Fraunhofer Institut
Solare Energiesysteme

Test Report: KTB Nr. 2007-41-en

Collector test according to EN 12975-1,2:2006

for:
ZHEJIANG SHENTAI SOLAR ENERGY CO.,LTD , China

Brand name:
SCM-Series

Responsible for testing:
Dipl.-Ing. (FH) K. Kramer

Date:
26th October 2007

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Deutscher Akkreditierungs Rat DAR

DIN CERTCO Anerkanntes Prüflaboratorium

Registration No.:
DAP-PL-3926.00

Contents

1 Summary

1.1 Preliminary remark

The tests have been performed according to EN 12975-1,2:2006. Main purpose for testing has been, to fulfill all requirements for the SolarKeymark label (Version 8, Jan 2003).

The present report is valid for the series of the collector type SCM of the company ZHEJIANG SHENTAI SOLAR ENERGY CO.,LTD with the collectors SCM 12 , SCM 15 and SCM 20 . The tests were performed at the largest collector and at the smallest collector of the series.

1.2 Collector efficiency parameters determined

Results:
The calculated parameters are based on following areas of the collector SCM 20 . These parameters are valid for the complete series.

aperture area of 1.876 m^2:	absorber area of 1.603 m^2:
η_{0a} = 0.679	η_{0A} = 0.795
a_{1a} = 1.696 W/m^{2}K	a_{1A} = 1.985 W/m^{2}K
a_{2a} = 0.0099 W/m^{2}K^2	a_{2A} = 0.0117 W/m^{2}K^2

1.3 Incidence angle modifier - IAM

θ:	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
$K_{\theta T}$:	**1.00**	1.01	**1.07**	1.16	**1.23**	1.33	**1.32**	1.20	0.92	0.00
$K_{\theta L}$:	**1.00**	1.00	1.00	0.99	0.97	**0.93**	0.85	0.71	0.46	0.00

Table 1: Measured **(bold)** and calculated IAM data for SCM 12

1.4 Effective thermal capacity of the collector

Effective thermal capacity:

26.4 kJ/K

The effective thermal capacity per square meter is (valid for the series):

14.09 kJ/K m^2

1.5 Schedule of tests and callculations

Test	Date	Result
Date of delivery:	4th June 2007	
1st internal pressure	15th July 2007	passed
High temperature resistance	14th July 2007	passed
Exposure	4th June - 2nd August 2007	passed
1st external thermal shock	25th July 2007	passed
2nd external thermal shock	1st August 2007	passed
1st internal thermal shock	14th July 2007	passed
2nd internal thermal shock	16th July 2007	passed
Rain penetration	1st August 2007	passed
Freeze resistance		not relevant
Mechanical load		passed
Stagnation temperature		225.4 °C
Final inspection	2nd August 2007	passed
Determination of collector parameters and determination of IAM	July 2007	passed
Effective thermal capacity		performed

1.6 Summary statement

No problems or distinctive observations occured during the measurements.

2 Test Center

Test Center for Thermal Solar Systems of Fraunhofer ISE
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3 Orderer, Expeller, Manufacturer

Orderer:	ZHEJIANG SHENTAI SOLAR ENERGY CO.,LTD
Expeller:	Heleos Hispania, S.L.N.E. Av. Libertad, 132 Elche Espana Tel: +34 965 46 27 94 Fax: +34 965 44 87 31 E-mail: tecnico@heleoshispania.es
Manufacturer:	ZHEJIANG SHENTAI SOLAR ENERGY CO.,LTD Haining Yuanhua Industry Park Zhejiang China Haining China Tel: +86 573 87 861 111 Fax: +86 573 87 862 577 E-mail: info@shen-tai.com

4 Overview of series SCM collectors

According to the SolarKeymark rules there is a agreement concerning collectors wich differ only in size, so called series. Only the biggest and the smallest collector have to be tested in this case. A complete collector test according to EN 12975-1,2 has to be performed at the biggest collector. The efficiency test only is sufficient at the smallest collector. The SolarKeymark label based on this tests is valid for the whole series.

(MS) = Manufacturer Specification

Brand name	test collector	number of tubes	length of tubes
SCM 12	yes	12 (MS)	1800 mm (MS)
SCM 15	no	15 (MS)	1800 mm (MS)
SCM 20	yes	20 (MS)	1800 mm (MS)

5 Description of the components

5.1 Collector

5.2 Specific data of the largest collector of the series

	(MS) = Manufacturer Specification
Type:	Vacuum tube collector, heat pipe
Brand name:	SCM 20
Serial no.:	not specified
Year of production:	2007
Number of test collectors:	1
Collector reference no.:	222 KT 69 001 062007 (function tests and efficiency tests)
Total area:	1.975 m * 1.571 m = 3.103 m^2 (total dimensions without fittings)
Aperture area:	1.876 m^2
Absorber area:	1.603 m^2 (projected area of the absorber tubes)
Material of the cover tube:	Borosilicate glass (MS)
Transmission of the cover tube:	95 %
Outer diameter of the cover tube:	58 mm (MS)
Thickness of the cover tube:	1.5 mm (MS)
Outer diameter of the inner tube	47 mm (MS)
Thickness of the inner tube:	1.5 mm (MS)
Length of the tubes:	1800 mm (MS)
Distance from tube to tube:	75 mm (MS)
Number of tubes:	20 (MS)
Weight empty:	64.4 kg
Volume of the fluid:	1.5 l (MS)
Heat transfer fluid:	water/glycole (MS)

5.3 Specific data of the smalest collector of the series

	(MS) = Manufacturer Specification
Type:	Vacuum tube collector, heat pipe
Brand name:	SCM 12
Serial no.:	not specified
Year of production:	2007
Number of test collectors:	1
Collector reference no.:	222 KT 69 002 062007 (efficiency tests)
Total area:	1.975 m * 0.982 m = 1.939 m^2 (total dimensions without fittings)
Aperture area:	1.108 m^2
Absorber area:	0.964 m^2 (projected area of the absorber tubes)
Material of the cover tube:	Borosilicate glass (MS)
Transmission of the cover tube:	95 %
Outer diameter of the cover tube:	58 mm (MS)
Thickness of the cover tube:	1.5 mm (MS)
Outer diameter of the inner tube	47 mm (MS)
Thickness of the inner tube:	1.5 mm (MS)
Length of the tubes:	1800 mm (MS)
Distance from tube to tube:	75 mm (MS)
Number of tubes:	12 (MS)
Weight empty:	40.7 kg
Volume of the fluid:	1.2 l (MS)
Heat transfer fluid:	water/glycole (MS)

5.4 Absorber

Material of the absorber:	Borosilicate glass (MS)
Kind/Brand of selective coating:	SS-CU-ALN/AIN (MS)
Absorptivity coefficient α:	92 % (MS)
Emissivity coefficient ε:	8 % (MS)
Material of the header pipe:	copper (MS)
Outer diameter of the header pipe:	14 mm (MS)
Inner diameter of the header pipe:	12.6 mm (MS)
Material of the heat pipes:	TU1 (MS)
Outer heat pipe diameter:	8 mm (MS)
Inner heat pipe diameter:	6.6 mm (MS)
Length of the heat pipe:	1770 mm
Material of the contact sheets:	Aluminium (MS)
Thickness of the contact sheets:	0.25 mm (MS)

5.5 Insulation and Casing

Collector dimensions Height, width, depth:	1.975 m; 0.982 m; 0.135 m
Medium between the inner and outer tubes of the vacuum flask:	hight vacuum <5*10^3 Pa (MS)
Thickness of the insulation in the header:	35 mm (MS)
Material:	rock wool with Polyurethane foam (MS)
Material of the casing:	aluminium (MS)
Sealing material:	silicon (MS)

5.6 Limitations

Maximum fluid pressure:	1200 kPa (MS)
Operating fluid pressure:	600 kPa (MS)
Maximum service temperature:	110 °C (MS)
Maximum stagnation temperature:	280 °C (MS)
Maximum wind load:	120 km/h (MS)
Recommended tilt angle:	45 °(MS)
Minimum tilt angel:	10 °(MS)
Flow range recommendation:	300 l/m^{2}h (MS)

5.7 Kind of mounting

Flat roof - mounted on the roof:	no (MS)
Tilted roof - mounted on the roof:	yes (MS)
Tilted roof - integrated:	yes (MS)
Free mounting:	no (MS)
Fassade:	no (MS)

5.8 Picture of the collector

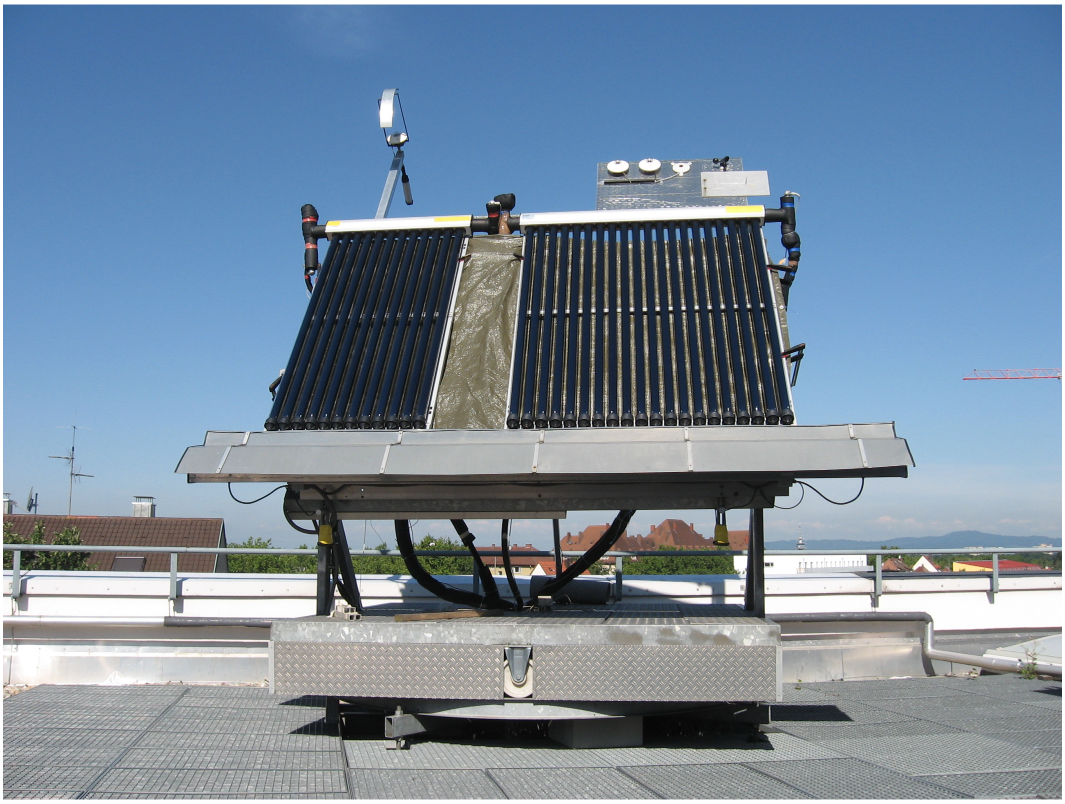

Figure 1: Picture of the collector SCM 20 and SCM 12

6 Collector efficiency parameters

6.1 Test method

Outdoor, steady state according to EN 12975-2:2006 (tracker)
Thermal solar systems and components-solar collectors,
Part 2: Test methods

6.2 Description of the calculation

The functional dependence of the collector efficiency on the meteorological and system operation values can be represented by the following mathematical equation:

$$\eta_{(G,(t_\mathrm{m}-t_\mathrm{a}))} = \eta_0 - a_{1\mathrm{a}}\frac{t_\mathrm{m}-t_\mathrm{a}}{G} - a_{2\mathrm{a}}\frac{(t_\mathrm{m}-t_\mathrm{a})^2}{G} \quad (1)$$

(based on aperture area)

$$t_m = \frac{t_e + t_{in}}{2}$$

where: G = global irradiance on the collector area (W/m^2)
t_in = collector inlet temperature (°C)
t_e = collector outlet temperture (°C)
t_a = ambient temperature (°C)

The coefficients η_0, $a_{1\mathrm{a}}$ and $a_{2\mathrm{a}}$ have the following meaning:

η_0: Efficiency without heat losses, which means that the mean collector fluid temperature is equal to the ambient temperature:

$$t_m = t_a$$

The coefficients $a_{1\mathrm{a}}$ and $a_{2\mathrm{a}}$ describe the heat loss of the collector. The temperature depedency of the collector heat loss is described by:

$$a_{1a} + a_{2a} * (t_m - t_a)$$

6.3 Efficiency parameters

Boundary conditions:

As the collector is constructed without a reflector or another defined reflecting backside, the efficiency messurements were performed by using a tarpaulin with a defined absorption coefficient of 83 %. This corresponds to typical absorption coefficients of common rooftile.

Test method:	outdoor, steady state
Latitude:	48.0°
Longitude:	7.8°
Collector tilt:	tracked between 35°and 55°
Collector azimuth:	tracked
Mean irradiation :	1019 W/m^2
Mean wind speed:	3 m/s
Mean flow rate:	135 kg/h
Kind of fluid:	water
Date of measurement:	June 2007

Results:
The calculated parameters are based on following areas of the collector SCM 20 . These values are also valid for the complete series. [1]:

aperture area of 1.876 m^2:	absorber area of 1.603 m^2:
η_{0a} = 0.679	η_{0A} = 0.795
a_{1a} = 1.696 W/m^{2}K	a_{1A} = 1.985 W/m^{2}K
a_{2a} = 0.0099 W/m^{2}K^2	a_{2A} = 0.0117 W/m^{2}K^2

The determination for the standard deviation (k=2) was performed according ENV 13025 (GUM). Based on this calculation the uncertainty is less than 2%-points of the efficiency values over the complete measured temperature range (η_{0a} = 0.679 +/- 0.02). Based on our experience with the test facilities the uncertainty is much smaller and in a range of **+/- 1%-point**. The standard deviation of the heat loss parameters resulting from the regression fit curve through the measurement points is:
a_{1a} = 1.696 +/- 0.1586 and a_{2a} = 0.0099 +/- 0.002031 .

For more detailed data and the calculated efficiency curve please see annex A.2.

[1] absorber area - projected area of absorber tube,
aperture area - projected area of inner diameter of cover tube

6.4 Power output per collector unit

The power output per collector unit will be documented for the largest collector of the series SCM-Series with the highest output per collector unit and for the smallest collector of the series SCM with the lowest output per collector unit.

Power output per collector unit [W] for collector SCM 20 (aperture area of 1.108 m^2):

$t_\mathrm{m} - t_\mathrm{a}$ [K]	400 [W/m^2]	700 [W/m^2]	1000 [W/m^2]
10	476	858	1240
30	397	779	1161
50	304	686	1068

The power output per collector unit can be calculated for other collectors of this series according to the follwoing procedure:

$$P = P_{ref} * \frac{A_a}{A_{a,ref}}$$

with:

P	= Collector output for a different collector of the series
P_{ref}	= Collector output for collector SCM 12 , (values see table)
A_a	= Aperture area of a different collector of the series
$A_{a,ref}$	= Aperture area of collector SCM 12 = 1.108 m^2

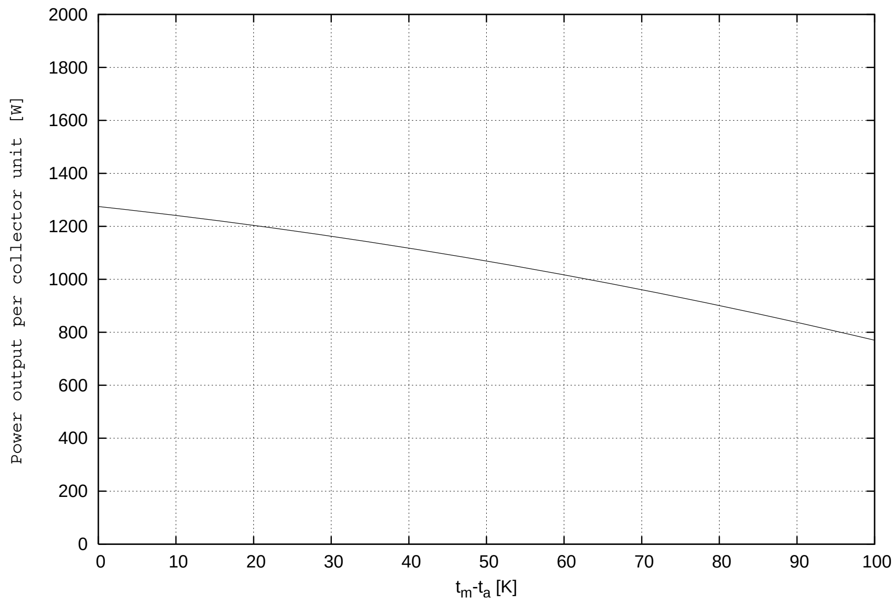

Figure 2: Power output for collector SCM 20 based on an irradiance of 1000 W/m^2

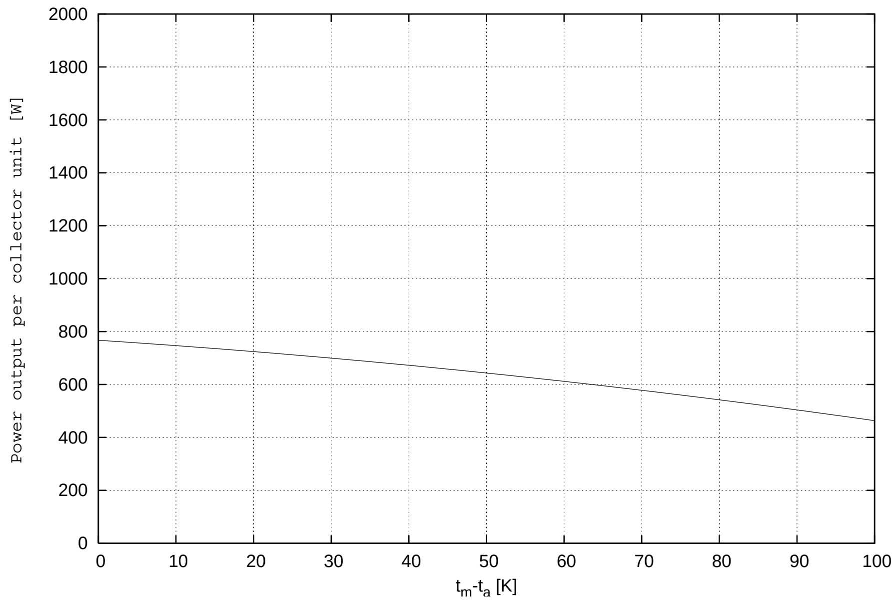

Figure 3: Power output for collector unit SCM 12 based on an irradiance of 1000 W/m^2

7 Incidence angle modifier IAM

The IAM (= Incidence Angle Modifier) is a correction factor representing how the angle of incident radiation affects the performance of a collector. For collectors which have a direction-depending IAM behaviour (for example vacuum tube collectors and collectors with CPC reflectors), it is necessary to meassure the IAM for more than one direction, to have a proper determination of the IAM.

The complex IAM can be estimated by calculating it as the product of both separately meassured incidence angle modifiers $K_{\theta L}$ and $K_{\theta T}$ of two orthogonal planes (equation 2).

$$K_{\theta} = K_{\theta L} x K_{\theta T} \quad (2)$$

The longitudinal plane (index L) is orientated parallelly to the optical axsis of the collector. The transversal plane is orientated orthogonally to the optical axsis of the collector. The angles θT and θL are the projection of the incidance angle of the radiation on the transversal or longitudinal plane.

Test method:	outdoor, steady state
longitudinal:	steady state
Latitude:	48.0°
Longitude:	7.8°
Collector tilt:	tracked
Collector azimuth:	tracked

θ:	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
$K_{\theta T}$:	**1.00**	1.01	**1.07**	1.16	**1.23**	1.33	**1.32**	1.20	0.92	0.00
$K_{\theta L}$:	**1.00**	1.00	1.00	0.99	0.97	**0.93**	0.85	0.71	0.46	0.00

Table 2: Measured **(bold)** and calculated IAM data for SCM 12

8 Effective thermal capacity of the collector

The effective thermal capacity of the collector is calculated according to section 6.1.6.2 of EN 12975-2:2006. For the heat transfer fluid a mixture 2/1 of water/propylenglycol at a temperature of 50°C has been chosen.

The effective thermal capacity per square meter is (valid for the series):

14.09 kJ/K m^2

9 Internal pressure test

Maximum pressure:	1200 kPa (MS)
Test temperature:	19,5 °C
Test pressure:	1800 kPa (1.5 times the maximum pressure)
Test duration:	15 min

Result:
During and after the test no leakage, swelling or distortion was observed or measured.

10 High temperature resistance test

Method:	Outdoor testing
Collector tilt angle:	45°
Average irradiance during test:	971.6 W/m^2
Average surrounding air temperature:	30.6 °C
Average surrounding air speed:	< 0.5 m/s
Average absorber temperature:	214.4 °C
Duration of test:	1 h

Result:
Sever degradation, distortion, shrinkage or outgassing was observed or measured at the collector. For details please see chapter 18.

The high temperature resistance test is **not** passed.

11 Exposure test

The collector tilt angle was 45° facing south. Annex B shows all test days of the exposure test.

Result:
The number of days when the daily global irradiance was more than 14 MJ/m^{2}d was 36 . The periods when the global irradiance G was higher than 850 W/m^2 and the surrounding air temperature t_a was higher than 10 °C was 78.1 h.

The evaluation of the exposure test is described in the chapter 18 "Final inspection".

12 External thermal shock tests

Test conditions	1st test	2nd test
Outdoors:	yes	yes
Combined with exposure test:	yes	yes
Combined with high temperatur resistance test:	no	no
Collector tilt angle:	45°	45°
Average irradiance:	942.3 W/m^2	915.2 W/m^2
Average surrounding air temperature:	24.7 °C	20.2 °C
Period during which the required operating conditions were maintained prior to external thermal shock:	1 h	1 h
Flowrate of water spray:	0.05 l/m^2 s	0.05 l/m^2 s
Temperature of water spray:	15.5 °C	16.0 °C
Duration of water spray:	15 min	15 min
Absorber temperature immediately prior to water spray:	208.8 °C	199.0°C

Result:
No cracking, distortion, condensation or water penetration was observed or measured at the collector.

13 Internal thermal shock tests

Test conditions	1st test	2nd test
Outdoors:	yes	yes
Combined with exposure test:	yes	yes
Combined with high temperature resistance test:	no	no
Collector tilt angle:	45°	45°
Average irradiance:	891.2 W/m^2	919.5 W/m^2
Average surrounding air temperature:	30.1 °C	31.7 °C
Period during which the required operating conditions were maintained prior to internal thermal shock:	1 h	1 h
Flowrate of heat transfer fluid:	0.02 l/m^2 s	0.02 l/m^2 s
Temperature of heat transfer fluid:	20.8 °C	20.9 °C
Duration of heat transfer fluid flow:	5 min	5 min
Absorber temperature immediately prior to heat transfer fluid flow:	204.2 °C	211.3 °C

No cracking, distortion or condensation was observed or measured at the collector.

14 Rain penetration test

Collector mounted on:	Open frame
Method to keep the absorber warm:	Exposure of collector to solar radiation
Flowrate of water spray:	0.05 l/m^2 s
Duration of water spray:	4 h

Result:
No water penetration was observed or measured at the collector.

15 Freeze resistance test

The freeze resistance test is not relevant, because the manufacturer suggestst a application of the collector only with a freeze resistance fluid.

16 Mechanical load test

16.1 Positive pressure test of the collector cover

16.2 Negative pressure test of fixings between the cover and the collector box

16.3 Negative pressure test of mountings

Result:
The construction was checked by sight.The collector construction is expected to withstand possible wind and snow loads to all appearances.

17 Stagnation temperature

The stagnation temperature was measured outdoors. The measured data are shown in the table below. To determine the stagnation temperature, these data were extrapolated to an irradiance of 1000 W/m^2 and an ambient temperatur of 30 °C. The calculation is as follows:

$$t_{\mathrm{s}} = t_{\mathrm{as}} + \frac{G_{\mathrm{s}}}{G_{\mathrm{m}}} * (t_{\mathrm{sm}} - t_{\mathrm{am}}) \tag{3}$$

t_{s}: Stagnation temperature
t_{as}: 30 °C
G_{s}: 1000 W/m^2
G_{m}: Solar irradiance on collector plane
t_{sm}: Absorber temperature
t_{am}: Surrounding air temperature

Irradiance	Surrounding air temperature	Absorber temperature
[W/m^2]	[°C]	[°C]
939	29.6	216.7
922	30.3	216.6
952	31	214.6
943	31.3	214.7
922	31.6	215.2
952	32	214.2
952	32.6	214.3
949	32.6	214.6
938	32.9	215.1
921	33.4	215.6

The resulting stagnation temperature is:

225.4 °C

18 Final inspection

The following table shows an overview of the result of the final inspection.

Collector component	Potential problem	Evaluation
Collector box/ fasteners	Cracking/ wraping/ corrosion/ rain penetration	0
Mountings/ structure	Strength/ safety	0
Seals/ gaskets	Cracking/ adhesion/ elasticity	0
Cover/ reflector	Cracking/ crazing/ buckling/ delamination/ wraping/ outgassing	0
Absorber coating	Cracking/ crazing/ blistering	0
Absorber tubes and headers	Deformation/ corrosion/ leakage/ loss of bonding	0
Absorber mountings	Deformation/ corrosion	0
Insulation	Water retention/ outgassing/ degradation	0

0: No problem
1: Minor problem
2: Severe problem
x: Inspection to establish the condition was not possible

19 Collector identification

The documentation according EN 12975-1 chapter 7 was incomplete in the following items:

- Drawings and data sheet
  - no drawings available
  - data sheets available
- Labeling of the collector - available
- Installer instruction manual
- – no instruction manual available

  List of used materials - available

20 Summary statement

The measurements were carried out in June 2007 .

21 Annotation to the test report

The results described in this test report refer only to the test collector. It is not allowed to make extract copies of this test report.

Test report: KTB Nr. 2007-41-en

Freiburg, 26th October 2007
Fraunhofer-Institute for Solar Energy Systems ISE

Dipl.-Phys. M. Rommel
Head of the Test Center for
Thermal Solar Systems

Dipl.-Ing. (FH) K. Kramer
Responsible for testing
and report

A Efficiency curve

A.1 Efficiency curve with measurement points based on aperture area 1.876 m²

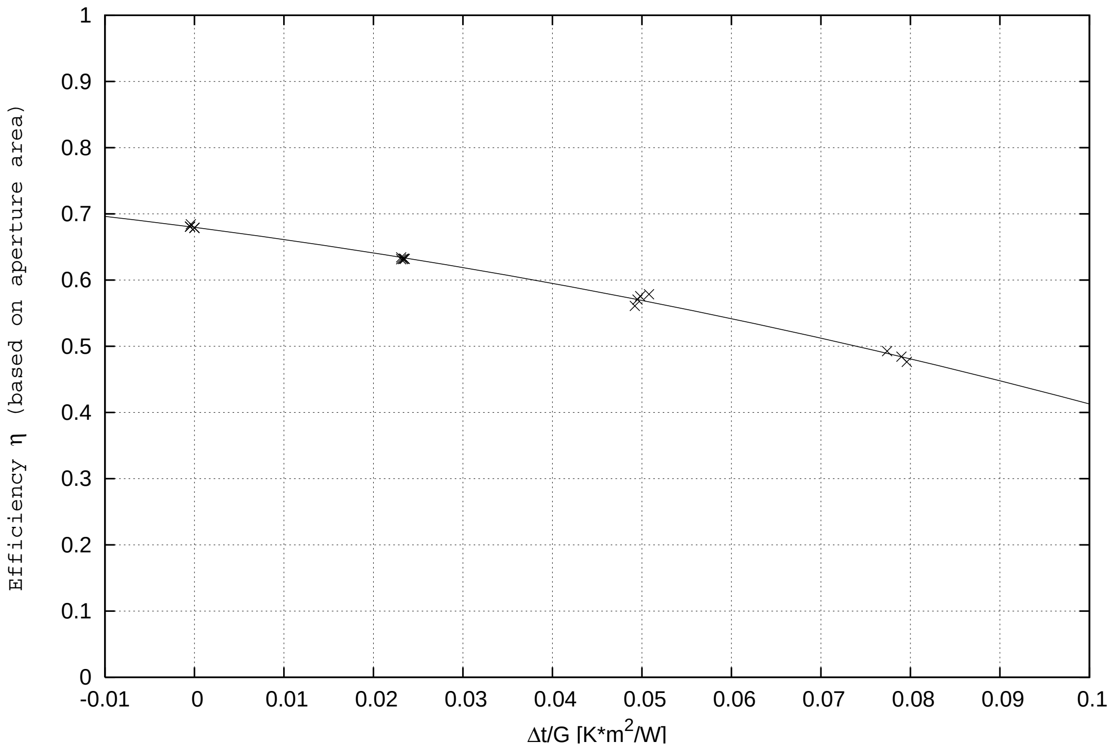

Figure 4: Efficiency curve with measurement points based on aperture area 1.876 m²

Results:
The calculated parameters are based on following areas:

aperture area of 1.876 m²:	absorber area of 1.603 m²:
η_{0a} = 0.679	η_{0A} = 0.795
a_{1a} = 1.696 W/m²K	a_{1A} = 1.985 W/m²K
a_{2a} = 0.0099 W/m²K²	a_{2A} = 0.0117 W/m²K²

A.2 Efficiency curve for the determined coefficients and for an assumed irradiation of 800 W/m^2 based on aperture area

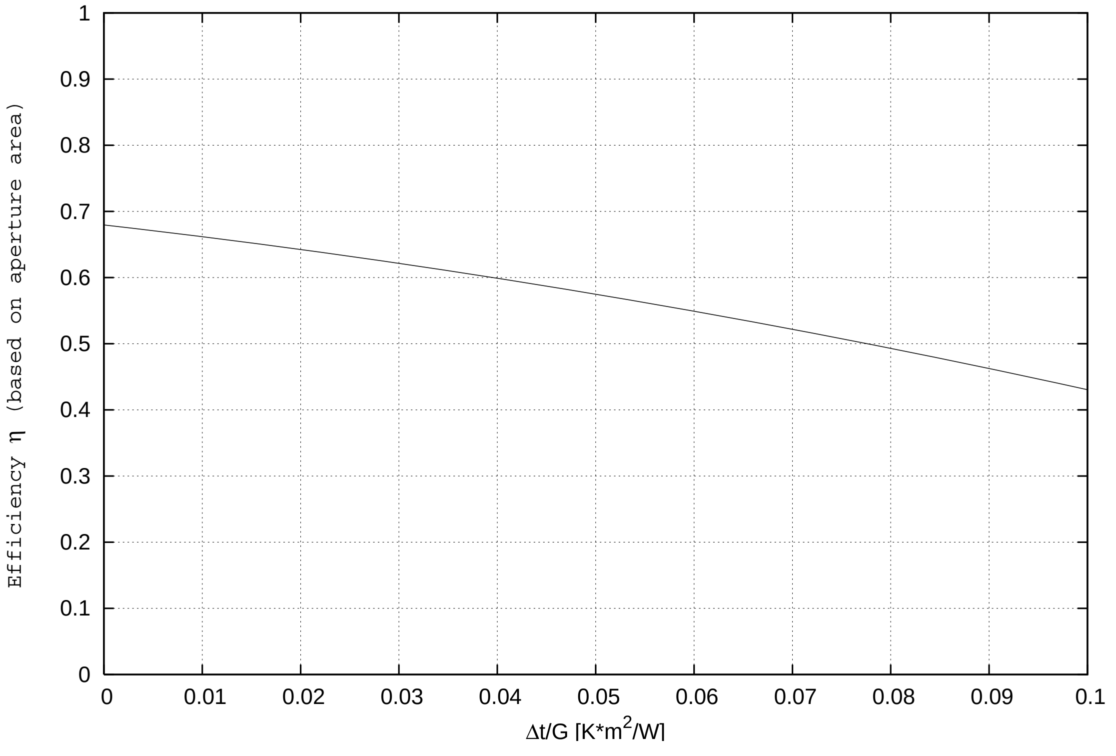

Figure 5: Efficiency curve scaled to 800 W/m^2 based on aperture area 1.876 m^2

The calculated parameters are based on following areas:

aperture area:	absorber area:
$\eta_{0.05a}$ = 0.574	$\eta_{0.05A}$ = 0.672

$\eta_{0.05}$ is the efficiency of the collector for typical conditions of solar domestic hot water systems:
irradiation of 800 W/m^2,
ambient temperature of 20 °C
mean collector temperture of 60 °C.

A.3 Measured data for efficiency curve

G [W/m^2]	G_d/G [-]	m [kg/h]	t_{in} [°C]	t_e [°C]	$t_e - t_{in}$ [K]	t_m [°C]	t_a [°C]	$t_m - t_a$ [K]	$(t_m - t_a)/G$ [K m^2/W]	η_a [-]
998	0.10	133.0	16.42	24.71	8.29	20.57	20.98	-0.41	-0.0004	0.684
1004	0.09	133.1	16.42	24.67	8.26	20.54	20.56	-0.01	-0.0000	0.679
984	0.10	133.3	16.44	24.56	8.11	20.50	20.95	-0.45	-0.0005	0.681
1002	0.10	133.2	16.42	24.66	8.24	20.54	20.57	-0.04	-0.0000	0.679
984	0.10	133.3	16.44	24.56	8.11	20.50	20.95	-0.45	-0.0005	0.681
1037	0.09	135.3	39.65	47.48	7.82	43.57	19.16	24.41	0.0235	0.632
1036	0.09	135.2	39.67	47.50	7.83	43.59	19.29	24.29	0.0234	0.632
1032	0.09	135.3	39.68	47.50	7.82	43.59	19.71	23.88	0.0231	0.634
1035	0.08	135.3	39.68	47.48	7.80	43.58	19.45	24.13	0.0233	0.632
1031	0.09	135.2	39.75	47.53	7.78	43.64	19.82	23.82	0.0231	0.631
1041	0.07	135.2	67.58	74.76	7.18	71.17	18.28	52.89	0.0508	0.579
1070	0.09	135.2	67.60	74.75	7.15	71.18	18.54	52.64	0.0492	0.561
1067	0.10	135.2	67.59	74.85	7.26	71.22	18.36	52.86	0.0495	0.570
1052	0.08	135.2	67.62	74.84	7.22	71.23	18.84	52.39	0.0498	0.576
977	0.09	135.8	91.00	96.50	5.50	93.75	15.97	77.78	0.0796	0.476
983	0.09	135.3	91.07	96.71	5.65	93.89	16.28	77.61	0.0790	0.484
989	0.09	135.9	91.19	96.94	5.76	94.07	17.48	76.59	0.0774	0.493

Table 3: Data of measured efficiency points

B Data of the exposure test

H:	daily global irradiation
$valid\ period$:	periods when the global irradiance G is higher than 850 W/m^2 and the surrounding air temperature t_a is higher than 10 °C
t_a:	surrounding air temperature
$rain$:	daily rain [mm]

$Date$	H [MJ/m^2]	$valid\ period$ [h]	t_a [°C]	$rain$ [mm]
20070604	17.7	1.9	19.5	25.0
20070605	14.3	0.7	19	0.0
20070606	18.1	0.6	20.5	3.5
20070607	19.1	1.6	21.6	0.0
20070608	23.3	2.9	22.1	3.5
20070609	16.5	0.5	22.2	
20070610	23.5	2.6	22.9	
20070611	20.9	3.2	20.4	10.0
20070612	18.6	1.5	21	0.5
20070613	25.9	2.9	22.5	11.0
20070614	21.4	1.6	23.7	0.0
20070615	5.1	0	17.4	7.0
20070616	25.5	3.5	19.3	
20070617	24.5	3.1	21.3	
20070618	23.3	2.7	22.8	27.0
20070619	26.7	3.5	24.8	0.0
20070620	23.6	2.5	24.1	3.0
20070621	9.5	0.2	18.9	2.1
20070622	18.9	3.3	17.3	0.0
20070623	14.4	0.8	17.2	
20070624	25.1	2.9	21.4	
20070625	6.7	0.1	18.8	15.0
20070626	6.2	0.1	14.2	13.5
20070627	10.2	0.4	13.3	11.0
20070628	15.2	0.6	15.3	7.0
20070629	19.4	1.6	17.6	0.0
20070630	23.8	2.2	20	
20070701	17.9	0.6	21.4	

Continuation, see next page:

Date	*H* [MJ/m^2]	*valid period* [h]	t_a [°C]	*rain* [mm]
20070702	12.9	1.4	17.7	5.0
20070703	7.6	0	16	2.3
20070704	14.4	1.3	13.9	19.0
20070705	6.3	0	14	3.0
20070706	15.1	0.6	17.7	2.0
20070707	17	0.7	19.5	0.5
20070708	11.6	0.1	19.2	
20070709	10.5	1.1	16.8	3.0
20070710	14.7	0.7	13.3	19.0
20070711	11.1	0.2	14.4	1.5
20070712	17.6	1.6	17.6	8.0
20070713	26.5	3.4	23.2	0.0
20070714	26.7	3.7	26	
20070715	26.5	3.4	28	
20070716	26	3.3	28	0.0
20070718	18	1.3	22.3	16.0
20070719	16.5	1.4	21.5	0.0
20070720	19.9	1.5	22.4	3.0
20070721	4.2	0	17.9	
20070722	25.6	3.5	19.7	
20070723	12.7	0.8	18.1	4.0