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Test Report No. C1192QPEN

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	Euroterm d.o.o
Model	ESK 2.5 SB
Type	Flat plate collector
Flow	Parallel grid
Serial product	Yes
Drawing number	A complete set of technical drawings is filed at the test institute
Serial number	ESK 2.5SB 00008
Date of manufacture	18.01.2010

Physical parameters	
Gross length	2.151 m
Gross width	1.162 m
Gross height	0.090 m
Gross area	2.499 m ²
Aperture area	2.349 m ²
Absorber area	2.311 m ²
Weight empty	45.0 kg
Fluid capacity	1.7 l

Construction	
Type	Flat plate collector
Number of absorber elements	1
Absorber pitch	92.0 mm
Number of hydraulically parallel tubes	12
Number of thermally serial glazings	1
Material of glazing(s)	Toughened glass
Thickness of glazing(s)	4.0 mm

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

Flow (manufacturers' recommendation)	
Flow range	50 - 360 l/h
Rated flow	120 l/h

Absorber	
Absorber element	Corrugated copper sheet
Length of absorber element	2093.0 mm
Width of absorber element	1104.0 mm
Thickness of absorber element	0.20 mm
Coating	Ceramic-metal-structure (Cermet)
Flowed through element	Copper pipe
Joining technique	Ultrasonic welded
Joining seam	Blank

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

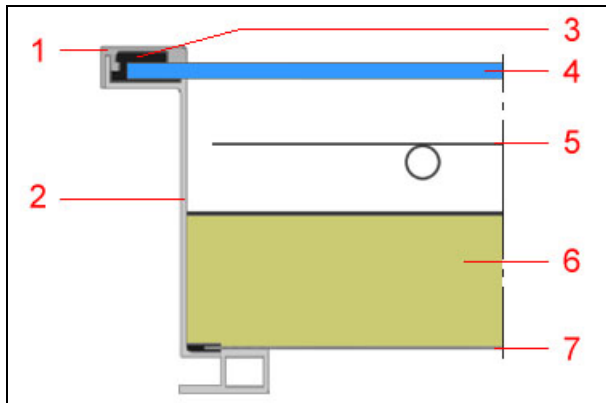
Casing and insulation	
Casing material	Aluminium
Sealing material	Silicone
Insulation material	Mineral wool
Thickness (in mm)	40
Aperture dimensions	2.105 m * 1.116 m

Limitations (manufacturers' information)	
Max. temperature	120°C
Max. pressure	10 bar
Other	--

Remarks on collector design	
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Test schedule	
Test procedure	EN12975:2006, Outdoor test
Sample received	02.02.2010
Start of test	08.02.2010
End of test	01.06.2010

1.2 Sketch of Collector



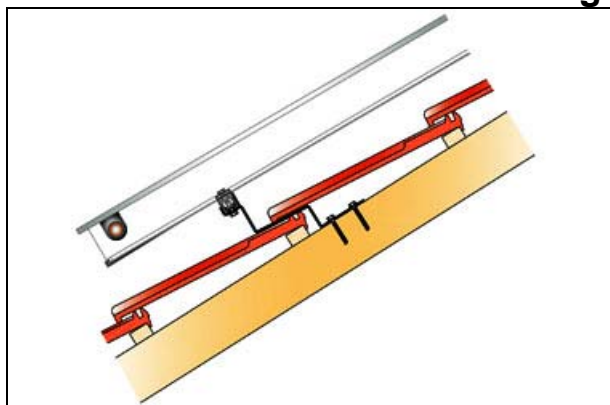
1.3 Specifications on Elements

1	Glass fixing profile Description:	Aluminum
2	Casing Type of construction: Material: Profile: Corners: Coating:	Frame Aluminium Extruded profile Glued corners Mill finished
3	Sealing Tradename: Description:	TERMOSIL N - 6 Silicone
4	Glazing Material: Thickness [mm]: Properties:	Toughened glass 4 Low iron, not structured
5	Absorber Absorber element: Flow-through element: Length of element [mm]: Width of element [mm]: Flow type: Joining technique: Joining seam:	Corrugated copper sheet Copper pipe 2093 1104 Parallel grid Ultrasonic welded Blank
5	Absorber coating Tradename: Description: Manufacturing process:	EtaPlus Ceramic-metal-structure (Cermet) Sputtering
6	Thermal insulation Tradename: Material: Lamination: Thickness [mm]:	Starflex BFG Mineral wool Black glass fleece 40
7	Rear panel Description: Thickness [mm]:	Structured aluminium 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 ² 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 loose 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 ²).	Yes
Instructions for the connection of the collector field to the heat transfer circuit (up to 20 m ²).	Yes
Instructions for the dimension of the pipe connections for collector arrays (up to 20 m ²).	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	08.02.2010	5.2	Passed
High-temperature resistance	19.03.2010	5.3	Passed
Exposure	08.02.2010 - 09.04.2010	5.4	Passed
External thermal shock	Shock Nr.1	06.04.2010	Passed
	Shock Nr.2	19.04.2010	Passed
Internal thermal shock	Shock Nr.1	19.03.2010	Passed
	Shock Nr.2	23.03.2010	Passed
Rain penetration	06.05.2010	5.7	Passed
Freeze resistance	--	5.8	N/A
Thermal performance	08.03.2010 - 13.04.2010	6.1 - 6.2 - 6.3	Passed
Impact resistance	--	5.10	N/A
Mechanical load	21.05.2010	5.9	Passed
Final inspection	01.06.2010	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)	48.7°
Average irradiance during test	1042 W/m ²
Minimum irradiance during test	1032 W/m ²
Average surrounding air speed	1.0 m/s
Average surrounding temperature	19.3°C
Minimum surrounding temperature	18.7°C
Average absorber temperature	195.0°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 ² Determined according to Annex C.2 of EN12975-2:2006	199°C
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2.5 Exposure Test

2.5.1 Remarks

Outdoor exposure test. Collector installed on a 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 ²]	T _{amb} [°C]	Rain [mm]	Valid days
08.02.2010	13.5	0.2	0.0	0
09.02.2010	11.9	-0.2	0.0	0
10.02.2010	3.2	-2.3	0.0	0
11.02.2010	6.5	-5.3	0.0	0
12.02.2010	4.8	-4.2	1.0	0
13.02.2010	14.0	-4.5	0.0	1
14.02.2010	4.6	-2.0	0.0	1
15.02.2010	13.5	-1.9	0.0	1
16.02.2010	14.7	-3.3	0.0	2
17.02.2010	5.5	0.5	0.0	2
18.02.2010	7.3	3.9	0.0	2
19.02.2010	2.2	2.3	9.0	2
20.02.2010	8.5	3.0	0.0	2
21.02.2010	21.2	3.2	0.0	3
22.02.2010	14.2	5.6	0.0	4
23.02.2010	8.1	6.0	1.0	4
24.02.2010	13.6	7.1	1.0	4
25.02.2010	14.5	7.2	0.0	5
26.02.2010	11.4	7.9	1.0	5
27.02.2010	21.3	6.4	0.0	6
28.02.2010	3.5	8.6	0.0	6
01.03.2010	14.0	8.3	0.0	7
02.03.2010	5.6	6.3	2.0	7
03.03.2010	14.2	6.1	0.0	8
04.03.2010	1.5	2.5	0.0	8
05.03.2010	12.9	1.0	0.0	8
06.03.2010	6.7	-0.7	2.0	8
07.03.2010	20.8	-1.0	0.0	9
08.03.2010	28.2	-2.5	0.0	10
09.03.2010	11.5	-3.3	0.0	10
10.03.2010	6.1	-1.1	0.0	10
11.03.2010	3.9	-0.8	1.0	10
12.03.2010	20.1	0.8	0.0	11
13.03.2010	26.9	1.8	0.0	12
14.03.2010	10.1	2.6	0.0	12
15.03.2010	8.7	4.2	0.0	12
16.03.2010	5.0	2.3	5.0	12

17.03.2010	20.8	5.9	0.0	13
18.03.2010	21.0	10.5	0.0	14
19.03.2010	14.0	10.3	0.0	15
20.03.2010	6.1	11.2	1.0	15
21.03.2010	3.0	10.5	15.0	15
22.03.2010	21.6	11.4	0.0	16
23.03.2010	14.0	10.3	0.0	17
24.03.2010	14.0	10.6	0.0	18
25.03.2010	14.0	15.2	0.0	19
26.03.2010	13.1	8.2	3.0	19
27.03.2010	14.0	7.8	6.0	20
28.03.2010	5.0	7.7	10.0	20
29.03.2010	19.5	11.6	0.0	21
30.03.2010	14.2	9.5	1.0	22
31.03.2010	23.4	7.7	0.0	23
01.04.2010	7.8	3.7	7.0	23
02.04.2010	15.8	4.8	0.0	24
03.04.2010	16.1	10.3	0.0	25
04.04.2010	6.7	7.8	2.0	25
05.04.2010	18.5	7.3	2.0	26
06.04.2010	36.0	9.1	0.0	27
07.04.2010	34.9	11.9	0.0	28
08.04.2010	24.7	12.3	0.0	29
09.04.2010	21.9	8.2	0.0	30

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

Date / Time	G [W/m ²]	T _{amb} [°C]	Δt [min]	Sum [min]
22.02.2010 13:40:00-14:17:30	947.4	10.4	37.5	37.5
24.02.2010 12:34:30-13:20:30	1001.3	12.0	46.0	83.5
01.03.2010 10:52:00-13:53:30	1049.3	12.4	181.5	265.0
17.03.2010 13:05:00-14:24:00	1032.6	12.8	79.0	344.0
19.03.2010 10:03:30-10:56:00	1020.6	13.7	52.5	396.5
19.03.2010 12:35:30-16:12:00	991.3	18.5	216.5	613.0
22.03.2010 11:05:30-11:50:30	943.3	13.6	45.0	658.0
23.03.2010 09:48:00-10:20:30	940.4	10.7	32.5	690.5
23.03.2010 12:05:30-15:42:30	974.2	16.2	217.0	907.5
24.03.2010 10:25:30-15:33:30	984.7	15.9	308.0	1215.5
25.03.2010 08:55:00-09:26:30	945.3	11.2	31.5	1247.0
25.03.2010 09:52:00-10:27:00	1146.3	13.5	35.0	1282.0
25.03.2010 10:54:30-11:37:30	1116.5	20.3	43.0	1325.0
25.03.2010 13:52:30-14:29:30	1135.1	24.6	37.0	1362.0
26.03.2010 07:48:30-09:04:30	949.7	13.5	76.0	1438.0
26.03.2010 09:05:30-09:50:00	1034.0	14.0	44.5	1482.5
27.03.2010 11:33:00-12:41:00	1042.3	13.4	68.0	1550.5
02.04.2010 12:55:30-16:27:00	1015.4	12.7	211.5	1762.0
03.04.2010 09:14:30-10:43:30	999.3	11.8	89.0	1851.0

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	1
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	°	41.9	38.3
Average irradiance	W/m ²	1069	1023
Minimum irradiance	W/m ²	1058	1009
Average surrounding temperature	°C	13.4	18.8
Minimum surrounding temperature	°C	12.4	17.8
Period during which the required conditions were maintained before the shock	min	> 60	> 60
Shock			
Spray rate	l/(s·m ²)	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	192.2	184.0
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	°	51.0	50.5
Average irradiance	W/m ²	1035	1001
Minimum irradiance	W/m ²	956	980
Average surrounding temperature	°C	18.9	16.0
Minimum surrounding temperature	°C	17.7	14.3
Period during which the required conditions were maintained before the shock	Min	> 60	> 60
Shock			
Flow rate of water	l/(s·m ²)	≥ 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	195.6	190.3
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	≥ 0.05 l/(s·m ²)
Temperature of water spray	< 30°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

2.8.4 Humidity measurement

Time	aHCol [g/kg]
12.0 h prior to rain test	6.9
12.0 h after rain test	8.7
36.0 h after rain test	12.4

aHCol: Absolute humidity inside the collector

2.8.5 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 ⁺⁾
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	1 ⁺⁺⁾

⁺⁾ Reduced elasticity of the gaskets

⁺⁺⁾ Slight outgassing

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, 01.06.2010



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