

Ordered by:

SAMMLER Solar  
8, Chiou str.  
Aspropyrgos Industrial Zone  
GR-19300 Athens

Tel. +30 210 2382867  
Fax: +30 210 2320337

# Test Report No. C1281QPEN

## Tests according to EN 12975-2: 2006, Paragraph 5

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## 1 Description of Collector

### 1.1 Technical Data of Sample

Product information	
Manufacturer	SAMMLER Solar
Model	ALTER 2504
Type	Flat plate collector
Flow	Serpentine
Serial product	Yes
Drawing number	A complete set of technical drawings is filed at the test institute.
Serial number	01520
Date of manufacture	01.07.2010

Absorber	
Absorber element	Aluminium sheet
Length of absorber element	1950.0 mm
Width of absorber element	1159.0 mm
Thickness of absorber element	0.50 mm
Coating	Ceramic-metal-structure (Cermet)
Flowed through element	Copper pipe
Joining technique	Laser welded
Joining seam	--

Physical parameters	
Gross length	2.046 m
Gross width	1.246 m
Gross height	0.090 m
Gross area	2.549 m <sup>2</sup>
Aperture area	2.288 m <sup>2</sup>
Absorber area	2.260 m <sup>2</sup>
Weight empty	53.0 kg
Fluid capacity	1.8 l

Installation	
On tilted roof	Yes
In tilted roof	Yes
On flat roof	No
On flat roof with stand	Yes
Facade	No

Construction	
Type	Flat plate collector
Number of absorber elements	1
Absorber pitch	90.0 mm
Number of hydraulically parallel tubes	1
Number of thermally serial glazings	1
Material of glazing(s)	Toughened glass
Thickness of glazing(s)	4.0 mm

Casing and insulation	
Casing material	Aluminium
Sealing material	Polyurethane sealant, Silicone
Insulation material	Glass wool, Mineral wool
Thickness (in mm)	20, 55
Aperture dimensions	1.967 m * 1.163 m

Limitations (manufacturers' information)	
Max. temperature	Not specified
Max. pressure	10 bar
Other	--

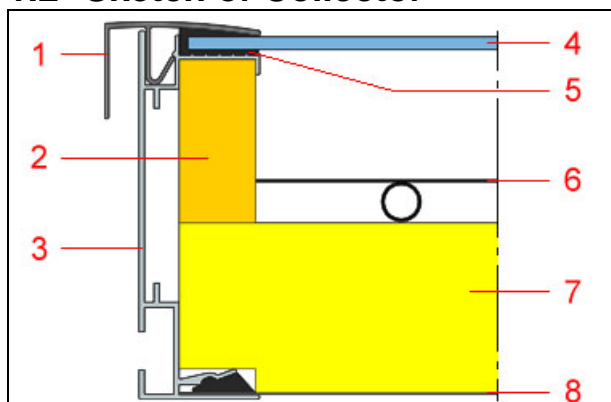
Heat transfer fluid (manufacturers' recommendation)	
Type	Water-glycol
Specifications	--

Remarks on collector design	
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Flow (manufacturers' recommendation)	
Flow range	90 - 200 l/h
Rated flow	150 l/h

Test schedule	
Test procedure	EN12975:2006, Outdoor test
Sample received	09.08.2010
Start of test	12.08.2010
End of test	02.02.2011

## 1.2 Sketch of Collector



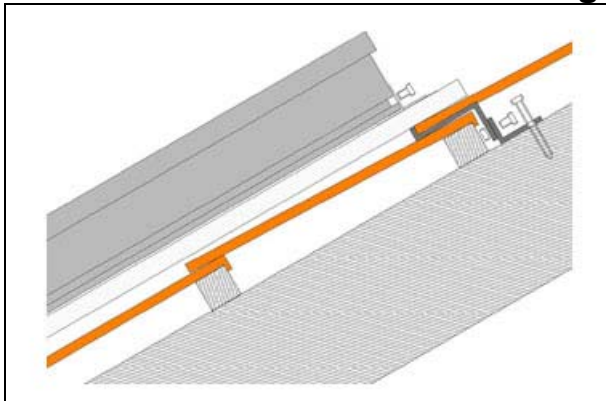
## 1.3 Specifications on Elements

<b>1</b>	<b>Glass fixing profile</b> Description:	Aluminum
<b>2</b>	<b>Lateral thermal insulation</b> Material: Lamination: Thickness [mm]:	Glass wool Black glass fleece 20
<b>3</b>	<b>Casing</b> Type of construction: Material: Profile: Corners: Coating:	Frame Aluminium Extruded profile Glued corners with corner joints Powder coated
<b>4</b>	<b>Glazing</b> Tradename: Material: Thickness [mm]: Properties:	SILK Toughened glass 4 Low ferrous content, structured on both sides
<b>5</b>	<b>Sealing</b> Description: Remarks:	Polyurethane sealant Glued corners
<b>6</b>	<b>Absorber</b> Absorber element: Flow-through element: Length of element [mm]: Width of element [mm]: Flow type: Joining technique:	Aluminium sheet Copper pipe 1950 1159 Serpentine Laser welded
<b>6</b>	<b>Absorber coating</b> Tradename: Description: Manufacturing process:	Mirotherm Ceramic-metal-structure (Cermet) Physical vapour deposition (PVD)
<b>7</b>	<b>Thermal insulation</b> Tradename: Material: Thickness [mm]:	TERVOL Mineral wool 55
<b>8</b>	<b>Rear panel</b> Description: Thickness [mm]:	Zinc-coated steel sheet 0.5

#### 1.4 Photo of Collector



#### 1.5 Sketch of Collector Mounting



## 1.6 Labelling

The collector carries a label.	Yes
The label is visible.	Yes
The label is durable.	Yes

The label includes the following information:

Name of manufacturer	Yes
Collector type	Yes
Serial number	Yes
Year of production	Yes
Gross area of collector	Yes
Maximum operating pressure	Yes
Stagnation temperature for 1000 W/m <sup>2</sup> and 30°C	Yes
Volume of heat transfer fluid	Yes
Weight of empty collector	Yes
Made in ...	Yes

## 1.7 Safety

The collector provides for safe installation and mounting. It has no sharp edges, no loos connections, and no other potentially dangerous features.	Yes
If the weight of the empty collector exceeds 60 kg an anchorage for a lifting device is included, except for collectors that are assembled on the roof.	Yes
If the collector is made to be filled with a heat transfer fluid that is irritant to human skin or eyes or that is toxic, the collector carries a warning label.	Yes

## 1.8 Installer Instruction Manual

The collector is accompanied by an installer instruction manual.	Yes
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The installer instruction manual includes the following information:

Dimensions and weight of the collector	Yes
Instructions about the transport and handling	Yes
Description of the mounting procedure	Yes
Recommendations about lightning protection	Yes
Instructions about the coupling of several collectors (up to 20 m <sup>2</sup> ).	Yes
Instructions for the connection of the collector field to the heat transfer circuit (up to 20 m <sup>2</sup> ).	Yes
Instructions for the dimension of the pipe connections for collector arrays (up to 20 m <sup>2</sup> ).	Yes
Recommendation about the heat transfer (also with respect to corrosion)	Yes
Precautions to be taken during filling, operation and service.	Yes
Maximum operating pressure	Yes
Pressure drop	Yes
Maximum and minimum tilt angle	Yes
Permissible wind and snow loads	Yes
Maintenance requirements	Yes
The documentation is available in the national language of the country where the collector is sold. (Manufacturers' information)	Yes

## 2 Test Methods and Results

### 2.1 Tests of Durability

The tests are carried out according to the EN 12975-2:2006, Chapter 5.

*Deviations from these test directions are marked with an \*) and highlighted by italic writing.*

### 2.2 Test Sequence and Summary

Test	Date of test	Chap. of standard	Result
Internal pressure	24.09.2010	5.2	Passed
High-temperature resistance	02.10.2010	5.3	Passed
Exposure	12.08.2010 – 04.10.2010	5.4	Passed
External thermal shock	Shock Nr.1	29.10.2010	Passed
	Shock Nr.2	05.11.2010	Passed
Internal thermal shock	Shock Nr.1	21.10.2010	Passed
	Shock Nr.2	27.10.2010	Passed
Rain penetration	31.01.2011	5.7	Passed
Freeze resistance	--	5.8	N/A
Thermal performance	12.08.2010 - 30.11.2010	6.1 - 6.2 - 6.3	Passed
Impact resistance	--	5.10	N/A
Mechanical load	28.01.2011	5.9	Passed
Final inspection	02.02.2011	5.11	Passed

Remarks	The test sequence may have been adapted to the internal requirements of the test institute. The test "Thermal performance" may have been made with a conformity-checked second collector.
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## 2.3 Internal Pressure Test

### 2.3.1 Remarks

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### 2.3.2 Technical details of collector

Glazed/unglazed?	Glazed
Maximum operation pressure (Manufacturers' information)	10 bar

### 2.3.3 Test conditions

Surrounding temperature	20°C
Test pressure	15 bar
Duration	15 min

### 2.3.4 Test results

Observations	None
Major failures according to 5.3.1 of EN12975-1:2006	None

## 2.4 High-Temperature Resistance Test

### 2.4.1 Remarks

Outdoor test

Temperature sensor attached to the rear side of the absorber.

### 2.4.2 Test conditions

Collector tilt angle (degrees from horizontal)	56.7°
Average irradiance during test	1031 W/m <sup>2</sup>
Minimum irradiance during test	999 W/m <sup>2</sup>
Average surrounding air speed	1.0 m/s
Average surrounding temperature	20.1°C
Minimum surrounding temperature	18.8°C
Average absorber temperature	196.2°C
Duration of test	>60 min

### 2.4.3 Test results

Observations	None
Major failures according to 5.3.1 of EN12975-1:2006	None

### 2.4.4 Determination of stagnation temperature

Temperature sensor attached to the rear side of the absorber.

Stagnation temperature for 30°C/1000 W/m <sup>2</sup> Determined according to Annex C.2 of EN12975-2:2006	201°C
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## 2.5 Exposure Test

### 2.5.1 Remarks

Outdoor exposure test.

Collector was installed partially under 45° elevation, orientation south and partially on a solar tracker.

### 2.5.2 Test conditions

Part A	Exposition for at least 30 days with a minimum daily irradiation $H \geq 14 \text{ MJ/m}^2$ .
Part B	Exposition for at least 30 hours at irradiance $G \geq 850 \text{ W/m}^2$ and ambient temperature $T_{\text{amb}} \geq 10^\circ\text{C}$ . The minimum duration of every period is $\Delta t \geq 30 \text{ min}$ .

### 2.5.3 Climatic conditions for all days during the test (Part A)

Date	H [MJ/m <sup>2</sup> ]	T <sub>amb</sub> [°C]	Rain [mm]	Valid days
12.08.2010	6.8	17.3	13.0	0
13.08.2010	9.4	17.1	0.0	0
14.08.2010	11.3	16.6	13.0	0
15.08.2010	8.5	15.4	3.0	0
16.08.2010	4.5	12.9	5.0	0
17.08.2010	7.2	15.3	2.0	0
18.08.2010	5.5	16.6	0.0	0
19.08.2010	15.2	17.6	2.0	1
20.08.2010	15.4	20.3	0.0	2
21.08.2010	14.0	21.8	0.0	3
22.08.2010	14.1	22.3	0.0	4
23.08.2010	8.4	21.9	0.0	4
24.08.2010	12.0	19.5	7.0	4
25.08.2010	18.0	19.3	0.0	5
26.08.2010	16.9	21.9	0.0	6
27.08.2010	11.9	20.6	11.0	6
28.08.2010	2.0	14.2	11.0	6
29.08.2010	16.4	14.6	0.0	7
30.08.2010	6.3	12.1	12.0	7
31.08.2010	17.0	13.2	3.0	8
01.09.2010	14.0	12.8	0.0	9
02.09.2010	22.3	14.8	0.0	10
03.09.2010	14.0	16.6	0.0	11
04.09.2010	14.0	16.8	0.0	12
05.09.2010	15.8	16.2	0.0	13
06.09.2010	16.9	16.1	0.0	14
07.09.2010	5.9	15.7	0.0	14
08.09.2010	2.7	14.5	8.0	14
09.09.2010	14.0	15.1	0.0	15
10.09.2010	14.0	15.8	0.0	16
11.09.2010	15.2	15.4	0.0	17
12.09.2010	20.2	17.0	14.0	18
13.09.2010	16.3	14.4	3.0	19
14.09.2010	15.9	13.7	0.0	20
15.09.2010	12.0	15.4	0.0	20
16.09.2010	4.0	13.7	6.0	20



17.09.2010	5.7	12.9	5.0	20
18.09.2010	11.6	12.5	0.0	20
19.09.2010	24.9	13.6	0.0	21
20.09.2010	25.9	14.3	0.0	22
21.09.2010	25.6	16.0	0.0	23
22.09.2010	23.4	16.3	0.0	24
23.09.2010	22.5	17.6	0.0	25
24.09.2010	8.3	14.5	11.0	25
25.09.2010	0.7	8.4	80.0	25
26.09.2010	5.1	9.0	9.0	25
27.09.2010	6.5	10.0	1.0	25
28.09.2010	7.1	10.4	0.0	25
29.09.2010	18.8	12.9	0.0	26
30.09.2010	4.1	12.0	0.0	26
01.10.2010	14.2	13.1	7.0	27
02.10.2010	18.7	14.5	0.0	28
03.10.2010	27.3	16.0	0.0	29
04.10.2010	24.5	16.6	0.0	30

#### 2.5.4 Climatic conditions for all days during the test (Part B)

Date / Time	G [W/m <sup>2</sup> ]	T <sub>amb</sub> [°C]	Δt [min]	Sum [min]
20.08.2010 11:18:30-11:49:00	922.8	23.3	30.5	30.5
20.08.2010 12:25:30-13:24:30	925.9	26.6	59.0	89.5
21.08.2010 10:54:00-14:08:00	912.7	27.6	194.0	283.5
22.08.2010 10:27:00-13:45:00	949.9	28.5	198.0	481.5
25.08.2010 10:50:30-11:44:00	961.4	22.5	53.5	535.0
25.08.2010 11:46:30-12:18:00	1020.9	23.7	31.5	566.5
25.08.2010 13:14:30-13:46:00	1001.0	25.0	31.5	598.0
26.08.2010 10:26:00-12:55:30	963.3	27.2	149.5	747.5
01.09.2010 10:48:30-14:35:00	985.8	19.8	226.5	974.0
03.09.2010 10:24:00-11:10:30	896.5	19.8	46.5	1020.5
03.09.2010 11:51:00-14:27:30	958.2	23.0	156.5	1177.0
04.09.2010 12:50:30-14:09:30	953.9	23.4	79.0	1256.0
05.09.2010 11:35:30-12:35:30	971.4	21.4	60.0	1316.0
09.09.2010 11:54:00-12:25:00	1108.9	21.1	31.0	1347.0
09.09.2010 12:38:00-14:41:30	980.3	22.1	123.5	1470.5
10.09.2010 10:05:30-11:45:00	962.4	18.9	99.5	1570.0
11.09.2010 10:54:30-14:06:30	975.9	21.5	192.0	1762.0
12.09.2010 13:45:00-14:25:00	901.0	24.7	40.0	1802.0

## 2.5.5 Test results

### 2.5.5.1 Observations and evaluation

Evaluation according to the following key:

0 – no problem

1 – Minor problem

2 – Severe problem

\* – Inspection or evaluation was not possible

Collector component	Potential problem	Result
Collector box / fasteners	Cracking / warping / corrosion / rain penetration	0
Collector mounting / structure	Strength / safety	0
Seals / gaskets	Cracking / adhesion / elasticity	0
Covers / reflectors	Cracking / crazing / buckling / delamination / warping / 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
Major failures according to 5.3.1 of EN12975-1:2006		None

## 2.6 External Thermal Shock

### 2.6.1 Remarks

Shock-Nr.1: Outdoor test  
Temperature sensor attached to the rear side of the absorber.

Shock-Nr.2: Outdoor test  
Temperature sensor attached to the rear side of the absorber.

### 2.6.2 Test conditions

Shock-Nr.		1	2
Conditioning phase			
Collector tilt angle	°	61.7	64.5
Average irradiance	W/m <sup>2</sup>	927	910
Minimum irradiance	W/m <sup>2</sup>	856	866
Average surrounding temperature	°C	12.7	15.8
Minimum surrounding temperature	°C	12.0	14.1
Period during which the required conditions were maintained before the shock	min	> 60	> 60
Shock			
Spray rate	l/(s·m <sup>2</sup> )	0.03 - 0.05	0.03 - 0.05
Temperature of water spray	°C	approx. 15	approx. 15
Duration of water spray	min	15	15
Absorber temperature prior to the shock	°C	179.1	177.8
Test combined with „Exposure Test“			
		No	No
Test combined with „High-Temperature Resistance Test“			
		No	No

### 2.6.3 Test results

Observations	Shock Nr.1	None
	Shock Nr.2	None
Major failures according to 5.3.1 of EN12975-1:2006	Shock Nr.1	None
	Shock Nr.2	None

## 2.7 Internal Thermal Shock

### 2.7.1 Remarks

Shock-Nr.1: Outdoor test  
Temperature sensor attached to the rear side of the absorber.  
Shock-Nr.2: Outdoor test  
Temperature sensor attached to the rear side of the absorber.

### 2.7.2 Test conditions

Shock-Nr.		1	2
Conditioning phase			
Collector tilt angle	°	60.5	65.7
Average irradiance	W/m <sup>2</sup>	1029	951
Minimum irradiance	W/m <sup>2</sup>	1012	855
Average surrounding temperature	°C	11.0	11.2
Minimum surrounding temperature	°C	10.4	10.3
Period during which the required conditions were maintained before the shock	Min	> 60	> 60
Shock			
Flow rate of water	l/(s·m <sup>2</sup> )	≥ 0.02	≥ 0.02
Temperature of water prior to the shock	°C	approx. 15	approx. 15
Duration of water flow	Min	5	5
Absorber temperature prior to the shock	°C	191.1	183.5
Test combined with „Exposure Test“			
		No	No
Test combined with „High-Temperature Resistance Test“			
		No	No

### 2.7.3 Test results

Observations	Shock Nr.1	None
	Shock Nr.2	None
Major failures according to 5.3.1 of EN12975-1:2006	Shock Nr.1	None
	Shock Nr.2	None

## 2.8 Rain Penetration Test

### 2.8.1 Remarks

Outdoor test.

The collector is installed on an open frame. Spraying from all sides.

In-roof collectors only: No spraying from the rear side.

The absorber of the collector is kept warm by circulating hot water at about 50 °C through the absorber.

The collector is protected from solar irradiance.

### 2.8.2 Test conditions

Collector tilt angle (degrees from horizontal)	30°
Flow rate of water	$\geq 0.05 \text{ l}/(\text{s}\cdot\text{m}^2)$
Temperature of water spray	$< 30^\circ\text{C}$
Duration	4 h

### 2.8.3 Determination of water penetration

Detection of ingress of water by the following method(s)

- a) Visual inspection
- b) Humidity measurement

The collector is opened after the rain test and inspected for any ingress of water.

In case of ingress of water the amount would be determined by weight.

### 2.8.4 Test results

Observations	None
Major failures according to 5.3.1 of EN12975-1:2006	None

## 2.9 Mechanical Load Test

### 2.9.1 Positive pressure test of the collector cover

#### 2.9.1.1 Method used to apply pressure

Positive pressure load is applied by means of evenly distributed pneumatically actuated suction cups.

#### 2.9.1.2 Test conditions

Maximum pressure load	1000 Pa
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### 2.9.2 Negative pressure test of fixings between the cover and the collector box

#### 2.9.2.1 Method used to apply pressure

Negative pressure load is applied by means of evenly distributed pneumatically actuated suction cups.

#### 2.9.2.2 Test conditions

Maximum lifting load	1000 Pa
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### 2.9.3 Negative pressure test of collector mountings

#### 2.9.3.1 Method used to apply pressure

Negative pressure load is applied by means of evenly distributed pneumatically actuated suction cups.

#### 2.9.3.2 Test conditions

Maximum lifting load	1000 Pa
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### 2.9.4 Test results

Observations	None
Major failures according to 5.3.1 of EN12975-1:2006	None

## 2.10 Final Inspection

### 2.10.1.1 Observations and evaluation

Evaluation according to the following key:

0 – no problem

1 – Minor problem

2 – Severe problem

\* – Inspection to establish the condition was not possible

Collector component	Potential problem	Result
Collector box / fastener	Cracking / warping / corrosion / rain penetration	0
Collector mounting / structure	Strength / safety	0
Seals / gaskets	Cracking / adhesion / elasticity	1 <sup>a</sup>
Covers / reflectors	Cracking / crazing / buckling / delamination / warping / outgassing	1 <sup>b</sup>
Absorber coating	Cracking / crazing / blistering	0
Absorber tubes and headers	Deformation / corrosion / leakage / loss of bonding	0
Absorber mountings	Deformation / corrosion	1 <sup>c</sup>
Insulation	Water retention / outgassing / degradation	0

<sup>a</sup> Gaskets for the hydraulic connectors are very hard and glued into the frame.  
Little flexibility to absorb the elongation of the absorber at high temperatures.

<sup>b</sup> Slight outgassing

<sup>c</sup> Deformation of the absorber.

### 3 Remarks

This report must not be copied except in full.  
The test methods applied fulfil the requirements of EN12975:2006.  
The test results only refer to the tested collector sample.  
This test report is made according to the requirements of EN12975:2006.  
This test report fulfils the requirements of ISO17025.

Rapperswil, 10.03.2011



Dr. Andreas Bohren  
Head of SPF Testing



Dipl.-Ing. Walter Gubler  
Test engineer