



**Institute for Building Energetics,
Thermotechnology and Energy Storage**
Research and Testing Center for Thermal Solar
Systems (TZS)
University of Stuttgart



Test Report

Solar Water Heater

Determination of energy efficiency according to SASO 2884:2017

Test Report No.: 21SU128OEM03

Stuttgart, November 3rd, 2021

Claimant:	ECOFER OIKONOMOU Z. KOSTAS Xanthippou 150 15669 Papagou Athens Greece
Manufacturer:	ECOFER OIKONOMOU Z. KOSTAS
System:	ECOFER SMARTSOL 200.25
Store:	ECOFER SMARTECO 200
Collector:	ECOFER SMARTEVO 25
Construction Year:	2021

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1 Technical data of store¹			
Manufacturer: ECOFER OIKONOMOU Z. KOSTAS			Product type: ECOFER SMARTECO 200
Model year: 2021	Serial No.: not specified	Rated capacity: 200 liters	Design: Horizontal thermosiphon solar domestic hot water store
Country of manufacture: Europe	Length ² : 1.29 m	Diameter ² : 0.58 m	Weight (empty): 69.0 kg
Water volume:			
Corrosion protection:		Enamel Powder Coated, Magnesium Anode	
Max operation pressure:		10 bar	
Max operation temperature:		95 °C	
Thermal insulation:		Polyurethane: 50 mm	
Mantle Heat exchanger			
Max operation pressure [bar]:		3.0	
Max operation temperature [°C]:		95	
Volume of heat exchanger [liters]:		6.5	
Area [m ²]:		0.96	

¹ as stated by the manufacturer

² with insulation

2 Technical data of collector³

Manufacturer:			Type:
ECOFER OIKONOMOU Z. KOSTAS			ECOFER SMARTEVO 25
Year:	Serial No.:	Weight (empty):	Design:
2021	not specified	35.0 kg	Flat plate collector
Gross area			2.52 m ²
Absorber area			2.31 m ²
Length			2.006 m
Width			1.257 m
Height			0.085 m
Max. operating pressure			10 bar
Absorber volume			1.9 liters
Stagnation temperature ⁴			230 °C

³ as stated by the manufacturer

⁴ determined by test laboratory

3. Calculation of the water heating energy efficiency η_{WH}

The water heating energy efficiency η_{WH} of the solar water heater is determined according to SASO 2884:2017, chapter C3.2.

3.1 Parameters of the storage tank

Type:	ECOFER SMARTECO 200
Rated capacity:	200 l
Total store volume $V_{sto,tot}$:	202.5 l
Auxiliary store volume $V_{sto,bu}$:	101.3 l
Heat loss rate of the whole store $H_{sto,los,tot}$:	1.95 W/K
Rated thermal losses Q_{PR} :	2.11 kWh/24h
For further details see:	Test report: 21STO396OEM03, dated 03.11.2021 Test Institute: IGTE Universität Stuttgart

3.2 Parameters of the solar collector

Type:	ECOFER SMARTEVO 25
Gross area A_G :	2.52 m ²
Zero-loss efficiency η_0 :	0.746
First-order coefficient a_1 :	3.26
Second-order coefficient a_2 :	0.01
Incidence angle modifier $K_{hem}(50^\circ)$:	0.96
Number of collectors	1
For further details see:	Test report: 21COL1591OEM03, dated 03.11.2021 Test Institute: IGTE Universität Stuttgart

3.3 Further parameters

Daily hot water load (tapping profile) Q_{ref} : "M"	5.85 kWh
Conversion coefficient CC according to SASO 2884:2017:	1
Auxiliary electric consumption Q_{aux} (no controller):	0 kWh
Heat generator water heating energy efficiency $\eta_{WH,nonsol}$ (electric heating element):	1
Monthly average cold water temperature $\vartheta_{w,low}$ according to EN 15316-4-3:2014:	10 °C
Hot water temperature $\vartheta_{w,high}$ according to EN 15316-4-3:2014:	40 °C
Power collector loop pump $P_{sol;pmp}$ (no pump, thermosiphon system):	0 W
Correction coefficient for the orientation of the collector f_{col} : according to table A.9, EN 15316-4-3:2014	0.8
Type of system according to EN 15316-4-3:2014 (SOL_TYPE):	parallel
Efficiency factor of the collector loop η_{loop} according to EN 15316-4-3:2014, table A.11	0.9
Correction coefficient f_{app} according to EN 15316-4-3:2014, table A.18	1.08

Correlation factor a according to EN 15316-4-3:2017, table A.18	1.029
Correlation factor b according to EN 15316-4-3:2017, table A.18	-0.065
Correlation factor c according to EN 15316-4-3:2017, table A.18	-0.245
Correlation factor d according to EN 15316-4-3:2017, table A.18	0.0018
Correlation factor e according to EN 15316-4-3:2017, table A.18	0.0215
Correlation factor f according to EN 15316-4-3:2017, table A.18	0
Factor describing the effect of insulation of the auxiliary heating loop $f_{bu,ins}$ according to EN 15316-4-3:2017, table B.14	0.02
recoverable heat losses of the solar system $Q_{x,sol;ls;rbl,m}$ (without solar space heating system):	0 kWh
Annual operation time for solar loop pump t_{aux} according to EN 15316-4-3:2017, table B.13	2000 h
Annual global irradiation $I_{glob,ref}$ according to SASO 2884:2017, table B2	1848 kWh/m ²
Auxiliary energy consumption of the auxiliary heat generator $W_{x;bu;aux;nom,m}$:	0 kWh
Heat losses of the auxiliary heat generator $Q_{x;bu;ls;nom,m}$:	0 kWh

3.4 Results

Table 1: Monthly Contribution of the auxiliary heater to the heat demand $Q_{w;bu,out,m}$ [kWh]

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
111.8	82.6	65.3	43.6	31.8	24.3	21.1	21.8	39.5	66.0	98.3	121.9

The annual non-solar heat contribution $Q_{non,sol}$ is calculated according to equation 1:

$$Q_{non,sol} = \sum_{m=1}^{12} Q_{w,bu,out,m} = 728.0 \text{ kWh} \quad (1)$$

The annual energy consumption Q_{tota} is calculated according to equation 2:

$$Q_{tota} = \frac{Q_{non,sol}}{1.1 \times \eta_{WH,non,sol} - 0.1} + Q_{aux} \times CC = 728.0 \text{ kWh} \quad (2)$$

The water heating energy efficiency η_{WH} is calculated according to equation 3:

$$\eta_{WH} = \frac{220 \times Q_{ref}}{Q_{tota}} = 176.8 \% \quad (3)$$

Table 2: Energy efficiency classification for load profile “M” according to SASO 2884:2017:

Energy class	A	B	C	D	E	F	G
η_{WH} [%]	210	140	93	87	80	73	65

4 Test occurrences

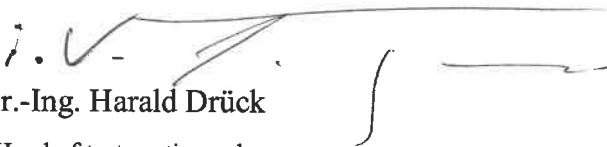
No special incidents

5 General

The determined results are only valid for the tested versions of the test samples.
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The nomenclature of SASO 2884:2017 and EN 15316-4-3:2014/2017 was used.

Arrival of test samples:	27.01.2021 (collector), 04.05.2021 (storage tank)
Testing period:	12.02. bis 10.05.2021
Test location:	Stuttgart, Pfaffenwaldring 10
Identification of test samples:	Adhesive label: 21STO396, 21COL1591
Test engineer:	Dipl.-Ing. S. Bachmann, F. Sansonnens

Stuttgart, November 3rd, 2021


Dr.-Ing. Harald Drück

- Head of test section solar -