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Test of solar collector

(2 appendices)

Task

Testing of solar collector according to EN12975-2.

Test object

Glazed flat plate collector BATEC BA22, serial number 14570. Technical specifications of collector see appendix 2.

The test object arrived at SP 2006-08-21 and was checked without remarks (in normal condition). The tests were performed between 2006-08-23 and 2006-10-02.

Measuring equipment

Hemispherical solar irradiance:	Kipp o. Zonen CM 11 SP.nr. 202 185
Diffuse solar irradiance:	Kipp o. Zonen CM 11 SP.nr. 200 940
Temperature:	Temp.sensor Pt-100 (fluid) ET.nr. 181134, 162912 and 12197, Pt-100 (air) ET.nr. SOL-557
Water flow (pressure drop):	Valmet MP115 SP.nr 202 202
Water flow (thermal perf.):	Valmet MP115 SP.nr 202 189
Pressure drop:	Fuji FKCX34V2BKBYAE SP.nr. 200 782
Pressure (mechanical load):	Pressure gauge SP.nr 202 733
Rain penetration:	Chamber for rain penetration SP.nr. 202 210 Humidity meter SP.nr. 200 479, SP.nr. 200 480
Air speed:	Young Gill Three Cup SP.nr. 202 510
Data collection:	HP VXI-system

Results

The solar collector has passed the tests with no remarks

Summary/Data sheet
Results from testing

See appendix 1
See appendix 2

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Laboratorier ackrediteras av Styrelsen för ackreditering och teknisk kontroll (SWEDAC) enligt svensk lag. Denna rapport får endast återges i sin helhet, om inte utfärdande laboratorium i förväg skriftligen godkänt annat.



Measuring uncertainties

Irradiance:	$\pm 3 \%$
Temperature water:	$\pm 0,1 \text{ K}$
Temp. difference water:	$\pm 0,05 \text{ K}$
Temperature air:	$\pm 0,5 \text{ K}$ but not less than $\pm 2 \text{ Pa}$
Pressure (pressure drop):	$\pm 4 \text{ mbar}$
Pressure (mechanical load):	$\pm 2 \%$
Water flow:	$\pm 0,8 \%$
Water flow, rain penetration:	$\pm 0.2 \text{ l/m}^2, \text{ min}$
Air speed:	$\pm 2 \%$
Humidity:	$\pm 5 \%$

SP Swedish National Testing and Research Institute
Energy Technology - Building Services Engineering

Monica Axell
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Solar collector data sheet

Description of solar collector

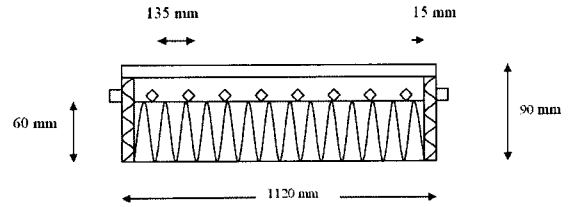
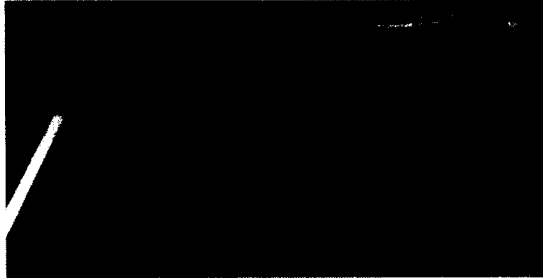


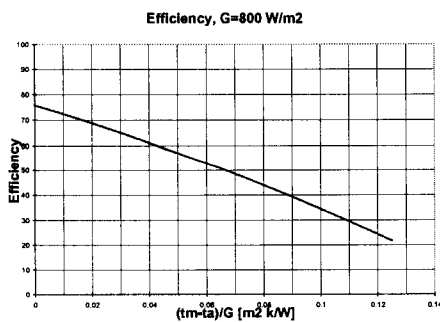
Photo of the collector

Cross section of collector

Manufacturer:	BATEC A/S	Weight ¹ :	35 kg
Brand name:	BA22	Heat transfer fluid ¹	Water or water/glycol
Collector type:	Flat plate	Pressure drop:	
Absorber area:		Operating pressure ¹	Max 6 bar
Aperture area:	2.19 m ²	Stagnation temperature:	<191°C ²
Gross area:	2.32 m ²		

Testing results

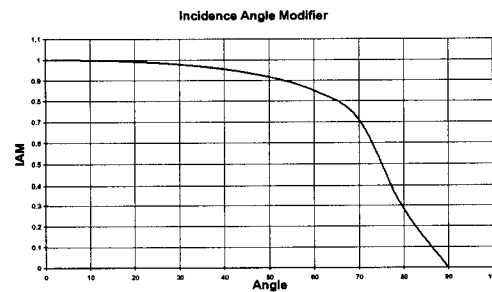
Efficiency based upon aperture area



$$\eta_a = \eta_{0a} - a_{1a}((t_m - t_a)/G) - a_{2a}G((t_m - t_a)/G)^2$$

- $\eta_{0a} = 0.767 [-]$
- $a_{1a} = 3.327 [W/m^2 K]$
- $a_{2a} = 0.010 [W/m^2 K^2]$
- $a_{3a} = 0.180 [J/m^3 K]$

Incidence angle modifier



θ	0	10	30	50	70	90
$K_{\theta b}$	1	0.998	0.977	0.954	0.709	0

Outdoor testing

Test method:	Outdoor, semi dynamic, QDT
Latitude:	57.7
Collector tilt:	45°
Longitude:	12.9
Local time at solar noon	12:07
Collector azimuth:	0° (South)
Test flow:	166 l/h

¹ Data from the manufacturer

² According to high temperature test on BA30



Appendix 1

Power output per collector unit, without wind (W)			
$t_m - t_a$ [K]	Irradiance [W/m²]		
	400	700	1000
10	597	1 101	1 606
30	434	938	1 441
50	253	757	1 261

<p>Thermal capacity: $C=9\ 200\ J/m^2K$</p> <p>Pressure drop: $\Delta p=144\ mbar$ using water, 20°C, and 166 l/h</p> <p>$\Delta p= 0.557q + 0.0019q^2$ [mbar]</p> <p>q = flow [l/h]</p>	<p>Terms</p> <p>η_a Collector efficiency</p> <p>η_{0a} Zero loss collector efficiency based on aperture</p> <p>a_{1a} Heat loss coefficient at $(t_m - t_a)=0$ based on aperture</p> <p>a_{2a} Temperature dependence of the heat loss coefficient based on aperture</p> <p>a_{3a} Wind dependence of the heat loss coefficient based on aperture</p> <p>t_m Mean temp. of heat transfer fluid</p> <p>t_a Ambient air temp.</p> <p>G Hemispherical solar irradiance</p> <p>K_{θ_s} Incidence angle modifier for direct irradiance</p> <p>θ Angle of incidence</p>
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Appendix 2

Number of covers:	1
Cover material:	Iron free glass
Cover thickness:	4 mm
Absorber:	
Material:	Copper
Surface treatment:	Selective, black chrome
Construction type:	Rolled tubeplate, parallel with 2 manifolds
Thermal insulation and casing:	
Thermal insulation thickness in casing:	Back 50 mm, edges 25 mm
Insulation material:	Mineral wool
Casing material:	Aluminum profile
Gross dimensions:	1120*2070*90 mm (w*h)
Sealing material:	Butylic joint filler and silicone
Limitations:	
Maximum operation temperature:	191°C
Maximum operation pressure:	10 bar