%	MJ/y	MJ/y	MJ/y	%
Stockholm SE	0	9492	4163	-	44	11164	4478	-	40	13939	4667	-	34
WürzburgDE	0	9114	4320	-	47	10691	4699	-	44	13371	4951	-	37
Davos CH	0	10281	5992	-	58	12110	6402	-	53	15137	6559	-	43
Athens GR	0	7064	5424	-	77	8326	6023	-	73	10407	6654	-	64

Perf. indicators for the table above

Qd,sh	MJ/y	**Not relevant for solar domestic hot water system**
Qd	MJ/y	**Annual heat demand for domestic hot water**
QL	MJ/y	**Annual heat energy delivered by the solar system**
Qpar	MJ/y	**Annual parasitic energy: (electricity for pumps/controllers)**
$f_{sol}=Q_L/Q_d$	-	**Solar fraction**

Ref. conditions		Stockholm SE	Würzburg DE	Davos CH	Athens GR
	G	1 157	1 230	1 684	1 736
	Ta,ave	7.5	9.0	3.2	18.5
	Tc,ave	8.5	10.0	5.4	17.8
	± ΔTc	6.4	3.0	0.8	7.4

G	kWh/m²	**Annual irradiation South, 45°**
Ta,ave	°C	**Annual average outdoor air temperature**
Tc,ave	°C	**Annual average mains cold water temp.**
ΔTc	K	**Seasonal variation of Tc**
Th	45 °C	**Desired hot water temperature (mixing valve temperature).**

Max. operating press. - collector side	250	kPa	Max. operating press. - tank side	800	kPa

Testing Laboratory	TÜV Rheinland Energy GmbH
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Company	Bosch Solarthermie GmbH		Country	Germany	
Brand (optional)	Vulcano, Junkers, Bosch		Website	www.bosch-thermotechnology.com	
Street	Prozessionsweg 10		E-mail	solarthermie@de.bosch.com	
Postal Code	48493	Wettringen	Tel. / Fax	-	-

System family overview

Collector name	For each storage and collector size, give number of collectors: TS200-2E//TS200-2
Vulcano FKC-2S	1
Junkers FKC-2S	1
Bosch FKC-2S	1

Annual performance parameters in the frame of the EU regulation CDR 811, 812 and 813 dated 2013

Name of system configuration				Storage name	TSS200-2E/FKC-2 Junkers
Collector name	Junkers FKC-2	No. Collectors	1		

Annual performance parameters in the frame of the EU regulation CDR 811, 812 and 813 dated 2013

Load profile	M	L	XL	XXL	
Annual heat demand (kWh)	1523	2799	4427	5626	
Auxiliary heat contribution			Qnonsol		section 5.9.3.6, see note 1
Average climate (kWh)	539	1349	2662	3790	Strasbourg
Cold climate (kWh)	-	-	-	-	Helsinki
Hot climate (kWh)	-	-	-	-	Athens
Qaux (kWh)	-	-	-	-	section 5.9.3.4, see note 1
Comply to the load profile (Yes/No)	-	-	-	-	section 5.10.6 , see note 1
ηwh_nonsol (%)	-	-	-	-	section 5.9.3.5 , see note 1
Qelec (kWh)	-	-	-	-	section 5.9.3.5 , see note 1
Qfuel (kWh)	-	-	-	-	section 5.9.3.5 , see note 1
V40, measured (l)	-	-	-	-	section 5.10.7, see note 1

Auxiliary thermostat setting	-	ºC	Effective power of auxiliary heater	-	kW

Note 1: Clause of EN 12976-2:2017

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Comments of test lab

Results are also valid for the following Brands and their nomenclature:
TSS200-2E/FKC-2 Vulcano;
TSS200-2/FKC-2 Junkers

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